Live Oak (*Quercus virginiana*), Louisiana.

THE PRINCIPAL SPECIES OF WOOD:

THEIR CHARACTERISTIC PROPERTIES.

BY

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PREFACE.

THE following is a brief untechnical presentation of general features characterizing economically important species of wood. It is the result of notes originally brought together from many already existing sources and later augmented, and verified so far as possible for the present use, by personal observation. The work of preparation has not been as simple as the result would indicate, and although great care has been taken to check each fact, errors do no doubt exist, although it is not believed that there are important ones.

Engineers while writing upon woods have, save exceptionally, emphasized strength beyond most other properties. Other works for expert foresters or botanists are of necessity too special, voluminous, fragmental, or technical for the casual student. Some popular books on trees, as distinct from woods, are available. The present form is distinct from these and is intended for those who are not foresters or botanists, but who use woods or desire knowledge of their distinguishing properties. Allusions to trees, historical and other references, aside from those directly regarding woods, are made for completeness and in order to mark, distinguish, or separate the species.

Acknowledgments are particularly due to the publications of the U. S. Forest Service and to those of Prof. Sargent, to Dr. B. E. Fernow, to Mr. Raphael G. Zon for suggestions and for technical revision, to the *Northwestern Lumberman* and other trade

journals, to many dealers, who have been uniform in their courtesy, and incidentally to Mr. Morris K. Jesup, whose magnificent collection of woods at the New York Museum of Natural History has been available to the writer as to others. These, with other sources of information acknowledged by the writer, and suggested to others, are suitably arranged in the following list. Of the 148 illustrations, 138 are original, the drawings having been prepared under the supervision of the writer from actual specimens by Mr. Irving T. Worthley of Cornell University and several students of New York University, and the photographs by Mr. John Hopfengartner, Jr., of Westchester, New York City. Other illustrations are, so far as possible, acknowledged in place.

PREFACE TO THE SECOND EDITION.

THE present book is far more complete and therefore more useful than the earlier one. The form or arrangement that found favor in the original edition has been retained; but corrections have been made, and some sections have been rewritten throughout. Over four hundred new names have been added to the index.

C. H. S.

UNIVERSITY HEIGHTS, March 1, 1908.

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COLOR, APPEARANCE OR GRAIN OF WOOD.

Jesup Collection at Museum of Natural History, New York City; Hough's "American Woods" (sections).

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"Timber," Roth (Bulletin No. 10, U. S. Forestry Div.); Vol. IX, Tenth U. S. Census; Prof. Sargent's "Catalogue Jesup Collections"; Prof. J. B. Johnson's "Materials of Construction"; Prof. Thurston's "Materials of Engineering," Part I; Dr. F. E. Kidder's "Inspection of Materials and Workmanship." Allusions in numerous publications U. S. Forestry Division; "Wood," Boulger (Arnold, London); "Timbers of Commerce," Stone (William Rider & Son, London). Manual of North American Gymnosperms Penhallow (Ginn & Co).

* The names Division of Forestry, Bureau of Forestry and Forest Service, have been successfully used to denote this division of the United States Department of Agriculture.

WEIGHTS AND MODULI.

Circular No. 15, U. S. Forestry Division; Prof. J. B. Johnson's "Materials of Construction"; Mr. S. P. Sharpless' Tables for the U. S. Census (Vol. IX, Tenth Census; also Executive Document No. 5, 48th Congress, 1st Session, and also *Sargent's "Catalogue Jesup Collection"*); Prof. Lanza's "Applied Mechanics."

AMERICAN SPECIES.

See foot-notes to species in question.

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GENERAL.

"Forestry for Farmers," Fernow, and other U. S. Forestry Division Publications, Vol. IX, Tenth U. S. Census; *Hough's American Woods (text)*; The Forester; The Northwestern Lumberman; The (New Orleans) Lumber Trade Journal; The New York Lumber Trade Journal; The Timber Trades Journal (London); "Lumber Trade of U. S." (Bureau Statistics U. S. Treas. Dept.); Trees in Winter, Huntington.

HISTORICAL.

Brockhaus, Konversations-Lexikon; etc.

MEDICINAL PROPERTIES.

U. S. Dispensatory.

Books particularly useful to beginners are in italics. Names are repeated when books could not be particularly classed under one heading. Also see foot-notes under subjects in questions.

THE PRINCIPAL SPECIES OF WOOD.

INTRODUCTION.

A KNOWLEDGE of the properties of the substances employed in construction causes confidence and permits smaller margins beyond calculated requirements than would otherwise be possible.

Wood is one of the primary materials of construction; the others are stone and iron. These principal substances possess distinguishing peculiarities, and each one includes a series of individuals that are also distinguished from one another by reason of minor characteristics. Iron thus includes the steels and cast irons, while stone includes brick, concrete and other artificial products, as well as sandstones and granites that occur in nature. Wood differs from the other primary structural substances. It is the only one that is organic.

Information relating to the general properties of wood is as desirable as information relating to properties of steel, stone or cement. Engineers use more wood than any other set of men, yet general facts aside from those relating to strength are often associated with the province of the botanist or forester.

Wood is the solid part of trees, the part that, when otherwise suitable, is used in construction. It consists of a groundwork of starch-like substance known as cellulose* permeated by materials collectively known as lignin; there are also secre-

* Flax is almost pure cellulose.

tions as resins, coloring matter and water. The small proportion of mineral in wood is evident as ash.*

When heated, wood first gives off about one quarter of its weight as water, after which the volatile, inflammable gases separate from a solid base of carbon which itself finally consumes with much heat but no flame and releases the residue of ash.

Wood is preferred because it is easily worked and light in weight. In many positions it is as durable as iron. It is a poor conductor of heat and electricity, and is stronger than is generally supposed. The tensile strength of a bar of hickory may exceed the tensile strength of a similar bar of wrought iron of the same length and weight.†

Wood is not homogeneous, like metal and most of the stones, but is more complicated and so variable that several portions of the same tree often exhibit widely different qualities.

The consumption of wood has never decreased, although metals and stones have been substituted for it in many positions. In England the per capita consumption more than doubled in the fifty years preceding (1895) in spite of the fact that nearly all of the wood used in that country had to be imported.‡ The total yearly *mill* value of wood products in the United States is now (1906) over nine times as great as its combined product of gold and silver, or twice as great as the value of its wheat crops.§

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* Wood, timber and lumber may not mean the same. Properly speaking all woody tissue is *wood*, but roots and branches contain much wood that is not suitable for construction. Wood that is suitable although not necessarily ready for construction is *timber*, and wood that is not only suitable but ready for construction is *lumber*.

The word timber may thus include living trees in the forest, as well as logs and shaped pieces, whereas lumber refers only to boards, planks, beams and other sawn pieces of limited sizes and then only in America. The term lumber, which is not sharply definable, is seldom used abroad.

† Roth, 1896 Yearbook, U. S. Dept. of Agriculture, p. 392.

‡ U. S. Forestry Bulletin No. 10, p. 5.

§ A conservative estimate places the yearly mill value of wood products at $1,100,000,000. The spring and winter wheat crops of 1905 were together valued at $518,372,727. The production of gold and silver (1904) was valued at $112,871,026.

Nearly five hundred species of trees grow in the United States,* and there are others that are peculiar to other countries, yet the great mass of wood used in construction comes from but few of them. Dr. Sudworth excludes all but 100 species in his "Trees of the United States Important to Forestry," while a Treasury Department Summary† contains the statement that but sixteen kinds of hard wood were quoted in Chicago markets on the first of September in the year nineteen hundred.

Woods appear to be more numerous than is actually the case, because several names are often applied to a single product. Woods have been brought long distances because the same ones nearer by were not recognized when called by different local names. The longleaf or southern pine (*Pinus palustris*) has about thirty common names. Such confusion can only be avoided by regarding the recognized botanical nomenclature.

Conditions are changing; many woods that were formerly common are now quite scarce while others that have been less familiar must be employed. Information is increasing with regard to valuable properties possessed by species that have been less familiar.

The botanical name of a plant consists of two principal terms denoting genus and species. Quercus, for example, is the generic name including all species of oak. Alba, rubra, and others are specific names denoting the said species. Quercus alba and Quercus rubra are completed terms. Genera are not fixed but differ with authorities, so that the abbreviated name of the botanist responsible for the classification adopted is often added, as Quercus alba Linn. and Ulmus fulva Michx.

A species is a collection of individuals that might well have sprung from some single root. A genus is a collection of related species. Genera are gathered into families. Families and genera

* Dr. Fernow credits 495 species to the United States (Introduction to U. S. Forestry Bul. 17); Prof. Sargent counting species only and excluding varieties, notes 422 species (Silva of North America).

† (1900, p. 1081). The statement is also made that the principal timbers of commerce in the United States are the species known popularly as pine, fir, oak, hickory, hemlock, ash, poplar, maple, cypress, spruce, cedar and walnut.

differ with authorities. A variety includes individuals differing slightly from accepted species. Its name when existing is part of the specific name. "Quercus robur var. pedunculata" specifies a variety (*pedunculata*) of "red" or strong (*robur*) oak (*Quercus*). A variety of one botanist is sometimes a distinct species of another.

Information relating to wood must include some information relating to the tree.

A tree has been defined* as "a perennial plant which grows from the ground with a single, permanent, woody, self-supporting trunk or stem ordinarily attaining a height at least twenty-five or thirty feet."

A tree has three principal parts or systems: they are the roots, the trunk, and the foliage. Roots and foliage are here regarded only as they are means by which wood is manufactured.

The root system of a tree consists of large branch-roots that enable the tree to stand firmly in the ground and small hair-roots that emerge from the larger ones to gather moisture and chemicals from the soil. The small roots are very sensitive and are the primary portions of the system. The larger roots serve as canals through which the fluids collected by the smaller ones travel upward toward the trunk and foliage.

The foliage of a tree separates carbon from the air and prepares it to unite with the faintly mineralized water that arises from the roots. The preparation of sap is thus completed by the foliage. The movement of fluids in a tree is a continuous movement. Up and down currents move together; the one in the inner sapwood and the other through the outer sapwood. Sap does not rise in the spring and fall in the autumn.

The sap thus completed in the foliage descends through the outer sapwood and deposits a layer of mucilage-like substance between the sapwood and the bark. This young substance or cambium is shortly quickened into life. Cells develop, some of which form a layer of new wood while others

* Century Dictionary.

form bast or bark. This ring or layer method of growth does not apply with trees such as palms.*

Moisture is the most important element that the tree draws from the soil. Trees require comparatively little mineral matter and this is in large part returned when they shed their leaves in the autumn. Carbon is the principal food of trees and carbon is derived from the atmosphere.

Leaves perform their functions through the instrumentality of chlorophyll, a substance upon which they depend for their color. The health of a tree depends upon that of its foliage, and the health of a tree can be told by the condition of its foliage.

Trees need sunlight, and are influenced by the way in which they receive it. Sunlight reaches the sides of trees that stand by themselves and these trees produce many branches. The sides of trees that stand together in the forest are shaded and the lower branches of such trees do not thrive. The foliage of forest trees reaches upward toward the sunlight; their trunks are thus lengthened and wood is deposited upon the trunks rather than upon the branches.

In this way it is possible to influence the shape of any tree. A full-branched tree such as is prized in landscape effects or a long straight trunk that is valued by lumbermen may be obtained by the required direction of sunlight. Lower branches die and fall away in forests, or they may be removed by pruning, and in either case wood diverted from the branches will concentrate upon the trunk.

The energy of a young tree is largely expended upon the development of its roots and foliage. The trunk grows very slowly during this interval. It is particularly wasteful to cut down young trees and saplings just as wood is about to be diverted to the trunk.†

Top-soil of forests is porous and loose. Roots break the originally compacted ground and leaves and twigs falling from

* See Exogens, p. 189.

† In Europe branches removed by pruning are used as firewood. These trimmings take the place of some better material that would otherwise be used for fuel. Practices are much more wasteful in America.

the trees protect it so that it remains soft. The mixture of leaves and loose top-soil forms what is known as humis. Humis receives and protects young seeds, and assists the small hair-roots which cannot so easily penetrate hardened soil.

Humis also acts by equalizing the flow of streams. Rain rolls quickly from sun-baked or otherwise compacted soil, but humis permits the rain drops to pass through into the protected sponge below and then reduces evaporation from this sponge. It is not known that forests influence rain-fall but their value in regulating stream-flow is beyond estimate.

Forestry includes the planting and management of forests and is agriculture as distinguished from lumbering. Forests are not destroyed for immediate profit but are maintained so as to secure recurring crops of matured and desirable trees. Appropriate species are planted, humis is preserved, fire risks are lessened and saplings are planted as the riper trees are cut down. Forestry calls for small profits but these continue from year to year, whereas the lumberman receives larger profits once and finally.

FIG. 1.—SOME WOOD ELEMENTS.

The size and character of the trunk, and the range, locality, or distribution of the tree, have much to do with the utility of the wood, since large or perfect timbers cannot be derived from species characterized by small or crooked trees, and since wood is always more used if it is widely distributed so as to be easily available.*

Wood is made up of cell-structures; as, the true fibre, which originates from several cells; the tracheid (tra-ke-id), which originates from one; the vessel, which is a short, wide tube joined vertically end to end

* Fossils show that many species covered wider ranges than at present.

with others of its kind; the pith-ray; the resin-duct, and others,—all of which are often popularly referred to as fibres.

The character and the arrangement of cell-structures differ with species. Wood is hard, soft, light, heavy, tough, porous, elastic, or otherwise, because of these differences. Appearance is affected, and woods may be distinguished from one another, because of this fact.

The character of wood not only depends upon the properties and the arrangement of the cell structures, but it also depends upon the characteristics and the quantities of substances associated with, although actually foreign to, the cell structures. Sap or pure water is thus within although not readily part of the wood tissue. Water distends and weakens cell structures which are then more pliable.

Most wood is used in "construction," that is, in mines, railways, houses and ships, where demand is for size or quantity, and where finish and appearance amount to but little. Much wood is used in decoration and furniture, where appearance, appropriateness, and finish are called for; but these woods, although much in evidence, are infinitely less in quantity than those employed in construction. Some wood is required for implements, turnery, carvings and small-piece work, where size is secondary and where qualities such as hardness, fine grain, and uniformity, controllable in small pieces, are primary. Some wood is used indirectly, as in the manufacture of paper-pulp, gunpowder and chemicals. There are also by-products of trees, such as tanbark, turpentine, resin, nuts and sugar.

The weight, strength, and other measurable properties of wood are variable. Weight varies from day to day as water is absorbed and evaporated. Strength differs with grain, age, moisture, specific gravity, and many other things. Two pieces from different portions of the same tree differ from each other. The proportions of sap and heart wood are seldom constant. Results from small specimens may differ from those obtained

from larger ones.* The botanical accuracy of a specimen is not always certain, therefore figures relating to the physical properties of wood should be employed with greater caution than those relating to the more homogeneous metals.

Many of the experiments conducted to establish statements regarding the physical properties of wood have been defective in that while the conclusions were correct as applied to the specimens immediately studied, such specimens did not stand for the species at large. The recognition of difficulties, the selection of specimens, the scientific standardizing of methods so that results could be generally utilized, as distinct from the simple manipulation of specimens in testing-machines, have not been exhaustively attempted until recently.†

The tests that have been made to obtain measures for woods may be arranged in several groups, each one depending upon the way in which test pieces were selected. The groups are as follows:

(1) Professors Fernow and Johnson acknowledged the difficulties that have been noted in a series of experiments conducted for the United States Division of Forestry. The details considered and the methods evolved during this study were of such nature as to influence all subsequent efforts. These figures are believed by many to be the most satisfactory in existence. The study is disappointing in that results were obtained for so few species. Some of these are of secondary importance commercially.

(2) Experiments were conducted for the Tenth United States Census by Mr. J. P. Sharpless at the Watertown Massachusetts Arsenal. It is certain that the specimens were of the exact species credited; but in other ways selections were not guided by factors that would now be considered. The

* Only because imperfections are more likely in larger pieces. Large and small pieces of equally perfect wood are equally strong. (Also see Publications U. S. Forestry Div. and J. B. Johnson's "Materials of Construction," p. 462.)

† It should be noted that the selection and preparation of specimens require the exercise of more judgment than the simple testing of speimens, if the conclusions are to be such that they can be generalized from.

series is valuable because it includes almost all American species and the results are the ones that are quoted in several text books.

(3) Some experimenters believe that practical figures may be obtained by testing large or life-sized pieces such as are actually used in construction. Professor Lanza is an advocate of this basis, which has also influenced experiments more recently inaugurated by the National Forest Service under Professor William Kendrick Hatt.

(4) The later series of investigations inaugurated by the National Forest Service and to which allusion was made in the preceding article is characterized by the fact that much attention is also paid to mechanical properties other than strength. This study includes investigations of physical properties such as shrinkage, and it also includes technological processes such as kiln drying, the application of preservatives, and the application of fire retardants; some of these matters are considered as they influence strength. This investigation is in charge of Professor William Kendrick Hatt.

(5) All other experiments are in this group. Many experiments have been made from time to time which are not characterized by any particular method or principal such as separate the investigations that are noted in the preceding articles. Details as to selection are incompletely given or are absolutely lacking, and the results differ very widely from one another. Such studies are referred to as are noted in the works of Hatfield, Lazlett, Rankine, Thurston, and many others. So far as is known some of these experimenters simply "broke specimens." Some series within this group are valuable in that they enable comparisons. Professor Rankine and Mr. Lazlett experimented principally upon foreign woods.

The figures established by the United States Bureau of Forestry and alluded to in item 1, page 1, appear, so far as they exist, upon the following pages. Where they do not exist, the leading spaces set apart for them are left vacant for other insertions as preferred.

The coefficients appearing in this book are, then,

First. *Those resulting from the United States Forestry Bureau Experiments noted in the preceding article and which, so far as they exist, occupy the* **leading spaces** *directly under the titles.*

Second. *Those conducted at the Watertown Arsenal by Mr. Sharpless for the tenth United States census and mentioned in item 2, pages 8 and 9. These appear in the* **second spaces,** *that is, in lines* **immediately following** *those occupied by or set apart for the Forestry figures or their equivalents.*

All coefficients are in pounds per square inch; fractions of pounds in weight and lower figures in coefficients have been omitted as superfluous.

It is not always easy to determine the species of living trees, because forms in the forest differ from those in the open, because bark varies with age, and because fruit and leaves of many trees are lacking in the winter. It is easier to tell genus than species—that a tree is an oak, than whether it is a red or a pin oak. Experience is required in this connection.

It is also hard to identify many woods. Colors and appearances vary and are hard to describe. Artisans become familiar with a few kinds of woods, but they are usually uncertain with regard to others. The key suggested by Professors Fernow and Roth (Bulletin 10, U. S. Forestry Bureau, pages 59–83), should be referred to. The sections prepared by Hough are very valuable. The Jesup Collection is available to those living near New York City.

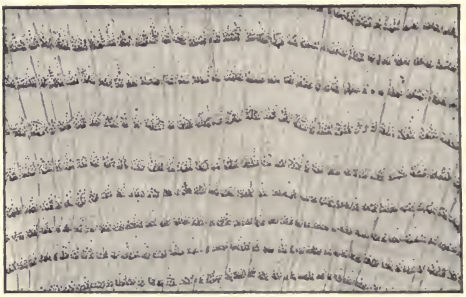
Trees are divided according to the manner in which new material is added to the section. This is sometimes on the outside of older growth and next to the bark or else it is inside distributed over the section. Woods are correspondingly dissimilar, and the two general divisions into which trees are thus separated are known as Exogens and Endogens.*

* This division coincides with that by which they are separated into Dicotyledons and Monocotyledons. It applies to all higher organized plants.

PLATE 2. EXOGENOUS STRUCTURE IN WOOD.

YEARLY RINGS OR LAYERS.

A section of a Longleaf Pine Tree.



A section of Oak showing "porous" structure in yearly layers. (Natural size.)

A section of Hard Pine showing "solid" structure in layers. (Natural size.)

EXOGENOUS TREES.

(*Dicotyledons.*)

Exogenous trees are those the trunks of which are built up by rings or layers, each deposited consecutively upon the outside of the others. A section exhibits first a central point or canal known as a pith-cavity, next and consecutively the annual layers, and finally the bark. The woods of this series are familiar to all. The oaks, pines, and practically all of the merchantable lumbers are among them. The forests are widely distributed, and the species are so numerous as to present an almost infinite range of possibilities.

FIG. 2.—SECTION BOX-ELDER, SHOWING PITH-CAVITY AT CENTRE. (ENLARGED.)

These trees grow in two ways, "length growth" being distinct from "thickness growth." Trees thicken, as stated, by reason of new material deposited upon the cross-section and lengthen by a sort of telescopic extension at buds or extremities. These last, once extended, later thicken, so as in turn to become trunks or boughs. A nail driven at a certain distance from the ground is never higher.

Central pith cavities, as they exist in exogenous trees are most pronounced in younger growth, saplings and small branches. They are later absorbed or compressed and are seldom directly evident in the sections of mature trunks.

The young wood of exogenous trees is porous. It permits the passage of sap and is known as sapwood (Alburnum). As a layer is enclosed by others and retreats from the surface of

the tree, it becomes denser, its canals are filled with gums or tannin, color changes, and the result is heartwood (Duramen). This change goes forward rapidly in some trees, such as locusts, so that their sections appear to be almost wholly heartwood; other species require longer time, and sapwood then predominates.

Professor von Schrenk believes that sapwood changes to heartwood suddenly; that the change does not take place in one ring every year, but that it frequently skips many years, so that eight, ten or even more rings may change from sapwood to heartwood in one year. He also calls attention to the fact that one side of the tree may change before the other, and that part of a ring may be heartwood while the rest remains sapwood.*

Heartwood gives stability to the tree, but is not needed in its physiological processes. It is tougher, heavier, stronger, and more valued in construction. Sapwood is vitally essential to the life of the tree, but is lighter, weaker, less durable, and less valued in construction. Sapwood is pliable, and the sapwoods of several trees are valued for this reason.

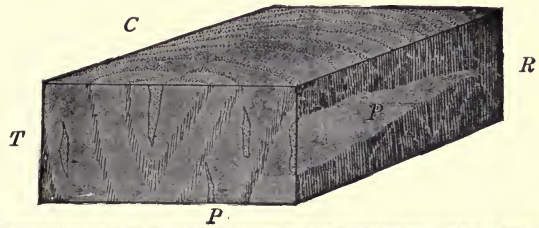
Wood-making varies as it takes place in the springtime and in the summer. Consequent differences in the densities of the deposits serve to mark the limits of the yearly rings. Some species, as the oaks and hickories, show pores throughout their spring woods which thus contrast with denser summer growths. Others, as Southern pines, change sharply, and their spring and summer growths appear as solid bands. In even climates, where seasons are not pronounced, growth is more regular and layers correspondingly less definite.†

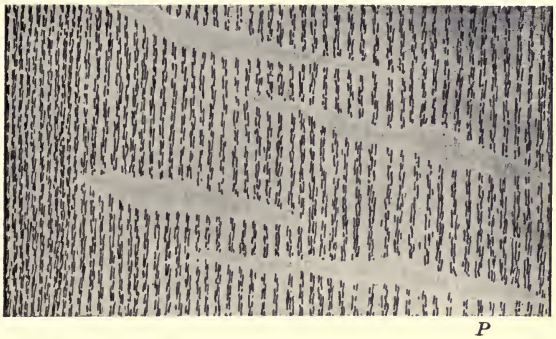
The cellular structure of wood is principally vertical, a fact that explains the ease with which wood is split up and down. Beside the vertical, there are horizontal cells, that cross the tree, strengthen and bind the vertical cells, and assist in the life-processes of the tree. These horizontal cells form what are known as medullary or pith-rays and appear as simple

* U. S. Bureau Plant Industry, Bulletin No. 14, p. 15.
† Circular No. 16, U. S. Forestry Division.

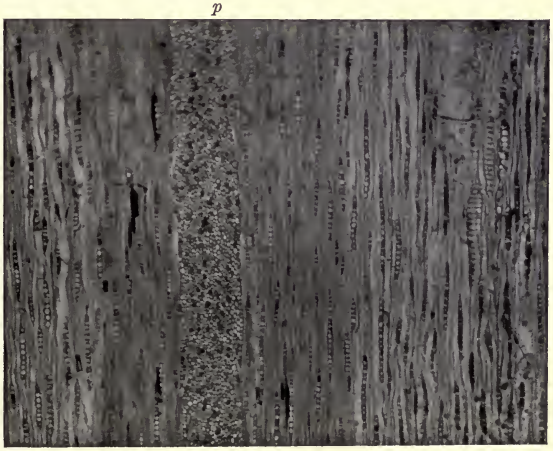
PLATE 3. EXOGENOUS STRUCTURE IN WOOD.

MEDULLARY OR PITH RAY.





Actual appearances of pith ray, *PP*.



Microscopic enlargement of a tangential section of White Oak showing large pith ray, *pp*.

lines or glistening plates according to the way in which the wood is cut. Woods differ in the size and number of these rays, which are by no means always visible to the eye (see plate 3).

Woods are easy or difficult to work in proportion as their fibres are arranged in a simple or a complicated manner. This is shown in the figures on plate 4. A knife pressed upon the oak must crush or cut into the fibres themselves, whereas with the pine it finds some natural passage between the cells. Wood may be cut so as to develop cross-sections (*C*, Fig. 3), radial sections (*R*), or tangential sections (*T*). The respect-

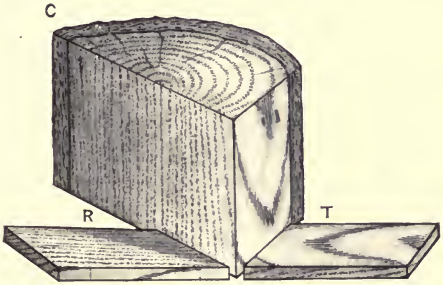


FIG. 3.

ive markings are in a general way indicated on the boards in the figure.

Logs are sometimes sawn into quarters and then into pieces crossing and exposing the yearly rings. (See Fig. 4.) These "quarter-sawn" surfaces are structurally stronger and better, but are, by reason of waste or small pieces, more costly than others. The pith-rays of some woods, such as oaks, are very prominent when split as they are in "quarter-sawing," and the appearance of such woods is consequently improved.* "Vertical grained," "straight grained," "edge grained," "rift grained" and "quartered woods" are names that mean the

FIG. 4.

* Some woods, as birdseye maple, are well developed by the rotary cut. A revolving log is advanced against a tool which pares a broad thin ribbon suitable for veneered work.

same thing whenever the names are applied to manufactured woods.

Planks and boards, with the exception of those that are intended for flooring, decoration or special purposes, are cut parallel to the diameters of the logs and when thus developed are referred to as "bastard," "slash" and "slice-cut" boards.

Boards cut from logs that have not been squared show parts of the outside surfaces of the logs. The uneven appearance caused in this way is known as "wane." These uneven and slanting strips, removed when the boards are cut to standard widths, are known as "edging."

Logs are often squared before they are sliced, and the segments of bark and sapwood that are then separated from the logs are known as "slabs." Edging and slabs are worked into laths or are burned as fuel.

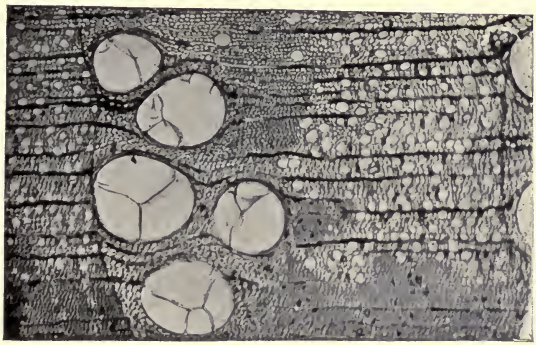
Vertical separations are often seen in trunks, and when caused by winds or frosts they are known as "windshakes" and "frostshakes." Yearly rings or layers sometimes separate from one another when the term "cupshakes" is employed and the pieces in which the defects occur are known as "rolled lumber" because it is inferred that the separations were caused when the winds rolled the trees to and fro. The bends that are sometimes seen in the lengths of beams or ties are known as "waves."

The short but sometimes deep cracks that appear in planks, and that are due to drying or seasoning, are known as "checks." Wood is sometimes lifeless and brittle as the result of age or disease, and such wood is called "brashwood."

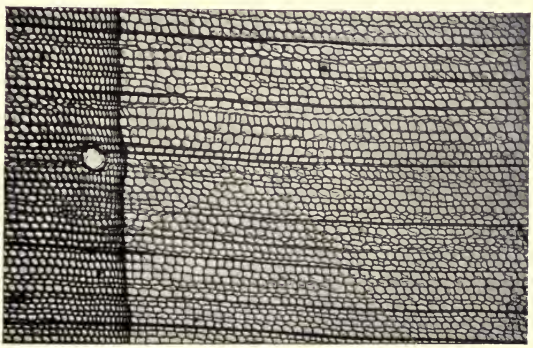
There are many names that refer to practically the same cause of disintegration in wood. "Wet rot," "dry rot," disease, decay, bluing, rust, mildew, canker, soft rot, bot, dote and other terms are thus employed. The results indicated by these names are, regardless of environment and of peculiarities of wreckage, due primarily to the presence of bacteria or fungi. These cannot act when wood is saturated with water, or when it is entirely dry, or when it has been subjected to certain chemicals.

PLATE 4. EXOGENOUS STRUCTURE IN WOOD.

(CROSS-SECTIONS, ENLARGED.)



Two yearly layers of White Oak. The larger pores were formed in spring, the smaller ones in summer. The small circles are ends of fibres. A knife pressed upon this surface would crush or cut into the cells. The mass would not split or separate evenly.



Two yearly layers of White Pine. The space in the outer or darker one is a resin-duct; the circles are ends of fibres (tracheids); pith rays are noticeable. A knife pressed upon this surface would find easy passage. The mass would separate easily.

Knots are the result of branches. Buds connected with "pith cavities" appear upon the bark and ultimately develop into branches. There are corresponding disturbances between the bark and pith that are known as knots. It is needless to say that such disturbances may be prevented by the early removal of the buds.

Lumber is now described or purchased upon the basis of some one of the several series of rules that have been prepared with reference to defects, dimensions and the general inspection of lumber. Such standards have been adopted or published by the Hardwood Manufacturers' Association of the United States, the Pacific Coast Lumber Manufacturers' Association, the Yellow Pine Manufacturers' Association and others.*

Exogenous trees are divided into broad-leaved trees and needle-leaved conifers. The broad, flat leaves of trees such as oaks and chestnuts gave rise to the former term, while the narrow resinous leaves of the pine and hemlock gave rise to the latter. The woods of the former group are usually referred to as hard woods, although some of them are very soft; those of the latter group are referred to as soft woods, although some of them are very hard. Most, but not all, of the broadleaf trees are deciduous, that is, they change their foliage every year; and most, but not all, of the needleleaf trees are evergreen, that is, the foliage is persistent. Needleleaf trees are also known as conifers, that is, cone-bearers.

It is usual to associate the terms broadleaf, deciduous, and hard wood; and likewise the terms needleleaf, conifer, evergreen, and soft wood. While generally correct, this is, as seen, not always so. A better division is into broadleaf trees or woods, and needleleaf conifers.

* Copies of these rules may be obtained from the secretaries of the several associations. The principal series have recently been published under one cover as "Forest Service Bulletin No. 71"—Hodson. This Bulletin is called "Rules and Specifications for the Grading of Lumber, Adopted by the Various Lumber Manufacturing Associations of the United States." Also see Trans. American Soc. for Testing Materials.

BROADLEAF WOODS.

The trees affording these woods are found in natural forests and under cultivation in nearly every portion of the globe. The histories of some of them extend back to very remote periods. Their woods were the principal ones in construction in many districts. The oaks, elms, maples, and many other so-called hard woods are of this group.

Broadleaf woods are characterized by complex fibre conditions, absence of resins, and greater weights.* They are composed of several kinds of cells and fibres, arranged without the regularity so noticeable in the conifers. Cross-sections exhibit numerous, often easily visible pores, arranged in zones or scattered throughout the rings (see plate 2). Pith-rays are numerous and more or less conspicuous, save in softer hard woods such as poplar. Woods are difficult to work in proportion as they are complicated in structure. The numerous members of the group vary from one another and present an extensive range of properties. Although there are exceptions, as the eucalyptus and tulip trees, individuals of this class are not commonly depended upon for the large straight pieces associated with the pines, spruces, firs, and redwoods. Many of the broadleaf woods are used in "construction," but the demand for this purpose is much less than that met by the needleleaf series. Woods for cabinet purposes, implements, and other fine needs are derived from the broadleaf group.

The leaves of broadleaf trees are easily distinguished from the resinous, usually evergreen ones of the conifers. Most of them are deciduous, that is, shed every season, although some are persistent, that is, "evergreen." "Broadleaf," "deciduous," and "hardwood" trees are the same.

* Neither resin-ducts nor resin exists in these woods, save sometimes in buds and leaves.

PLATE 5. WHITE OAK (*Quercus alba*).

OAK.

(*Quercus.*)

The oaks are found on all of the continents of the northern hemisphere, as well as at high altitudes just south of the equator. Their woods stand pre-eminent among those of the broadleaf series and have been highly prized from early periods. Formerly relied upon for all purposes of house and naval architecture, they did not give way to the so-called "soft woods" for houses, and to iron for vessels, until comparatively recent periods. They were supplanted for the former purposes upon the opening of the soft-wood forests of North America and of the Baltic, and for vessels subsequent to the conclusions of the American Civil War.

The historical importance of oak is founded upon the reputation of the English Oak as derived from two trees, Quercus robur var. pedunculata and Quercus robur var. sessiliflora, [illegible] as sub-species of Quercus robur.* It is said that these two once formed large forests over Northern and Central Europe. Live-oak has always been highly esteemed, but is now very scarce. It is one of the hardest, heaviest, and most durable of constructive woods and was once largely employed in ship-building. The wood of the White Oak (*Quercus alba*) is at present preferred for most purposes for which oak is now employed, and is one of the most valuable of the American hard woods.

Oak is tough, durable, easily obtained, liable to warp and check in seasoning, often hard to nail without splitting, susceptible of high polish, and not greatly liable to attack by insects. It contains gallic acid, causing peculiar taste and odor and attacking iron, the solutions staining the wood. Experiments† indicate that iron fastenings are shortly protected by an insoluble scale of resulting salt, and that the wood, although

* Thought by some botanists to be distinct species, namely, Quercus pedunculata and Quercus sessiliflora.

† Havemeyer Chemical Laboratory, N. Y. University. See foot-note, p. 32.

darkened, remains practically uninjured. The later oaken vessels were iron-fastened,* and cabinet-makers now employ that metal in joining oak. The barks of all species are also so charged with acid as to be used in the tanning of leather. The several kinds of oak are commercially divisible into three general groups, white oak, red or black oak, and live oak.† The principal species affording woods under each head are as follows:

White Oak.	Red or Black Oak.	Live Oak.
White Oak (Q. alba).	Red Oak (Q. rubra).	Live Oak (Q. virginiana).
Cow Oak (Q. michauxii).	Pin Oak (Q. palustris).	California Live Oak (Q. agrifolia).
Chestnut Oak (Q. prinus).	Spanish Oak (Q. digitata).	Live Oak (Q. chrysolepis).
Post Oak (Q. minor).	Yellow or Black Oak (Q. velutina).	
Bur Oak (Q. macrocarpa).		
Pacific Post Oak (Q. garryanna).		

WHITE OAK (*Quercus alba*).

RED OAK (*Quercus rubra.*)

Oak trees are characterized by oblong, thin-shelled kernels, protruding from hard scaly cups and called acorns. The foliage is sometimes deciduous and sometimes evergreen. Most oaks require many years to reach maturity, but are then long-lived. Fifty of the nearly three hundred known species of oak are natives of the United States and Canada; all but four become trees under favorable conditions. Quercus is from two Celtic words, *quer*, signifying fine, and *cuex*, a tree.

LIVE OAK (*Quercus virginiana*)

* Communication. Mr. Chas. H. Cramp, President Cramp Ship-building Co., Philadelphia.

† This division is also a botanical one based not only on differences in anatomical structure of the wood itself, but on the time required by fruit in attaining maturity, and on persistence of foliage (evergreen or deciduous), etc.

White Oak. *Quercus alba Linn.*

Nomenclature.
White Oak (general). Stave Oak (Ark.).

Locality.
Widespread, north-central and eastern United States.

Features of Tree.
Seventy-five to one hundred feet in height. Three to six feet in diameter, fine shape and appearance. Grayish-white bark. Comparatively sweet ovoid oblong acorns in rough shallow cups. Rounded lobes or projections to leaves.

Color, Grain, or Appearance of Wood.
Heartwood brown with sapwood lighter. Annual layers well marked.
Medullary rays broad and prominent.

Structural Qualities of Wood.
Tough, strong, heavy, hard, liable to check unless seasoned with care. Durable in contact with the soil. Receives a high polish.

Representative Uses of Wood.
Ship-building, construction, cooperage, cabinet-making, railway ties, fuel, etc. Bark is rich in tannin.

Weight of Seasoned Wood in Pounds per Cubic Foot.
50 (U. S. Forestry Div.).*
46.

Modulus of Elasticity.
2,090,000 (average of 218 tests by U. S. Forestry Div.).*
1,380,000.

Modulus of Rupture.
13,100 (average of 218 tests by U. S. Forestry Div.).*
12,800.

Remarks.
A tree of the first economic importance. The most widely employed of all American oaks. Name refers to appearance of bark. The supply diminishing because of value of timber, also the sweetness of nuts causes them to be eaten by animals. Oaks warp and check easily because of their complicated fiber arrangements. Some cell-structures dry faster than others. Oaks stand well after having once been seasoned; there is then little further distortion.

* See page 8.

Cow Oak. *Quercus michauxii Nutt.*

Nomenclature. (Sudworth.)

Cow Oak (local and common name).
Basket Oak (Ala., Miss., La., Tex., Ark.).
Swamp White Oak (Del., Ala.).
Swamp Chestnut Oak (Fla.).

Locality.

Southeastern United States, Delaware and Florida, westward along Gulf to Texas. Also southern Indiana and Illinois to Gulf. Best on rich bottoms in Arkansas and Louisiana.

Features of Tree.

Seventy-five to one hundred feet in height. Three to six feet in diameter, rough, light-gray bark with loose scaly ridges.

Color, Appearance, or Grain of Wood.

Heartwood light brown, light buff sapwood,, conspicuous medullary rays, close-grained.

Structural Qualities of Wood.

Hard, heavy, very strong, tough, durable, easily split.

Representative Uses of Wood.

Construction, agricultural implements, wheel stock.

Weight of Seasoned Wood in Pounds per Cubic Foot.

46 (U. S. Forestry Div.).*
50.

Modulus of Elasticity.

1,610,000 (average of 256 tests by U. S. Forestry Div.).*
1,370,000.

Modulus of Rupture.

11,500 (average of 256 tests by U. S. Forestry Div.).*
15,800.

Remarks.

The principal white oak of Southern States; edible acorns devoured by cattle, whence its name.

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* See page 8.

Chestnut Oak. *Quercus prinus Linn.*

Nomenclature. (Sudworth.)

Chestnut Oak (local and common name).
Rock Oak (N. Y., Del., Pa.).
Rock Chestnut Oak (Mass., R. I., Pa., Del., Ala.).
Tanbark Oak (N. C.).
Swamp Chestnut Oak (N. C.).
Mountain Oak (Ala.).

Locality.

Maine to Georgia, westward intermittently to Kentucky and Alabama. Best development in southern Alleghany Mountain region.

Features of Tree.

Seventy-five to eighty feet in height, three or four feet in diameter. Leaves resemble those of chestnut.

Color, Appearance, or Grain of Wood.

Heartwood dark brown, sapwood lighter, close-grained, medullary rays conspicuous.

Structural Qualities of Wood.

Heavy, tough, hard, strong, and durable in contact with soil.

Representative Uses of Wood.

Largely used for railway ties. Bark rich in tannin.

Weight of Seasoned Wood in Pounds per Cubic Foot.

46.

Modulus of Elasticity.

1,780,000.

Modulus of Rupture.

14,600.

Remarks.

Prinus is a Greek name applied to a species of oak.

Post Oak. { *Quercus minor Sargent,* / *Quercus obtusiloba Michx.*

Nomenclature. (Sudworth.)

Post Oak (local and common name).
Iron Oak (Del., Miss., Neb.).
Box White Oak (R. I.).
Chêne étoilé (Quebec).
Overcup Oak (Fla.).
White Oak (Ky., Ind.).
Box Oak (Md.).
Brash Oak (Md.).

Locality.

East of Rocky Mountains—Massachusetts to northern Florida, westward intermittently to Nebraska and Gulf States.

Features of Tree.

Fifty to seventy feet in height, two to three feet in diameter. Low shrub in Florida. Blunt lobes or projections to leaves. Leaves clustered at ends of branches. Fine tree with rounded top.

Color, Appearance, or Grain of Wood.

Heartwood light or dark brown with lighter sapwood. Close-grained, annual rings well marked. Numerous and conspicuous medullary rays.

Structural Qualities of Wood.

Heavy, hard, strong, checks badly in drying. Durable in contact with soil.

Representative Uses of Wood.

Largely used, particularly in Southwest, for fencing, railway ties, and fuel; also for cooperage, construction, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

50 (U. S. Forestry Div.).*
52.

Modulus of Elasticity.

2,030,000 (average of 49 tests by U. S. Forestry Div.).*
1,180,000.

Modulus of Rupture.

12,300 (average of 49 tests by U. S. Forestry Div.).*
12,900.

Remarks.

Most common and widely distributed oak in Gulf States west of the Mississippi River. Obtusiloba, the Latin for blunt-lobed, refers to the shapes of the leaves. Wood seldom commercially distinguished from white oak.

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* See page 8.

Bur Oak. *Quercus macrocarpa Michx.*

Nomenclature. (Sudworth.)

Bur Oak (local and common name).
Overcup Oak (R. I., Del., Pa., Miss., La., Ill., Minn.).
Mossycup White Oak (Minn.).
Mossycup Oak (Mass., Pa., Del., Miss., La., Tex., Ark., Ill., Iowa, Neb., Kan.).
Scrub Oak (Neb., Minn.).
Overcup White Oak (Vt.).

Locality.

New Brunswick, New England, westward intermittently to Montana and Texas.

Features of Tree.

Seventy to one hundred and thirty feet in height, five to seven feet in diameter. Deep opposite depressions to leaves. Mossy, fringed border at top of acorn-cup. Corky wings on young branches.

Color, Appearance, or Grain of Wood.

Heartwood rich brown, sapwood lighter, close-grained, broad conspicuous medullary rays.

Structural Qualities of Wood.

Heavy, hard, strong, tough, very durable in contact with ground.

Representative Uses of Wood.

Similar to those of Quercus alba.

Weight of Seasoned Wood in Pounds per Cubic Foot.

46.00.

Modulus of Elasticity.

1,320,000.

Modulus of Rupture.

13,900.

Remarks.

Extends farthest west and northwest of any other Eastern oak. Especially recommended for prairie planting.

White Oak. *Quercus garryana Douglas.*

Nomenclature. (Sudworth.)

White Oak (Cal., Oreg.).
Pacific Post Oak (Oreg.).
Western White Oak (Oreg.).
Oregon White Oak (Cal.).
California Post Oak.

Locality.

Pacific coast, British Columbia into California.

Features of Tree.

Sixty to ninety feet high, one and one half to two and one half feet in diameter. A small shrub at high elevations.

Color, Appearance, or Grain of Wood.

Heartwood light brown or yellow. Sapwood lighter, often nearly white. Compact structure. Distinctly marked annual rings. Medullary rays often conspicuous.

Structural Qualities of Wood.

Heavy, strong, hard, tough.

Representative Uses of Wood.

Ship-building, carriages, furniture, indoor decoration, fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

46.

Modulus of Elasticity.

1,150,000.

Modulus of Rupture.

12,400.

Remarks.

Locally important. The best substitute for Eastern White Oak produced on Pacific coast.

The Weeping, Valley, Swamp, White or California White Oak (*Quercus loblata*), a native of central western California, is one of the largest and most symmetrical of all oaks. It adds to landscapes where it grows as elms add to the landscapes in the East. The brittle wood is seldom used in construction, but is an important local fuel.

Red Oak. *Quercus rubra Linn.*

Nomenclature. (Sudworth.)
Red Oak (local and common name).
Black Oak (Vt., Conn., N. Y., Wis., Ia., Neb., So. Dak. Ont.).
Spanish Oak (Pa., N. C.).

Locality.
East of Rocky Mountains, Nova Scotia to Georgia, westward intermittently to Nebraska and Kansas, best in Massachusetts.

Features of Tree.
Ninety to one hundred feet in height. Three to six feet and over in diameter, brownish-gray bark smooth on branches. Leaves have sharp-pointed lobes, very large acorns in flat shallow cups. A fine complete tree.

Color, Appearance, or Grain of Wood.
Heartwood light brown or red, sapwood lighter, coarse-grained, well-marked annual rings, medullary rays few but broad.

Structural Qualities of wood.
Heavy, hard, strong, inclined to check in drying, acid, inferior to white oak.

Representative Uses of Wood.
Works of secondary importance, clapboards, cooperage, fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.
45 (U. S. Forestry Div.).*
40.

Modulus of Elasticity.
1,970,000 (average of 57 tests by U. S. Forestry Div.).*
1,600,000.

Modulus of Rupture.
11,400 (average of 57 tests by U. S. Forestry Div.).*
14,000.

Remarks.
Grows more rapidly than other oaks. Bark used in tanning.

* See page 8.

Pin Oak. *Quercus palustris Muenchh.*

Nomenclature. (Sudworth.)

Pin Oak (local and common name).
Swamp Spanish Oak (Ark., Kan.).
Water Oak (R. I., Ill.).
Swamp Oak (Pa., Ohio, Kans.).
Water Spanish Oak (Ark.).

Locality.

Minnesota to Kansas, eastward intermittently to Massachusetts and Virginia.

Features of Tree.

Fifty to eighty feet in height, two to four feet in diameter. Full-rounded or pyramidal top, smooth thin bark, numerous small pin-like branches.

Color, Appearance, or Grain of Wood.

Heartwood variegated light brown, sapwood nearly white, coarse-grained, medullary rays numerous and conspicuous.

Structural Qualities of Wood.

Heavy, hard, strong, checks badly in seasoning.

Representative Uses of Wood.

Shingles, clapboards, construction, interior finish, cooperage.

Weight of Seasoned Wood in Pounds per Cubic Foot.

43.

Modulus of Elasticity.

1,500,000.

Modulus of Rupture.

15,400.

Remarks.

Palustris, the Latin for swampy, refers to favorite location of tree. The numerous slender secondary branches suggesting pins cause tree to be easily recognized, particularly in winter.

Spanish Oak. { *Quercus digitata Sudworth,* / *Quercus falcata Michx.*

Nomenclature. (Sudworth.)
Spanish Oak (local and common name).
Red Oak (N. C., Va., Ga., Fla., Ala., Mis., La., Ind.).
Spanish Oak (La.).

Locality.
New Jersey and Florida, westward intermittently to Illinois and Texas.

Features of Tree.
Thirty to seventy feet in height, two and one half to four feet in diameter. Variable foliage. Globular to oblong acorns.

Color, Appearance, or Grain of Wood.
Heartwood light red, sapwood lighter, coarse-grained, annual layers strongly marked, medullary rays few but conspicuous.

Structural Qualities of Wood.
Hard, heavy, strong, not durable, checks badly in drying.

Representative Uses of Wood.
Somewhat used for cooperage, construction, etc. Bark very rich in tannin.

Weight of Seasoned Wood in Pounds per Cubic Foot.

43.

Modulus of Elasticity.

1,900,000.

Modulus of Rupture.

16,900.

Remarks.
Dry barren soils. Grows rapidly.

Black Oak, Yellow Oak. { *Quercus velutina Lam.* / *Quercus tinctoria Barti.*

Nomenclature. (Sudworth.)
Black Oak, Yellow Oak (local and common names).
Yellow Bark, Yellow-bark Oak (R. I., Minn.).
Dyer's Oak (Tex.).
Tanbark Oak (Ill.).
Spotted Oak (Mo.).
Quercitron Oak (Del., S. C., La., Kans., Minn.).

Locality.
East of longitude 96 degrees, Maine and Florida, westward intermittently to Minnesota and Texas. Best in North Atlantic States.

Features of Tree.
Ninety to one hundred and thirty feet in height, three to five feet in diameter. Dark gray to black bark, yellow inner bark. Acorns have bitter yellow kernels. Foliage turns handsomely in autumn.

Color, Appearance, or Grain of Wood.
Heartwood light reddish brown, sapwood lighter, coarse grain, annual layers strongly marked, thin medullary rays.

Structural Qualities of Wood.
Heavy, hard, strong, liable to check in drying, not tough.

Representative Uses of Wood.
Cooperage, construction, furniture, and decoration.

Weight of Seasoned Wood in Pounds per Cubic Foot.
45 (U. S. Forestry Div.).*
44.

Modulus of Elasticity.
1,740,000 (average of 40 tests by U. S. Forestry Div.).*
1,470,000.

Modulus of Rupture.
10,800 (average of 40 tests by U. S. Forestry Div.).*
14,800.

Remarks.
Yellow inner bark affords yellow dye.

* See page 8.

Live Oak. { *Quercus virginiana Mill.* / *Quercus virens Ait.*

Nomenclature. (Sudworth.)
Live Oak (Va., N. C., S. C., Ga., Fla., Miss., Ala., Tex., La., Calif.). Chêne Vert (La.).

Locality.
Southern States—coast from Virginia to Florida, westward to Texas and Lower California, southern Mexico, Central America, and Cuba. Best in south Atlantic States.

Features of Tree.
Fifty to sixty feet high, diameter three to six feet. General resemblance to apple-tree. Evergreen foliage.

Color, Appearance, or Grain of Wood.
Heartwood light brown or yellow, sapwood nearly white, close-grained, compact structure, pronounced medullary ray, annual layers often hardly distinguishable.

Structural Qualities of Wood.
Heavy, strong, tough, hard, difficult to work, splits easily. Receives high polish, very durable.

Representative Uses of Wood.
Ship-building.

Weight of Seasoned Wood in Pounds per Cubic Foot.

59.

Modulus of Elasticity.

1,600,000.

Modulus of Rupture.

14,000.

Remarks.
Trunk and branches furnish small straight pieces, but principally knees, crooked or compass timbers. Virens refers to evergreen foliage. Splits so easily that it is better fastened with bolts or trenails than spikes. Now scarce, grows rapidly.

California Live Oak. *Quercus agrifolia Nee.*

Nomenclature. (Sudworth.)
Coast Live Oak (Cal.). Encena (Cal.).
California Live Oak (Cal.). Evergreen Oak (Cal.).

Locality.
California.

Features of Tree.
Forty to seventy-five and occasionally more feet in height, three to six feet in diameter. Evergreen foliage, leaves spiked like those of holly. Shape resembles that of apple tree.

Color, Appearance, or Grain of Wood.
Heartwood creamy white, but darkens on exposure. Compact structure, annual layers hardly distinguishable.

Structural Qualities of Wood.
Heavy, hard, but brittle.

Representative Uses of Wood.
Fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

51.

Modulus of Elasticity.

1,350,000.

Modulus of Rupture.

13,200.

Remarks.
Agrifolia is from the Latin *acer*, sharp, and *folium*, leaf, alluding to the spinous toothed leaves.

Live Oak. *Quercus chrysolepis Liebm.*

Nomenclature. (Sudworth.)
Live Oak (Cal., Oreg.). Canyon Oak, Iron Oak, Maul Oak, Valparaiso Oak (Cal.). Canyon Live Oak, Black Live Oak, Golden-cup Oak (Cal.).

Locality.
West of Rocky Mountains, canyons, and high elevations.

Features of Tree.
Fifty to eighty feet in height, three to six feet in diameter. Often low shrub. Impressive appearance. Evergreen foliage.

Color, Appearance, or Grain of Wood.
Heartwood light brown, sapwood lighter, small pores in wide bands parallel to conspicuous medullary rays. Close-grained.

Structural Qualities of Wood.
Hard, heavy, strong, tough, difficult to work.

Representative Uses of Wood.
Implements, wagons, tool-handles.

Weight of Seasoned Wood in Pounds per Cubic Foot.

52.

Modulus of Elasticity.

1,700,000.

Modulus of Rupture.

18,000.

Remarks.
Said to be the most valuable of the California oaks. Grows at elevations of 2000 to 5000 feet. Highland Oak (*Quercus wislizeni*) is an evergreen and a Pacific Coast variety.

English Oak. *Quercus robur var. pedunculata.*

Nomenclature.
English Oak. British Oak. Common Oak.

Locality.
Widespread throughout northern and central Europe.

Features of Tree.
Seventy to one hundred feet in height, three to five feet in diameter. Crooked branches, stalkless leaves, long-stalked acorns.

Color, Appearance, or Grain of Wood.
Heartwood light brown, darker spots frequent, sapwood lighter. Compact structure.

Structural Qualities of Wood.
Hard, tough, strong, durable, difficult to work, liable to warp in seasoning.

Representative Uses of Wood.
Ship-building, beams, cabinet-work, formerly carpentry.

Weight of Seasoned Wood in Pounds per Cubic Foot.
51 (Laslett).

Modulus of Elasticity.
1,170,000 (Thurston).

Modulus of Rupture.
10,000 (Thurston).

Remarks.
The English, Chestnut, Durmast, or Red Oak, Q. robur var. sessiliflora, distinguished by long leaf stalks and short acorn stalks, affords practically similar but lower-rated wood. The two varieties supply the British Oak of commerce. Dantzic, Rigi, and some other European oaks take names from port of shipment. Rubrus is red, but robur is a noun meaning strength; the adjective robustus means "oaken" or vigorous. Durmast Oak, which is the Quercus pubescens of some botanists, is less common than Quercus var. pedunculata. The two woods are often confused. Laslett states that it is difficult to distinguish one wood from the other without tracing logs back to original sources. Early writers advised against the use of iron fastenings with oak, but woods are now better seasoned, and, as stated (see page 17), later practise does not support this view, at least as applied to American woods.*

* To determine the effect of gallic acid on iron: Five grams of clean iron wire were immersed in a five per cent. solution of gallic acid. In nine days the weight was 4.720 grams and the solution intensely black. Thirteen days later the same specimen weighed 4.7453. This indicated the formation of a crust weighing more than the original iron and probably protecting it to some extent.

PLATE 6. WHITE ASH (*Fraxinus americana*).

ASH.

(*Fraxinus.*)

Ash is widely distributed over the temperate regions of the northern hemisphere, and occurs in the tropics, on the island of Cuba. The tree has occupied a position second only to that of oak. Our Teutonic forefathers relied upon its wood for boats and weapons. Their ancient faith connects it with the creation of the original man. It is often associated with oak in country proverbs.* Europeans regard the trees for ornamental purposes, but Americans value them for wood.

WHITE ASH (*Fraxinus americana*).

Ash and oak woods resemble one another in that there are bands of open pores in both woods, but the pith-rays of the ash are thinner and scarcely discernible. Ash is coarser, less attractive, easier to work, tough, elastic, and somewhat lighter than oak. It seasons well, but does not last when exposed to the weather. Lumbermen separate the woods into white and black ash, the former including the lighter-colored and more desirable pieces. This commercial division is also a botanical one in the North, where the only species of any note are the white ash and black ash (*F. americana* and *F. nigra*). The Southern green ash (*F. lanceolata*) is usually classed as white ash. The trees that grow up after the cutting of the virgin forest afford tougher, more pliable, but not necessarily stronger pieces, known as "second-growth" ash. Although not relied upon for out-of-door construction, ash is one of the most important of the cheaper cabinet woods and is used in stairs, furniture, and similar works.

* A tradition, old in Pliny's time, is that serpents avoid ash trees; another is that ash is particularly liable to be struck by lightning.

One half of the thirty known species of the genus Fraxinus inhabit North America.

The name ash is also applied to several species of the genus Pyrus or Sorbus, to which the apple, pear, quince, and some other trees belong. Olive, orange and other "fruitwoods" are in different genera.

Most trees that yield common edible fruits are valued for them and such trees are not normally cut down to any extent for wood.

The Sweet or American Crab Apple tree (Pyrus coronaria) is native, intermittently, from Massachusetts and Nebraska, southward into Georgia and Texas. It rarely grows over twenty-five feet in height and one foot in diameter, and is often a low shrub. The hard, close-grained wood is occasionally used in turnery. The trees are particularly prized in landscape effects, because of their sweet scented flowers. The Oregon Crab Apple (Pyrus rivularis) grows naturally from California to Alaska and is sometimes forty feet in height. The fine, hard, heavy, close-grained wood is used for tool handles, mallets and similar small, turned objects. The Narrowleaf Crab Apple (Pyrus angustifolia) affords a similar wood.

The Apple (Pyrus malus) is a small tree, rarely much over thirty feet in height. It origated in Europe, but is now common in all temperate climates. The hard, heavy, close-grained wood is brittle and apt to warp during seasoning. It is preeminently an implement wood and is sometimes turned into tool handles and other small objects. Many varieties have been perfected by cultivation, as see "The Apples of New York," Beach, Booth & Taylor, published by N Y. State Dept. Agriculture, etc.

The Pear (Pyrus communis) is a native of Europe and Asia, but is now cultivated in most temperate climates. The wood is rather hard and heavy, and so firm, tough, fine and close-grained that it has been used in printing. It was once valued for drawing-squares and triangles, but has been largely replaced for these purposes by hard rubber and celluloid. Pearwood is turned. It is used for furniture and is sometimes ebonized for small objects. Many varieties have been obtained by cultivation.

The Orange (several species of Citrus as Citrus aurantium and Citrus trifoliata) was introduced into the West Indies, Florida, Louisiana and California from Asia or the Mediterranean shores. It is a small tree with oily, evergreen foliage, fragrant flowers and edible fruit. Fruit, oils and essences are highly prized. Trees are seldom cut. The strong, hard, heavy, very close-grained, lemon colored wood is made into souvenirs or other small objects. A piece of American orange wood ten inches wide was exhibited at the St. Louis Exposition. Many varieties of orange have been obtained by cultivation.

The Olive (Olea europaea) was introduced from Asia or the Mediterranean countries into Southern California by the early Spanish Missions. The irregular trees, thirty or forty feet in height, have evergreen foliage and oily fruit. The fruit is so valuable that the trees are seldom cut. The mottled, rich orange-brown heartwood of foreign trees, made into souvenirs, inlaid work and other small objects, is hard, heavy, very close-grained and may be highly polished, but is not prized unless taken from older trees. American olive wood is not particularly attractive, because the heartwood has not matured sufficiently. Many varieties of olive have been obtained by cultivation.

White Ash. *Fraxinus americana Linn.*

Nomenclature. (Sudworth.)

White Ash (local and common name).
Ash (Ark., Ia., Wis., Ill., Mo., Minn.).
Cane Ash (Ala., Miss., La.).
American Ash (Ia.).

Locality.

Nova Scotia to Florida, westward intermittently to Minnesota and Texas. Greatest development in the Ohio River basin.

Features of Tree.

Forty-five to ninety feet in height, occasionally higher. Three to four feet in diameter. Usually smooth leaves, have whitish under surfaces. Gray bark in prominent vertical ridges.

Long-winged seed.

Color, Appearance, or Grain of Wood.

Heartwood reddish brown, usually mottled; sapwood much lighter or nearly white. Coarse-grained, compact structure. Layers clearly marked by large open ducts. Medullary rays obscure.

Structural Qualities of Wood.

Heavy, hard, strong, elastic, becoming brittle with age, not durable in contact with soil.

Representative Uses of Wood.

Agricultural implements, carriages, handles, oars, interior and cheap cabinet-work.

Weight of Seasoned Wood in Pounds per Cubic Foot.

39 (U. S. Forestry Div.).*
40.

Modulus of Elasticity.

1,640,000 (average of 87 tests by U. S. Forestry Div.).*
1,440,000.

Modulus of Rupture.

10,800 (average of 87 tests by U. S. Forestry Div.).*
12,200.

Remarks.

Economically valuable. Rapid growers, preferring low, rather moist soil. Not apt to form in forests, but found often in clumps mingled with other varieties. Large trees sometimes have large heart-cracks.

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* See page 8.

White ash is subject to a fungus disease by which its wood is reduced to a soft, pulpy, yellowish mass, unfit for lumber. The disease which known as white rot progresses until the tree becomes so weak that it is blown over by the winds. (See windfalls, page 155.) It does not attack dead or seasoned woods. Von Schrenk, U. S. Bureau Plant Industry, Bulletin No. 32.

Red Ash. { *Fraxinus pennsylvanica Marsh.* / *Fraxinus pubescens Lam.*

Nomenclature. (Sudworth.)

Red Ash (local and common name).	Brown Ash (Mo.).
River Ash (R. I., Ont.).	Black Ash (N. J.).
	Ash (Nebr.).

Locality.
New Brunswick to Florida, westward intermittently to Dakota and Alabama. Best developed in North Atlantic States.

Features of Tree.
A small tree, rarely over forty-five feet high, and about one foot in diameter. Downy-covered young twigs and leaves.

Color, Appearance, or Grain of Wood.
Heartwood rich brown, sapwood light brown streaked with yellow, coarse-grained compact structure.

Structural Qualities of Wood.
Heavy, hard, strong, brittle.

Representative Uses of Wood.
Agricultural implements, handles, boats, oars, paper-pulp.

Weight of Seasoned Wood in Pounds per Cubic Foot.

38.

Modulus of Elasticity.

1,154,000.

Modulus of Rupture.

12,300.

Remarks.
Grows on borders of streams and swamps in low ground. Often confused with and substituted for the more valuable white ash. Pubescens is in allusion to the downy covering of the new twigs (those of white ash usually smooth). Pennsylvanica refers to locality in which it is well developed.

Blue Ash. *Fraxinus quadrangulata Michx.*

Nomenclature. (Sudworth.)
Blue Ash (Mich., Ill., Ky., Mo., Ala.).

Locality.
Central States, Mississippi Valley, Michigan, and southward, cultivated in Pennsylvania. Best in low Wabash Valley.

Features of Tree.
Fifty to seventy-five feet in height, occasionally higher, one to two feet in diameter. Slender. Blue properties in inner bark, smooth square twigs.

Color, Appearance, or Grain of Wood.
Heartwood light yellow, streaked with brown, sapwood lighter, close-grained, compact structure satiny.

Structural Qualities of Wood.
Hard, heavy, brittle, not strong, most durable of ash woods.

Representative Uses of Wood.
Largely used in floorings, carriage-building, pitchfork- and other tool-handles.

Weight of Seasoned Wood in Pounds per Cubic Foot.

44.

Modulus of Elasticity.

1,100,000.

Modulus of Rupture.

11,500.

Remarks.
Has no superior among ash woods. Blue Ash pitchfork-handles are very fine. Prefers limestone formations. Inner bark colors water blue, whence name.

Black Ash. { *Fraxinus nigra Marsh.* / *Fraxinus sambucifolia Lam.*

Nomenclature. (Sudworth.)

Black Ash (local and common name).
Water Ash (W. Va., Tenn., Ind.).
Swamp Ash (Vt., R. I., N. Y.).
Brown Ash (N. H., Tenn.).
Hoop Ash (Vt., N. Y., Del., Ohio, Ill., Ind.).

Locality.

Northern and Northeastern States—Newfoundland to Virginia, westward intermittently to Manitoba and Arkansas.

Features of Tree.

Seventy to eighty feet in height, one to one and one-half feet in diameter. Leaves resemble those of Elder. A thin tree. Excrescences or knobs frequent on trunk. Dark, almost black, winter buds.

Color, Appearance, or Grain of Wood.

Heartwood dark brown, sapwood light brown, often nearly white, coarse-grained, compact structure, medullary rays numerous and thin.

Structural Qualities of Wood.

Separates easily in layers, rather soft and heavy, tough, elastic, not strong or durable when exposed.

Representative Uses of Wood.

Largely used for interior finish, fencing, barrel-hoops, cabinet-making, splint baskets, chair-bottoms.

Weight of Seasoned Wood in Pounds per Cubic Foot.

39.

Modulus of Elasticity.

1,230,000.

Modulus of Rupture.

11,400.

Remarks.

Excrescences known as burls; their distorted grain causes them to be prized for veneers. The most northerly of ash-trees; one of the most slender of trees.

Green Ash. { *Fraxinus lanceolata Borkh.* / *Fraxinus viridis Michx. f.*

Nomenclature. (Sudworth.)

Green Ash (local and common name).
Blue Ash (Ark., Iowa).
White Ash (Kans., Neb.).
Ash (Ark. Iowa).
Swamp Ash (Fla., Ala., Tex.).
Water Ash (Iowa).

Locality.

East of Rocky Mountains. Vermont and northern Florida intermittently to Utah and Arizona.

Features of Tree.

Forty to fifty feet in height, one to two feet in diameter. Bright green upper and lower surfaces of smooth leaves.

Color, Appearance, or Grain of Wood.

Heartwood brownish, sapwood lighter, rather coarse-grained, compact structure.

Structural Qualities.

Hard, heavy, strong, brittle.

Representative Uses.

Similar to those of White Ash.

Weight of Seasoned Wood in Pounds per Cubic Foot.

39 (U. S. Forestry Div.).*
44.

Modulus of Elasticity.

2,050,000 (average of 10 tests by U. S. Forestry Div.).*
1,280,000.

Modulus of Rupture.

11,600 (average of 10 tests by U. S. Forestry Div.).*
12,700.

Remarks.

Sometimes considered a variety of Red Ash.

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* See page 8.

Oregon Ash. *Fraxinus oregona Nutt.*

Nomenclature.
Oregon Ash (Calif., Wash., Oregon).

Locality.
Pacific coast, Washington to California. Best developed in bottom lands, southwestern Oregon.

Features of Tree.
Fifty to occasionally seventy-five feet in height, one to one and one-half feet in diameter. Dark grayish-brown, bark exfoliates in thin scales.

Color, Appearance, or Grain of Wood.
Heartwood brown, sapwood lighter, coarse-grained, compact structure, numerous thin medullary rays.

Structural Qualities of Wood.
Rather light, hard, not strong.

Representative Uses of Wood.
Manufacture of furniture, carriage-frames, cooperage, and fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

35.

Modulus of Elasticity.

1,200,000.

Modulus of Rupture.

9400.

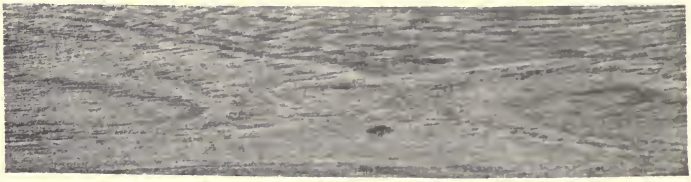
Remarks.
One of the valuable deciduous trees of the Pacific coast. Thrives only on moist soils and in moist climates.

"Mountain Ash" is either Pyrus americana or Pyrus sambucifolia. Both species, with their bright red berries, are to be classed as shrubs rather than trees; their light, soft, weak, close-grained woods having no economic importance, save perhaps for fuel. The series is partially as follows: also see page 34.

Pyrus malus (Common apple).
Pyrus coronaria (American crab-apple).
Pyrus communis (Common pear).
Pyrus vulgaris (Common quince).
Pyrus americana (Mountain ash).
Pyrus sambucifolia (Mountain ash).
Pyrus aucuparia (Rowan tree, European Mountain ash).

The Toothache Trees, Xanthoxylum americana and Xanthoxylum clava-herculis (Linn.), are known as ash and prickly ash. The gopher wood, Cladrastis tinctoria, is yellow ash. These woods are not important.

PLATE 7. ELM (*Ulmus americana*).



ELM.

(*Ulmus.*)

The different species of elm are distributed over the cold and temperate portions of the northern hemisphere, save western United States and Canada. A high degree of perfection is attained in eastern North America, where trees are greatly prized for their form and appearance.

The foliage of the elm is concentrated at the top, and the absence of lower branches causes it to be a good tree to plant near houses or along streets. Much of the wood is tough, fibrous, durable, strong, hard, heavy, and, because it is so often cross-grained, difficult to split and work. The large pores of the spring wood arranged in one or several rows mark the annual deposit, while the minute pores of the summer wood arranged in concentric wavy lines are so peculiar as to distinguish this wood from all others. The tall, straight trunks afford pieces of considerable size. Elm piles sustain constant and severe shocks for long intervals. The grain arrangement of elm is often very beautiful, so that it is increasingly used for decoration. It is more commonly employed in the construction of cars, wagons, boats, agricultural implements, machinery, and furniture.

ELM (*Ulmus americana*).

The shape of the trees is so marked as to cause them to be easily noted. Fifteen or sixteen species have been recognized. Five are known to exist in the eastern American forests, and all of them furnish good wood of commercial importance. *Ulmus* was the ancient name of the elm.

Geo. B. Emerson's "Trees and Shrubs of Massachusetts."

White Elm. *Ulmus americana Linn.*

Nomenclature. (Sudworth.)
White Elm (local and common name).
Water Elm (Miss., Tex., Ark., Mo., Ill., Ia., Mich., Minn., Neb.).
Elm (Mass., R. I., Conn., N. J., Pa., N. C., S. C., Ia., Wis.).
American Elm (Vt., Mass., R. I., N. Y., Del., Pa., N. C., Miss., Tex., Ill., Ohio, Kans., Neb., Mich., Minn.).

Locality.
East of Rocky Mountains, Newfoundland to Florida, westward intermittently to Dakota, Nebraska, and Texas.

Features of Tree.
Ninety to one hundred feet in height, three to seven feet in diameter. Characteristic and beautiful form, smooth buds; leaves, smaller than those of Slippery Elm, are rough only when rubbed one way.

Color, Appearance, or Grain of Wood.
Heartwood light brown, sapwood yellowish white, rather coarse-grained, annual rings clearly marked.

Structural Qualities of Wood.
Strong, tough, fibrous, difficult to split.

Representative Uses of Wood.
Flooring, wheel-stock, cooperage, ship-building, flumes, piles.

Weight of Seasoned Wood in Pounds per Cubic Foot.
34 (U. S. Forestry Division.)*
40.

Modulus of Elasticity.
1,540,000 (average of 18 tests by U. S. Forestry Div.).*
1,060,000.

Modulus of Rupture.
10,300 (average of 18 tests by U. S. Forestry Div.).*
12,100.

Remarks.
The concentration of foliage at top, together with the form of the tree, renders it valuable in landscape work. It does not cause dense shade. Elm and silver-maple trees are among the first to show life in spring. Discarded brownish scales then cover ground in vicinity.

* See page 8.

Cork Elm. *Ulmus racemosa Thomas.*

Nomenclature. (Sudworth.)

Cork Elm (local and common name).
Hickory Elm (Mo., Ill., Ind., Ia.).
Rock Elm (R. I., W. Va., Ky., Mo., Ill., Wis., Ia., Mich., Nebr.).
White Elm (Ont.).
Cliff Elm (Wis.).

Locality.

Quebec and Vermont, westward intermittently to Nebraska and Tennessee. Best developed in southern Ontario and Michigan.

Features of Tree.

Seventy to ninety feet in height, two to three feet in diameter. Thick, corky, irregular projections give bark a shaggy appearance and mark the species.

Color, Appearance, or Grain of Wood.

Heartwood light brown, often tinged with red; sapwood yellowish or greenish white. Compact structure, fibres interlaced.

Structural Qualities of Wood.

Heavy, hard, very strong, tough, difficult to split, susceptible of a beautiful polish, elastic.

Representative Uses of Wood.

Heavy agricultural implements, wheel-stocks, railway ties, sills, bridge-timbers, axe-helves, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

45.

Modulus of Elasticity.

2,550,000.

Modulus of Rupture.

15,100.

Remarks.

Cork Elm is the best of the elm woods.

Slippery Elm, Red Elm. { *Ulmus pubescens Walt.* / *Ulmus fulva Michx.*

Nomenclature. (Sudworth.)
Slippery Elm, Red Elm (local and common name).
Rock Elm (Tenn.).
Redwooded Elm (Tenn.).
Moose Elm (occasional).

Locality.
Ontario and Florida, westward intermittently to Nebraska and Texas. Best developed in Western States.

Features of Tree.
Forty-five to sixty feet in height, one to two feet in diameter. Characteristic shape, mucilaginous inner bark. Buds hairy. Leaves, larger than American Elm, are rough when rubbed either way.

Color, Appearance, or Grain of Wood.
Heartwood dark brown or red, sapwood lighter, compact structure, annual layers marked by rows of large open ducts. Heartwood greatly preponderates.

Structural Qualities of Wood.
Heavy, hard, strong, and durable in contact with soil.

Representative Uses of Wood.
Largely used for fence-posts, rails, railway ties, sills, sleigh-runners, and wheel-stocks. Mucilaginous bark, employed in medicine.

Weight of Seasoned Wood in Pounds per Cubic Foot.

43.

Modulus of Elasticity.

1,300,000.

Modulus of Rupture.

12,300.

Remarks.
Mucilaginous inner bark renders this species unmistakable. This bark is used in medicine.

Wing Elm, Winged Elm. *Ulmus alata Michx.*

Nomenclature.

Wing Elm, Winged Elm (local and common names).
Wahoo, Whahoo (W. Va., N. C., S. C., La., Tex., Ky., Mo.).
Cork Elm, Corky Elm (Fla., S. C., Tex.).
Mountain Elm, Red Elm (Fla., Ark.).
Elm, Witch Elm (W. Va.).
Water Elm (Ala.).
Small-leaved Elm (N. C.).
Wahoo Elm (Mo.).

Locality.

Southern United States, Virginia and Florida westward intermittently to southern Illinois and Texas.

Features of Tree.

Forty feet or more in height, one to two feet in diameter. Corky "wings" on branches.

Color, Appearance, or Grain of Wood.

Color brownish, sapwood lighter, close-grained, compact structure.

Structural Qualities of Wood.

Hard, heavy, tough.

Weight of Seasoned Wood in Pounds per Cubic Foot.

46.

Modulus of Elasticity.

740,000.

Modulus of Rupture.

10,200.

Remarks.

Not a very common tree.

MAPLE.

(*Acer.*)

The maples grow on all of the continents of the northern hemisphere. Nearly one half of the known species belong in China, Japan, and the Orient. The principal European species (*Acer pseudo-platanus*) is the European scycamore.* The hard or sugar maple (*Acer saccharum*) is one of the principal deciduous trees of North America.

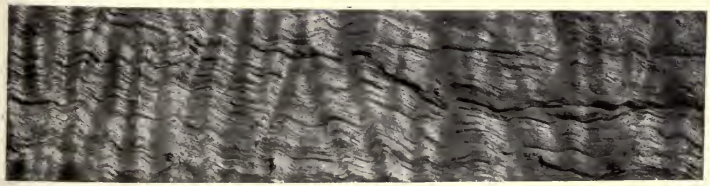
Maple wood † is characterized by its appearance and by its fine compact texture. The first quality is so marked that selected pieces take rank among the most beautiful of cabinet woods; the last is so pronounced as to fit it for carvings and even for type. "Birdseye," "blister," and "curly" maples are not from different species, but are the results of fibre distortions, possible in some form in any tree of any species, but peculiarly liable to occur in the maple; birdseye and blister effects for the most part in the hard maples, curly effects in the hard, but generally in the softer, species. The distortions do not occur in all trees, and it is seldom possible to tell whether the woods are thus figured until after the trees have been cut. Maple wood shrinks moderately, stands well in protected places, is strong, tough, but not durable when exposed. Pores are not arranged in circles, but are scattered irregularly throughout the layers. Maple is used for ceiling, flooring, panelling, car and ship construction, shoe-lasts, shoe-pegs, furniture, school supplies, implements, and machinery. Sugar is principally, although not exclusively, present in the sap of the sugar maple.‡ The softer species are sometimes

* See Sycamore, page 65.

† These notes apply to the American product.

‡ Vermont, New York, and Michigan produce the larger portion of the about fifty million pounds of sugar and three million gallons of syrup annually manufactured in the United States. Third Annual Report of the Fisheries, Game, and Forest Commissioners, New York, 1897, p. 308.

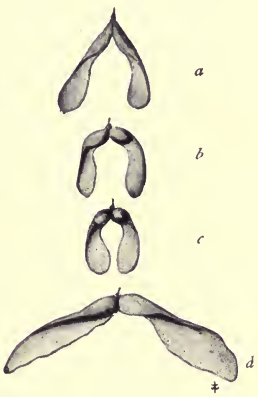
PLATE 8. SUGAR MAPLE (*Acer saccharum*).



"Curly" Maple Wood (*dissection*).

tapped, and sugar is also present in the sap of other trees, such as the butternut and birch. A sugar maple will, on an average, produce about twenty-five gallons of sap, containing a total of about six pounds of sugar, in a season.

The Boxelder (*Acer negundo*) is a true maple, remarkable in that it is widely distributed from Canada to Mexico and from the Atlantic to the Rocky Mountains, on low bottom lands, and at elevations of five thousand and six thousand feet.* The trees are beautiful and, like other maples are valued for ornamental purposes. The soft, light wood is not particularly noted, although occasionally used for woodenware, interior finish, and paper-pulp. Small quantities of sugar are present in the sap of this tree.



a, Boxelder. *b*, Hard or Sugar Maple. *c*, Soft or Red Maple. *d*, Soft or Silver Maple.

The maples may be told by their leaves of characteristic shape, but chiefly by their two-seeded fruit or "keys," the two wings of which spread differently in different species. The leaves of some species change in autumn from green to red and other brilliant colors. Those of other species change to yellow without trace of red. Sixty to seventy species have been distinguished, nine of which occur in North America.

* Sargent.

Sugar Maple, Hard Maple. { *Acer saccharum Marsh.* / *Acer saccharinum Wang.*

Nomenclature. (Sudworth.)

Sugar Maple, Hard Maple (local and common names).
Black Maple (Fla., Ky., N. C.).
Sugar Tree (frequent).
Rock Maple (Me., Vt., N. H., Conn., Mass., R. I., N. Y., Tenn., Ill., Mich., Ia., Kans., Wis., Minn.).

Locality.

Best development Maine to Minnesota; range extends southward to Florida and Texas.

Features of Tree.

Seventy to one hundred feet and more in height, one and one-half to four feet in diameter. The fruit or "maple-key" with wings less than right angles ripen in early autumn; one seed-cavity is usually empty. Foliage turns to brilliant reds and other colors later. Large impressive tree.

Color, Appearance, or Grain of Wood.

Heartwood brownish, sapwood lighter, close-grained, compact structure, occasional "curly," "blister," or "birdseye" effects.

Structural Qualities of Wood.

Tough, heavy, hard, strong, susceptible of good polish, wears evenly, not durable when exposed.

Representative Uses of Wood.

Furniture, shoe-lasts, piano-actions, wooden type for showbills, pegs, interior finish, flooring, ship-keels, vehicles, fuel, veneers, rails, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

43.

Modulus of Elasticity.

2,070,000.

Modulus of Rupture.

16,300.

Remarks.

Birdseye, blister, and to a less extent curly and landscape effects pronounced in this species. Saccharum refers to sugar manufactured from the sap. Hard maple is because of hardness of wood.

Silver Maple, Soft Maple. { *Acer saccharinum Linn.* / *Acer dasycarpum Ehr.*

Nomenclature. (Sudworth.)

Silver Maple, Soft Maple (local and common names).
Swamp Maple (W. Va., Md.).
Water Maple (Pa., W. Va.).
River Maple (Me., N. H., R. I., W. Va., Minn.).
White Maple (Me., Vt., R. I., N. Y., N. J., Pa., W. Va., N. C., S. C., Ga., Fla., Ala., Miss., La., Ky., Mo., Ill., Ind., Kans., Nebr., Minn.).

Locality.

New Brunswick to Florida, westward intermittently to Dakota and Indian Territory. Best development in lower Ohio River basin.

Features of Tree.

Forty to ninety feet in height, occasionally higher. Three to five feet in diameter. Fine shape, sometimes suggests elm. Fruit or "maple-key" with long, stiff, more than right-angled wings ripens in early summer. Leaves whitish beneath, turn showing yellow, but little or no red, in autumn.

Color, Appearance, or Grain of Wood.

Heartwood reddish brown, sapwood ivory-white, fine grain, compact structure. Fibres sometimes twisted, waved, or curly.

Structural Qualities of Wood.

Light, brittle, easily worked, moderately strong; receives high polish. Not durable when exposed.

Representative Uses of Wood.

Woodenware, turned work, interior decoration, flooring, fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

32.

Modulus of Elasticity.

1,570,000.

Modulus of Rupture.

14,400.

Remarks.

Waved, spiral, or curly figure pronounced in this species, very real resemblance to lights and shadows on planed surfaces. Small quantities of sugar present in sap, occasionally utilized.

Red Maple, Swamp Maple. *Acer rubrum Linn.*

Nomenclature. (Sudworth.)

Red Maple, Swamp Maple (local and common names).
Soft Maple (Vt., Mass., N. Y., Va., Miss., Mo., Kans., Neb., Minn.).
Water Maple (Miss., La., Tex., Ky., Mo.).
White Maple (Me., N. H.).
Red Flower (N. Y.).

Locality.

New Brunswick and Florida, westward intermittently to Dakota and Texas. Wide range.

Features of Tree.

Sixty to eighty feet and more in height, two and one-half to four feet in diameter. Red twigs and flowers in early spring.

Color, Appearance, or Grain of Wood.

Heartwood brown tinged with red, sapwood lighter, close-grained, compact structure. Red blossoms, twigs, and stems. Leaves turn scarlet in autumn.

Structural Qualities of Wood.

Easily worked, heavy, hard, not strong, elastic, qualities between those of silver and sugar maple.

Representative Uses of Wood.

Largely used in cabinet-making, turnery, woodenware, gun-stocks, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

38.

Modulus of Elasticity.

1,340,000.

Modulus of Rupture.

15,000.

Remarks.

Occasionally shows "curly" figure. Trees are occasionally tapped and small quantities of sugar are obtained from the sap.

Oregon Maple. *Acer macrophyllum Pursh.*

Nomenclature. (Sudworth.)

Oregon Maple (Oreg., Wash.).
White Maple (Oreg., Wash.).
Maple (Calif.).
Broad-leaved Maple (Central Calif., Willamette Valley, Oreg.).

Locality.

Alaska to California. Best in rich bottom lands of southern Oregon.

Features of Tree.

Seventy to one hundred feet in height, three to five feet in diameter. Beautiful appearance.

Color, Appearance, or Grain of Wood.

Reddish brown, sapwood whitish, close-grained, compact structure, occasionally figured.

Structural Qualities.

Light, hard, strong; receives polish.

Representative Uses of Wood.

Locally used for tool-handles, turned work, and furniture.

Weight of Seasoned Wood in Pounds per Cubic Foot.

30.

Modulus of Elasticity.

1,100,000.

Modulus of Rupture.

9720.

Remarks.

Ornamental tree has been introduced into Europe. Said to be one of the most valuable Pacific coast broadleaf woods.

Boxelder, Ash-leaved Maple. { *Acer negundo Linn.* / *Negundo aceroides Moench.*

Nomenclature. (Sudworth.)

Boxelder, Ash-leaved Maple (local and common names).
Red River Maple, Water Ash (Dak.).
Cut-leaved Maple (Colo.).
Stinking Ash (S. C.).
Negundo Maple (Ill.).
Three-leaved Maple (Fla.).
Black Ash (Tenn.).
Sugar Ash (Fla.).

Locality.

Atlantic Ocean westward intermittently to Rocky Mountains, Mexico.

Features of Tree.

Forty to seventy feet in height, one and one-half to three feet in diameter. Wings to keys are straight or incurved. Leave sparingly and coarsely toothed, show yellow but little or no red in autumn.

Color, Appearance, or Grain of Wood.

Thin heartwood, cream-white; sapwood similar; close-grained, compact structure.

Structural Qualities of Wood.

Light, not strong, soft.

Representative Uses of Wood.

Woodenware, cooperage, etc., paper-pulp (largely), occasionally interior finish.

Weight of Seasoned Wood in Pounds per Cubic Foot.

26.

Modulus of Elasticity.

82,000.

Modulus of Rupture.

7500.

Remarks.

A rapid grower. Withstands severe climatic changes. A good tree to plant in naturally treeless sections. Sugar is sometimes obtained from the sap of this species. The "Boxelder" is a true maple.

Black Walnut Tree (*Juglans nigra*).
Black, White, and English Walnuts.

Black Walnut Trunk (*Juglans nigra*)
Black Walnut Wood (*Juglans nigra*).

WALNUT.

(*Juglans.*)

The English or Royal Walnut (*Juglans regia*), a native of Persia, was the only available species of this genus until the introduction of the nearly similar Black Walnut of North America.* As oak gave way first to soft woods for construction, so it gave way first to walnut for cabinet purposes. The wood soon became very fashionable, and exorbitant prices were paid for it. Walnut was extremely popular in the United States until about 1880, when oak began to resume its place as the popular cabinet wood. The nuts of the English or Persian walnut are better than those of the American species, but the wood of the latter is superior.

The use of walnut wood for gun-stocks began in Europe, the demands early becoming so great that, until the general peace following the battle of Waterloo, the greater part of the French product was diverted for that purpose, while prices rose in England so that six hundred pounds sterling is reported to have been paid for a single tree. In spite of the innumerable woods that have since been introduced, this one is yet regarded as best for gun-stocks.† Walnut is a firm, hard, chocolate-colored wood, with pores not arranged in rings but scattered somewhat irregularly. The sombre, although rich, color has been objected to for some positions. Large excrescences or "burrs" are common on foreign trees, particularly those near the Black Sea and in Italy. The grain in such growths is beautifully irregular, and the wood, known as "burl," is prized for veneers. Trees are very scarce, and walnut is now seldom seen save in cabinet work or gun-stocks. The related White Walnut or Butternut (*Juglans cinerea*) affords a less-prized and

* About the middle of the seventeenth century.

† France used twelve thousand trees in 1806. (Stevenson's "Trees of Commerce," p. 77.)

lighter-tinted wood. (The nuts of the walnuts are a source of profit.) This is particularly true of the English Walnut (*Juglans regia*), which is extensively cultivated for its fruit in California. The City of Pasadena has in a single season (1904) realized $7375 from sixteen hundred fifteen-year-old trees cultivated in connection with its sewage farm.*

Black walnut trees seldom form forests by themselves, but occur generally in mixed growth. They grow quickly, but the heartwood for which the tree is valued begins to form only when the tree is at a considerable age, so that a number of years must elapse before a tree can produce wood of the desired quality. Trees one hundred years old furnish the best quality of wood.

Small pieces of dark, rich brown wood are available from the Mexican or Arizona Walnut (*Juglans rupestris*), which grows in sparsely settled areas from Texas and Arizona southward into Mexico, and is also known as the Western, Dwarf, Little, and California Walnut. The California Walnut (*Juglans californica*) inhabits the coast region, intermittently, from the Sacramento River to the San Bernardino Mountains. Trees are often very small, but diameters of fifteen inches are not uncommon. The blue brown woods, while suited for cabinet making, are seldom used. Both Mexican and California species afford coarse nuts, gathered by children. The English Walnut is sometimes grafted on trees of the last named species.

Circassian Walnut wood is distinct from common black walnut in that the color is not solid. There are large open figures, waves and streaks showing black with yellowish white. The rich effects and the scarcity of this product rank it with satinwood. It is used in piano cases, panel work, and other costly decorations.

Walnut trees may be known by their nuts, the husks or pods of which adhere unbroken, instead of loosening, completely divided into four sections, as with the hickories. Juglans is from *Jovis*, signifying *Jove's* and *glans*, signifying acorn. This nut, not the fruit of the oak, was the acorn of the ancients.†

* The *net* returns of the preceding season amounted to $4738.

† The ancients considered the shade of the walnut as harmful to all life. It is certain some vegetation is affected, probably by properties in fallen leaves.

Black Walnut. *Juglans nigra Linn.*

Nomenclature. (Sudworth.)
Black Walnut (local and common name).
Walnut (N. Y., Del., W. Va., Fla., Ky., Mo., Ohio, Ind., Ia.).

Locality.
Ontario and Florida, westward intermittently to Nebraska and Texas.

Features of Tree.
Ninety to one hundred and twenty-five feet in height, three to eight feet in diameter. A tall handsome tree with rough brownish, almost black, bark. Large, rough-shelled nuts.

Color, Appearance, or Grain of Wood.
Heartwood dark, rich, chocolate-brown. Thin sapwood much lighter, rather coarse-grained.

Structural Qualities of Wood.
Heavy, hard, strong, easily worked, durable, susceptible to high polish.

Representative Uses of Wood.
Cabinet-making, gun-stocks, also formerly furniture and decoration.

Weight of Seasoned Wood in Pounds per Cubic Foot.

38.

Modulus of Elasticity.

1,550,000.

Modulus of Rupture.

12,100.

Remarks.

The English, Royal, or Persian Walnut (*Juglans regia*) affords nearly similar wood. Widely distributed over Europe. Italian trees furnish best, French next, and English least desirable, palest and coarsest wood. Occasional trees in Eastern United States, as New York; very plentiful in California.

Butternut, White Walnut. *Juglans cinerea Linn.*

Nomenclature.

Butternut, White Walnut (local and common names).
Oil Nut (Me., N. H., S. C.).
Walnut (Minn.).
White Mahogany.

Locality.

New Brunswick to Georgia, westward to Dakota and Arkansas. Best in Ohio River basin.

Features of Tree.

Medium size, sometimes seventy-five feet or over in height, two to four feet in diameter. Branches widespread; large-sized oblong edible nuts.

Color, Appearance, or Grain of Wood.

Heartwood light gray-brown, darkening with exposure; sapwood nearly white, coarse-grained compact structure, attractive.

Structural Qualities of Wood.

Light, soft, not strong, easily worked. Susceptible of high polish.

Representative Uses of Wood.

Interior finish, cabinet-work. Inner bark furnishes yellow dye.

Weight of Seasoned Wood in Pounds per Cubic Foot.

25.

Modulus of Elasticity.

1,150,000.

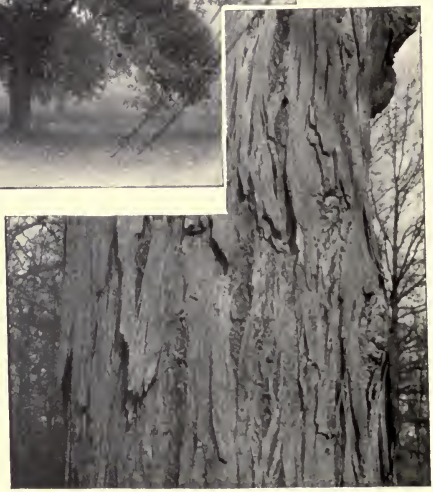
Modulus of Rupture.

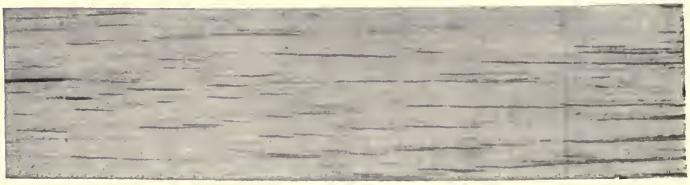
8400.

Remarks.

The sap contains sugar and is occasionally mixed with maple-sap in the manufacture of "maple" sugar. Butternuts when half grown are often pickled. The bark affords a mild cathartic that resembles rhubarb in its action and that was much employed by the physicians attached to the American Army during the Revolutionary War. Butternut wood is one of the cheaper woods that must now be employed.

PLATE 10. HICKORY (*Hicoria ovata*).





HICKORY.

(*Hicoria* or *Carya.*)

The Hickories occur only in the eastern part of North America. They produce woods in which the qualities of toughness, elasticity, and resilience are unusually pronounced, and since these qualities are greatest in the sapwood, hickories are peculiar in that the sapwood is more valuable than the heart. Second-growth wood is much prized, since, being younger, it contains more of the pliable sapwood.* Most second growth woods are regarded as being inferior to first growth woods because sapwood is usually less desirable. The reputation of American hammers and axes owe much to the qualities of their hickory handles.

Hickory is not durable when exposed and is more or less subject to attack by boring-insects. It is used for implements, machinery, carriages, and the like; hickory axe-helves have no superiors. The nuts of the shagbark or white hickory are a source of considerable profit. The pecan (*Hicoria pecan*) affords wood so inferior as to be little used in construction, although it makes an excellent fuel. Pecans are planted in many of the Southern States because of the nuts, for which a considerable demand exists.

The Hickories are known by their nuts, the husks or pods of which loosen completely from the nut in four pieces, instead of adhering unbroken as in the case of the walnuts. The nine species are American trees, eight of them being natives of the United States. *Carya* was the Greek name of the common walnut. Hickory is said to be derived from the Indian *powcohicora*, a liquor once obtained from the nuts of the hickory.

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* See Second-growth Ash.

Shagbark (Hickory), Shellbark (Hickory). { *Hicoria ovata Mill.* / *Carya alba Nutt.*

Shagbark

Nomenclature. (Sudworth.)

Shagbark or Shellbark Hickory (local and common name).
Scalybark Hickory (W. Va., S. C., Ala.).
Shellbark (R. I., N. Y., Pa., N. C.).
Shagbark (R. I., Ohio).
Hickory (Vt., Ohio).
Upland Hickory (Ill.).
White Hickory (Ia., Ark.).
Walnut (Vt., N. Y.).
Sweet Walnut (Vt.).
Shagbark Walnut (Vt.).

Locality.

Maine to Florida, westward intermittently to Minnesota and Texas. Wide range, best in Ohio valley.

Features of Tree.

Seventy-five to ninety feet in height, occasionally higher; two and one-half to three feet in diameter. Shaggy bark, thin-shelled edible nuts.

Color, Appearance, or Grain of Wood.

Heartwood light brown, sapwood ivory- or cream-colored. Close-grained, compact structure. Annual rings clearly marked. Medullary rays numerous but thin.

Structural Qualities of Wood.

Very heavy, very hard, strong, exceptionally tough and flexible, not durable when exposed.

Representative Uses of Wood.

Largely used for agricultural implements, wheels, and runners, axe-handles, baskets, fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

51 (U. S. Forestry Div.).*
52.

Modulus of Elasticity.

2,390,000 (average of 137 tests by U. S. Forestry Div.).*
1,900,000.

Modulus of Rupture.

16,000 (average of 137 tests by U. S. Forestry Div.).*
17,000.

Remarks.

The nuts form an important article of commerce. "Shagbark" refers to the shaggy appearance of the bark.

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* See page 8.

Pignut (Hickory). *Hicoria glabra Mill.* / *Carya porcina Nutt.*

Nomenclature. (Sudworth.)

Pignut (local and common name).	Bitternut (Ark., Ill., Ia., Wis.).
	White Hickory (N. H., Ia.).
Black Hickory (Miss., La., Ark., Mo., Ind., Ia.).	Broom Hickory (Mo.).
	Hardshell (W. Va.).
Brown Hickory (Del., Miss., Tex., Tenn., Minn.).	Red Hickory (Del.).
	Switchbud Hickory (Ala.).

Locality.
Ontario to Florida, westward intermittently to southern Nebraska and eastern Texas.

Features of Tree.
Seventy-five to one hundred feet in height, occasionally higher; Two to four feet in diameter. Rather smooth bark. Large thick-shelled nuts, kernels often astringent or bitter.

Color, Appearance, or Grain of Wood.
Heartwood light and dark brown, thick sapwood, lighter, nearly white. Close-grained.

Structural Qualities of Wood.
Heavy, hard, flexible, tough, strong.

Representative Uses of Wood.
Similar to those of shagbark hickory.

Weight of Seasoned Wood in Pounds per Cubic Foot.
56 (U. S. Forestry Div.).*
51.

Modulus of Elasticity.
2,730,000 (average of 30 tests by U. S. Forestry Div.).*
1,460,000.

Modulus of Rupture.
18,700 (average of 30 tests by U. S. Forestry Div.).*
14,800.

Remarks.
Nuts are devoured by pigs, whence the name *porcina*.

* See page 8.

Mocker Nut (Hickory). { *Hicoria alba Linn.* / *Carya tomentosa Nutt.*

Nomenclature. (Sudworth.)
Mocker Nut, Whiteheart Hickory (local and common names).
Bullnut (N. Y., Fla., Miss., Tex., Mo., Ohio., Ill., Minn.).
Black Hickory (Tex., Miss., La., Mo.).
Hickory (Ala., Tex., Pa., S. C., Neb.).
Big-bud, Red Hickory (Fla.).
Common Hickory (N. C.).
White Hickory (Pa., S. C.).
Hickory Nut (Ky., W. Va.).
Hog Nut (Del.).
Hard bark Hickory (Ill.).

Locality.
Ontario to Florida, westward intermittently to Missouri and Texas. Wide range.

Features of Tree.
Seventy-five to one hundred feet in height, two and one-half to three and one-half feet in diameter. A tall slender tree with rough, but not shaggy, bark. Thick shell, edible nut.

Color, Appearance, or Grain of Wood.
Heartwood rich dark brown, thick sapwood nearly white, close-grained.

Structural Qualities of Wood.
Very heavy, hard, tough, strong, and flexible.

Representative Uses of Wood.
Similar to those of shellbark hickory.

Weight of Seasoned Wood in Pounds per Cubic Foot.
53 (U. S. Forestry Div.).*
51.

Modulus of Elasticity.
2,320,000 (average of 75 tests by U. S. Forestry Div.).*
1,630,000.

Modulus of Rupture.
15,200 (average of 75 tests by U. S. Forestry Div.).*
16,000.

Remarks.
The most generally distributed species of the genus in the South. Mocker nut or moker nut is said (Britton) to be from a Dutch word meaning hammer, or else (Keeler) from disappointing quality of nuts.

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* See page 8.

Pecan, (Hickory). { *Hicoria pecan Marsh.* / *Carya oliviæformis Nutt.*

Nomenclature. (Sudworth.)
Pecan (local and common name).
Pecan Nut, Pecan-tree, Pecanier (La.).

Locality.
Valley of Mississippi, southward to Louisiana, Texas, and Mexico.

Features of Tree.
Ninety to one hundred feet in height, sometimes higher. Two and one-half to five feet in diameter. A tall tree, smooth-shelled oblong edible nuts.

Color, Appearance, or Grain of Wood.
Heartwood light brown, tinged with red, sapwood lighter brown. Close-grained and compact, medullary rays numerous but thin.

Structural Qualities of Wood.
Heavy, hard, not strong, brittle.

Representative Uses of Wood.
Fuel, seldom used in construction.

Weight of Seasoned Wood in Pounds per Cubic Foot.
49 (U. S. Forestry Div.).*
44.

Modulus of Elasticity.
2,530,000 (average of 37 tests by U. S. Forestry Div.).*
940,000.

Modulus of Rupture.
15,300 (average of 37 tests by U. S. Forestry Div.).*
8,200.

Remarks.
Grows on borders of streams in low rich soil. Largest and most important tree of western Texas. The sweet edible nuts form an important article of commerce.

* See page 8.

CHESTNUT, CHINQUAPIN.

(*Castanea.*)

The chestnut is found in the temperate regions of central and southern Europe, northern Africa, China, Japan, and eastern North America. The wood is valued in construction, and the much-prized nuts are regarded as a food rather than a confection. European chestnut wood was once high in favor, although examination of structures in which it was supposed to have been used indicates that in some instances oak had been mistaken for it and had been employed in its place.

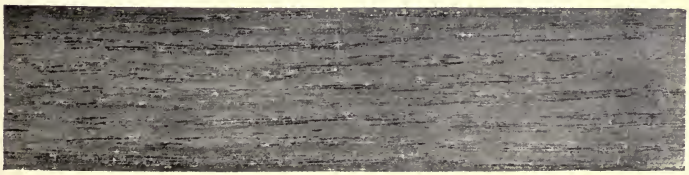
The North American chestnut affords a weak, brittle, but easily worked and very durable wood, such as is admirably adapted for beams, ties, and sills, where lightness and durability rather than much transverse strength are required. Trees in Europe have attained to great size and age. Micheaux mentions one thirty feet in circumference six feet from the ground and said to have been standing for a thousand years. The famous Mt. Etna chestnut * is reported to have measured two hundred and four feet in circumference. Large trunks are apt to be hollow, affording brittle, useless wood. The botanical relation between the American and European chestnuts is not distinct. Some consider the former a distinct species, others a variety only. The name "Chinquapin" applies to two distinct botanical species, one, the Castanea pumila, closely related to the common chestnut; the other, Castanopsis chrysophylla, belonging to the same family (Cupuliferæ), but to quite another genus. Both afford woods resembling, but heavier than, chestnut.

The Western, Golden or California Chinquapin (*Castanopis chrysophylla*) has a light, compact, soft, reddish wood, that

* "Castagno di cento cavalli," so called from having sheltered 100 mounted cavaliers, measured by Brydon in 1770. It had the appearance of five distinct trees, but was probably one trunk. (G. B. Emerson, "Trees and Shrubs of Massachusetts," Vol. I, page 192.)

PLATE 11. CHESTNUT (*Castanea dentata*).

(*Courtesy N. C. Geological Survey.*)



suggests chestnut and that is sometimes locally used for implements. The handsome evergreen leaves have golden under surfaces. The sweet hard-shelled nuts resemble filberts. The trees are very beautiful and are fitted for landscape purposes. They grow from Oregon to Central California. The Golden Chestnut, which is the nearest native Pacific Coast approach to the Eastern or American chestnut, is sometimes called the Evergreen Chestnut.

The American Chestnut (*Castanea vulgaris*) may be regarded for its wood, its tanin and its fruit. The very durable wood is one of the best of its range for fence-posts and mudsills. Hough mentions a fence-rail that was good after having been exposed for about one hundred years. This durability is largely due to the presence of tannic acid that is so abundant as to be separated and employed in tanning.* The nuts are finer and sweeter than those produced by foreign species, yet American chestnut trees are seldom cultivated for nuts. The Spanish, French and Italian nuts are highly prized and are gathered as commercial crops. The best of these nuts are imported or are eaten when fresh, the others are dried and made into a flour that is used for bread and cake. Some nuts are candied (*marrons glaces*). The Italian government encourages the production of nuts by gratuitously distributing young trees.† The American chestnut tree is equally worthy of cultivation since it will grow rapidly on any soil within its native areas. Its wood and its bi-products are likely always to be in demand.

The chestnut may be known by its large prickly burr, containing from one to three thin-shelled, triangular, wedge-shaped nuts. Both chinquapins have prickly burrs containing one, or sometimes two, sweet edible nuts. Three of the four known species of the genus Castanea grow in North America, one the common chestnut (*Castanea vulgaris*); another the Chinquapin (*Castanea pumila*); the third a plant never attaining to the size of a tree. The Chinquapin (*Castanopsis chrysophylla*) is the only North American representative of a genus including twenty-five species.

* Chestnut leaves are sometimes made into a tea, employed in connection with whooping cough. (U. S. Dispensatory.)

† Penn. Dept. Forestry Statement, 1901, 1902. p. 93, 101. "Chestnut in Southern Maryland," Zon. U. S. Forestry Bureau Bulletin No. 53.

Chestnut. { *Castanea dentata* (*Marsh*) *Borkh.*
Castanea vesca var. americana Michx.
Castanea vulgaris var. americana A. de C.

Nomenclature.
Chestnut (local and common name).

Locality.
New England, New York to Georgia, Alabama, Mississippi. Kentucky, Missouri, Michigan. Best on western slope of Alleghany Mountains.

Features of Tree.
Seventy-five to one hundred feet in height, five to twelve feet in diameter. Fine characteristic shape, not easily distinguished from Red Oak in winter. Blossoms in midsummer. Prickly burrs contain three thin-shelled nuts.

Color, Appearance, or Grain of Wood.
Heartwood brown, sapwood lighter, coarse-grained.

Structural Qualities of Wood.
Light, soft, not strong, liable to check and warp in drying. Easily split. Very durable in exposed positions.

Representative Uses of Wood.
Cabinet-making, railway ties, posts, fencing, sills.

Weight of Seasoned Wood in Pounds per Cubic Foot.

28.

Modulus of Elasticity.

1,200,000.

Modulus of Rupture.

9800.

Remarks.
The nuts of the foreign species (*C. vesca*) as well as those of the domestic species are much prized. The former are larger and the latter sweeter. One of the latest trees to blossom. Foreign species are cultivated in California for their nuts.

Chinquapin. *Castanea pumila* (*Linn.*) *Mill.*

Nomenclature. (Sudworth.)
Chinquapin (Del., N. J., Pa., Va., W. Va., N. C., S. C., Ga., Ala., Fla., Miss., La., Tex., Ark., Ohio, Ky., Mo., Mich.).

Locality.
Pennsylvania to Florida, Mississippi, Louisiana, Texas, Arkansas, Ohio, Kentucky, Missouri, Michigan.

Features of Tree.
A small tree, sometimes forty-five feet in height, one to two feet or over in diameter. Sometimes reduced to low shrub. Small prickly burr with single small chestnut-colored nut.

Color, Appearance, or Grain of Wood.
Heartwood dark brown, sapwood hardly distinguishable. Coarse-grained, annual layers marked by rows of open ducts.

Structural Qualities of Wood.
Rather heavy, hard, strong. Durable in exposed positions. Liable to check in drying.

Representative Uses of Wood.
Posts, rails, railway ties, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

36.

Modulus of Elasticity.

1,620,000.

Modulus of Rupture.

14,000.

Remarks.

The Chinquapin (*Castanopsis chrysophylla*), is a tree with characteristics between oak and chestnut. Its wood is nearly similar to that of the Chinquapin Castanea pumila, and is sometimes used for implements. It is native in Oregon and California.

BEECH. IRONWOOD.

(*Fagus.*) (*Carpinus, Ostrya, etc.*)

Beech is well known on the eastern continent. The common beech (*Fagus atropunicca*) is the only American representative. Eastern species have figured in literature since the time of Virgil. The northern nations early wrote upon thin tablets of beechwood, and *boc*, *bok*, and *buche*, the northern names for beech, finally gave origin to the word book.* American Indians believed that the beech was proof against lightning.

BEECH (*Fagus atropunicea*).

Beechwood is hard, heavy, strong, not durable when exposed, and somewhat subject to attack by insects. European engineers employ it to a considerable extent in construction, but it is seldom used in America save for indoor finish, furniture, handles, flooring, and the like. The small edible nuts, known as beech-mast, are pressed abroad for a fixed oil, resembling and used in place of that from the olive. They are seldom gathered in this country, but are devoured by animals. Beech-trees have smooth, light-colored bark, and are very attractive in their winter appearance. They may be recognized earlier in the season by their small prickly burrs, each containing two triangular, sharp-edged nuts. There are fifteen or more species known to belong to this genus. *Fagus* is from *phago*, to eat, and refers to the nut.

The name Ironwood has been applied to Blue Beech (*Carpinus caroliniana*), to the Hornbeam (*Ostrya virginiana*), and to at least eight other North American species affording unusually hard and heavy woods, such as are used for handles

**Liber*, the Latin for book, is from *liber*, the inner bark of a tree, while *papyrus*, the Latin for paper, is from an Egyptian reed of that name. The words "book," "library," and "paper" are thus drawn from trees and plants.

PLATE 12. BEECH (*Fagus*).

and implements.* Trunks of trees affording these woods are generally small and the weight of the woods is so great as to prevent their use in construction.

* Prosopis juliflora, Olneya tesota, Guajacum sanctum, Cliftonia monophylla, Cyrilla racemiflora, Exothea paniculata, Bumelia tenax, Bumelia lycioides. (Sudworth.)

The Coffee, Coffeenut, Coffeebean, Coffeebean-tree or Mahogany (*Gymnocladus dioicus*) grows best between the Mississippi and the Alleghany Mountains. Trees are cultivated in many places. The strong, durable, rich-brownish wood works easily, polishes well and is well suited for cabinet work. The trees are valued in landscapes. The beans were once used for coffee.

The Hackberry, Sugarberry, One-berry, Nettle-tree, False Elm or Juniper (*Celtis occidentalis*) grows intermittently from Canada to Florida and from the Atlantic to Arizona. Isolated specimens are sometimes locally famed as "unknown trees." The rather hard, strong wood is sometimes seen in fencing and in cheap furniture.

Beech. { *Fagus atropunicea* (*Marsh.*) *Sudworth.*
{ *Fagus ferruginea Ait.*

Nomenclature. (Sudworth.)

Beech (local and common name).
White Beech (Me., Ohio., Mich.).
Red Beech (Me., Vt., Ky., Ohio.).
Ridge Beech (Ark.).

Locality.

Nova Scotia to Florida, westward intermittently to Wisconsin and Texas.

Features of Tree.

Sixty to eighty feet, occasionally higher; two to four feet in diameter. Small rough burr contains two thin-shelled nuts.

Color, Appearance, or Grain of Wood.

Heartwood reddish, variable shades, sapwood white. Rather close-grained, conspicuous medullary rays.

Structural Qualities of Wood.

Hard, strong, tough, not durable when exposed. Takes fine polish. Liable to check during seasoning.

Representative Uses of Wood.

Shoe-lasts, plane-stocks, ship-building, handles, and fuel. Carpentry (abroad), wagon-making, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

42.

Modulus of Elasticity.

1,720,000.

Modulus of Rupture.

16,300.

Remarks.

The nuts are seldom gathered in the United States, nor is the wood there often utilized in carpentry. This is sometimes divided commercially into Red and White Beech, according to color of wood. Such division has no botanical basis.

Ironwood, Blue Beech. *Carpinus caroliniana Walt.*

Nomenclature. (Sudworth.)

Ironwood, Blue Beech (local and common name).
Water Beech (R. I., N. Y., Pa., Del., W. Va., Ohio, Ill., Ind., Mich., Minn., Nebr., Kans.).
Hornbeam (Me., N. H., Mass., R. I., Conn., N. Y., N. J., Pa., Del., N. C., S. C., Ala., Tex., Ky., Ill., Kans., Minn.).

Locality.

Quebec to Florida, westward intermittently to Nebraska and Texas.

Features of Tree.

Thirty to fifty feet in height. Six inches to occasionally two feet in diameter. A small tree, dark bluish-gray; bark resembles that of beech save in color.

Color, Appearance, or Grain of Wood.

Heartwood light brown, thick sapwood nearly white, close-grained.

Structural Qualities of Wood.

Very hard, tough, strong, heavy, very stiff, inclined to check during seasoning, not durable when exposed.

Representative Uses of Wood.

Levers, tool-handles, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

45.

Modulus of Elasticity.

1,630,000.

Modulus of Rupture.

16,300.

Remarks.

Prized by wheelwrights in Europe. Resemblance of bluish bark to light-gray bark of beech gave rise to name.

Ironwood, Hop Hornbeam. *Ostrya virginina Willd.*

Nomenclature. (Sudworth.)

Ironwood, Hop Hornbeam (local and common names).
Hornbeam (R. I., N. Y., Fla., S. C., La.).
Leverwood (Vt., Mass., R. I., N. Y., Pa., Kans.).
Hardhack (Vt.).

Locality.

Nova Scotia to Florida, westward intermittently to Dakota and Texas.

Features of Tree.

Thirty to forty feet in height, one foot or less in diameter. The bark exhibits long vertical rows of small squares. Small fruit resembles hops. Leaves resemble those of birch.

Color, Appearance, or Grain of Wood.

Heartwood reddish brown, sometimes white, sapwood lighter or white. Close-grained, compact structure.

Structural Qualities of Wood.

Very strong, hard, heavy, tough, durable when exposed.

Representative Uses of Wood.

Posts, levers, tool-handles, axe-helves, mill-cogs, wedges.

Weight of Seasoned Wood in Pounds per Cubic Foot.

51.

Modulus of Elasticity.

1,950,000.

Modulus of Rupture.

16,000.

Remarks.

Trees over twelve inches in diameter are often hollow.

PLATE 13. SYCAMORE (*Platanus occidentalis*).

Quartered Sycamore Wood.

SYCAMORE.

(*Platanus.*)

The name Sycamore applies to a maple (*Acer pseudo-platanus*) in Europe, to a fig-tree (*Ficus sycomorus*) in the Orient,* and to the buttonball or plane tree (*Platanus*) in North America. Of the plane trees (*Platanus*) the common or Oriental plane (*Platanus orientalis*) is a native of Europe; the plane, buttonball, or sycamore tree (*Platanus occidentalis*) is a native and common tree in eastern North America; and the California plane, buttonball, or sycamore (*Platanus racemosa*) is a native of western North America.

SYCAMORE (*Platanus occidentalis*).

The sycamore stands for curiosity, because of its Biblical association with Zaccheus. Many European sycamores were planted by religious persons during the middle ages because of the belief that they were the trees thus referred to in the Bible.

The woods afforded by the American sycamores have unusually complicated, cross-grained, but beautiful structures, difficult to work, but standing well and valued for cabinet work and small articles. American trees are often very large.

American buttonball or sycamore trees are distinguished by rough balls which remain hanging on long stems throughout the winter. The bark also is shed to an unusual extent; flakes of the outer cover drop away, exposing smooth inner surfaces so white as to appear as if painted. Six or seven species are included in the genus; three occur in North America. *Platanus* is from *platus*, signifying broad, and refers to the shape of the leaves.

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* Brockhaus, Konversations-Lexicon (B. 15, p. 536).

Sycamore.
Buttonwood.
Buttonball-tree. } *Platanus occidentalis Linn.*

Nomenclature. (Sudworth.)

Sycamore, Buttonwood, Buttonball-tree (local and common names).
Buttonball (R. I., N. Y., Pa., Fla.).
Plane Tree (R. I., Del., S. C., Kans., Nebr., Ia.).
Water Beech (Del.).
Platane cotonier, Bois puant (La.).

Locality.

Maine to Florida, westward intermittently to Nebraska and Texas. Best in bottom lands of Ohio and Mississippi River basins.

Features of Tree.

Ninety to over one hundred feet in height, six to sometimes twelve feet in diameter. Inner bark exposed in white patches. Large rough balls or fruit.

Color, Appearance, or Grain of Wood.

Heartwood reddish brown, sapwood lighter, close-grained, compact structures, satiny conspicuous medullary rays. Attractive when quartered.

Structural Qualities of Wood.

Heavy, hard, difficult to work, not strong, stands well when not exposed.

Representative Uses of Wood.

Tobacco-boxes, ox-yokes, butcher-blocks, cabinet-work.

Weight of Seasoned Wood in Pounds per Cubic Foot.

35.

Modulus of Elasticity.

1,220,000.

Modulus of Rupture.

9000.

Remarks.

Some specimens rank among the largest of American deciduous trees. These are usually hollow. The remarkably rigid bark does not stretch to accommodate the growth and is thus discarded to an unusual degree.

California Sycamore. *Platanus racemosa Nutt.*

Nomenclature.
Sycamore, Buttonwood, Buttonball Tree, Buttonball (California).

Locality.
California.

Features of Tree.
Seventy-five to one hundred feet in height, occasionally higher; three to four feet in diameter. The bark exfoliates in irregular patches.

Color, Appearance, or Grain of Wood.
Heartwood light reddish brown, sapwood lighter, close-grained, compact structure, medullary rays numerous and conspicuous. Beautiful when quartered.

Structural Qualities of Wood.
Brittle, very difficult to split and to season. Qualities similar to those of P. occidentalis.

Representative Uses of Wood.
Decoration, furniture, similar to P. occidentalis.

Weight of Seasoned Wood in Pounds per Cubic Foot.

30.

Modulus of Elasticity.

800,000.

Modulus of Rupture.

7900.

Remarks.
Hough mentions* a tree twenty-nine feet seven inches in circumference.

* "American Woods," Part 6, p. 36.

BIRCH.

(*Betula.*)

The birches grow in Europe, Asia, and North America, their ranges on the latter continent extending far into the north.* Their history is remote and probably began with attention to the bark rather than to the wood.

Birch-bark is smooth, pliable, water-tight, and by reason of its resinous oils so durable that it often remains intact long after the wood inside of fallen trees has disappeared. It is separable into thin layers and was early employed as a writing material.† Houses have been covered by it and it has been used for cordage, utensils, "damp courses," and even rude clothing. The American Indians employed it for canoes, tents, troughs, and buckets. The wood is hard, heavy, strong, fine-grained, and beautiful. It shrinks in seasoning, works easily, stands well when not exposed. It is used for spools, woodenware, and other small articles, as well as for interior finish and cabinet work. Figured birch is one of the most beautiful of American cabinet woods.‡ Birch is often stained so as to imitate cherry and mahogany; the best imitations of the latter wood are of birch. Birch is commercially divided, according to the quantity of heartwood present, into white birch and red birch. The wood is "white" when the amount is small, and as heartwood increases with age the same tree might at one time afford white and at another red wood.

The paper birch (*Betula papyrifera*) is the American species, most noted for its bark. This tree prefers the north and thrives

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* Birch forms large forests in the North.

† Pliny and Plutarch agree that the famous books of Numa Pompilius, written 700 years before Christ, were upon birch-bark.

‡ The banquet-hall of the famous Auditorium Hotel in Chicago is finished in birch.

PLATE 14. BIRCH (*Betula*).

Yellow Birch Tree (*Betula lutea*).
Yellow Birch Foliage (*Betula lutea*).
White Birch Bark (*Betula populifolia*).
Birch Wood.

at higher latitudes than other American broadleaf trees. It is easily recognizable by its white bark and is particularly beautiful during the winter because of contrasts that are then more apparent. The bark of this species was preferred for canoes because of its pliability, and its availability in large pieces where it was most needed. The layers of other barks, as Betula populifolia, do not separate so easily from one another, nor do they divide so readily from the trunk.

The yellow and sweet birches (*Betula lutea* and *Betula lenta*) are the American birches most prized for woods. The European birches often afford the cheapest hard-woods of their districts, and these woods are used for sabots, plates, spoons, wheels, pegs, buttons, and furniture. The Russians reduce birch logs into veneers, that are then glued across one another (see page 125 so as to form thin planks; the planks are used for tea chests, chair bottoms, and the like. Burls, that sometimes occur on trunks, afford figured woods that are turned into bowls, cups, or mallets. Europeans also use birch indirectly, as in tanning, smoking meat, etc. The bark and leaves of some species are widely esteemed as domestic remedies. Oils are separated by distillation.* The sweet sap drawn from some of the birches is nsed as a beverage.

Birch trees may be known by their more or less laminated bark with its peculiar long horizontal lenticles or dashes. The leaves of the several birches differ but little, but the decided colors exhibited by their barks give names and serve to distinguish the species. Nine of the twenty-four known species of birch occur in North America; six are trees and the others low shrubs. *Betula* is said to be derived from bitumen.

* Wintergreen oil was formerly distilled from the leaves of the wintergreen, but almost all "natural oil" is now obtained from the sweet birch (*Betula lenta*). (Forestry and Irrigation, December, 1905). These oils and their manufactured products consist almost entirely of Methyl salicylate.

White Birch. *Betula populifolia Marsh.*

Nomenclature. (Sudworth.)

White Birch (local and common name).
Gray Birch (Me., R. I., Mass.).
Oldfield Birch, Poverty Birch (Me.).
Poplar-leaved Birch, Small White Birch (Vt.).

Locality.

Atlantic coast, Canada to Delaware.

Features of Tree.

Twenty to forty feet in height, rarely one foot in diameter. Durable, laminated, smooth, white bark on large branches and on trunk, save near ground; is not very easily detached from tree. Tremulous leaves.

Color, Grain, or Appearance of Wood.

Heartwood light brown, sapwood lighter, close-grained.

Structural Qualities of Wood.

Soft, light, not strong or durable.

Representative Uses of Wood.

Clothes-pins, shoe-pegs, tooth-picks, paper-pulp.

Weight of Seasoned Wood in Pounds per Cubic Foot.

35.

Modulus of Elasticity.

1,036,000.

Modulus of Rupture.

11,000.

Remarks.

The white bark is distinct from that of the paper birch in that it does not cover the whole trunk and in that it remains more perfectly intact.

Paper Birch, White Birch. *Betula papyrifera Marsh.*

Nomenclature. (Sudworth.)

Paper Birch, White Birch (local and common names).
Silver Birch (Minn.).
Large White Birch (Vt.).
Boleau (Quebec).
Canoe Birch (Me., Vt., N. H., R. I., Mass., N. Y., Pa., Wis., Mich., Minn.).

Locality.

Northern United States, northward into Canada, valley of the Yukon in Alaska.

Features of Tree.

Fifty to seventy feet in height, one and one-half to two and one-half feet in diameter. Smooth white exterior bark on large limbs and trunks away from ground. Brown or orange inner surfaces of bark. Splits freely into thin paper-like layers.

Color, Grain, or Appearance of Wood.

Heartwood brown tinged with red, sapwood nearly white. Very close-grained, compact structure.

Structural Qualities of Wood.

Strong, hard, tough, not durable.

Representative Uses of Wood.

Spools, shoe-lasts, pegs, paper-pulp, fuel, bark used in canoes.

Weight of Seasoned Wood in Pounds per Cubic Foot.

37.

Modulus of Elasticity.

1,850,000.

Modulus of Rupture.

15,000.

Remarks.

Starch is said to be manufactured from inner bark by Northern Indians. Reaches higher latitude than any American deciduous tree. Forms forests. The name White Birch is because of the color of the bark. Used for pill boxes. One of the few woods that burn well while green.

Red Birch. *Betula nigra Linn.*

Nomenclature. (Sudworth.)

Red Birch (local and common name).
Black Birch (Fla., Tenn., Tex.).
River Birch (Mass., R. I., N. J., Del., Pa., W. Va., Ala., Miss., Tex., Mo., Ill., Wis., Ohio).
Birch (N. C., S. C., Miss., La.).
Water Birch (W. Va., Kans.).
Blue Birch (Ark.).

Locality.

Massachusetts to Florida, westward intermittently to Minnesota and Texas. Best development in south Atlantic and lower Mississippi valley regions.

Features of Tree.

Thirty to eigthy feet in height, one to three feet in diameter, sometimes larger. Dark red brown scaly bark on trunk. Red to silvery-white bark on branches. Bark separates in thin paper-like scales curling outward.

Color, Appearance, or Grain of Wood.

Heartwood light brown, sapwood yellowish white. Close-grained, compact structure.

Structural Qualities of Wood.

Light, rather hard and strong.

Representative Uses of Wood.

Furniture, woodenware, shoe-lasts, ox-yokes. inferior cask-hoops from branches.

Weight of Seasoned Wood in Pounds per Cubic Foot.

35.

Modulus of Elasticity.

1,580,000.

Modulus of Rupture.

13,100.

Remarks.

Dark brown bark, whence name Red Birch. Prefers moist bottoms, whence name River Birch.

Yellow Birch. *Betula lutea Michx. f.*

Nomenclature. (Sudworth.)

Yellow Birch (local and common name).
Gray Birch (Vt., R. I., Pa., Mich., Minn.).
American Mahogany.
Swamp Birch (Minn.).
Silver Birch (N. H.).
Merisier, Merisier Rouge (Quebec).

Locality.

Newfoundland to North Carolina, westward intermittently to Minneosta and Texas. Best developed north of the Great Lakes.

Features of Tree.

Sixty to eighty feet or more in height, two to four feet in diameter. A medium-sized tree. Bark on trunk silvery gray to silvery yellow, branches green to lustrous or dull brown. Bark exfoliates, causing a rough, ragged appearance.

Color, Appearance, or Grain of Wood.

Heartwood light reddish brown, sapwood nearly white, close-grained, compact structure, satiny.

Structural Qualities of Wood.

Heavy, very strong, and hard, tough, susceptible of high polish. Qualities suggest those of maple. Not durable when exposed.

Representative Uses of Wood.

Furniture, buttons, tassel-moulds, pill-boxes, spools, and wheel-hubs. Chair seats.

Weight of Seasoned Wood in Pounds per Cubic Foot.

40.

Modulus of Elasticity.

2,290,000.

Modulus of Rupture.

17,700.

Remarks.

Occasional trees have thin outer bark ruptured, and exhibit inner bark of almost metallic yellow. Lutea, signifying yellow, alludes to color of bark. Inner bark has pungent, pleasant flavor. Burls, as frequently found, are valued for making mallets.

Sweet Birch, Cherry Birch. *Betula lenta Linn.*

Nomenclature. (Sudworth.)

Sweet Birch, Cherry Birch (many localities).
Black Birch (N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., W. Va., Ga., Ill., Ind., Mich., Ohio).
Mahogany Birch (N. C., S. C.).
River Birch (Minn.).
Mountain Mahogany (S. C.).

Locality.

Newfoundland intermittently to Illinois, southward intermittently along Alleghanies to Kentucky, Tennessee, and Florida.

Features of Tree.

Fifty to eighty feet in height, three to four feet in diameter, dark reddish-brown bark, resembling that of cherry; does not separate into layers as paper-birch. Leaves, bark, and twigs sweet, spicy, and aromatic.

Color, Appearance, or Grain of Wood.

Heartwood dark brown tinged with red, sapwood light brown or yellow, close-grained, compact structure.

Structural Qualities of Wood.

Heavy, very strong, hard, receives stains and high satin-like polish.

Representative Uses of Wood.

Woodenware, furniture, ship-building (Canada), fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

47.

Modulus of Elasticity.

2,010,000.

Modulus of Rupture.

17,000.

Remarks.

A common tree in Northern States. Wood often stained so as to resemble cherry and mahogany. Essences suggest wintergreen, contain much salicylic acid, and are used in medicine. The name "cherry" is because bark resembles that of cherry. "Sweet" is because of essences.

Black Locust Tree and Bark (*Robinia pseudacacia.*)
Honey Locust (*Gleditsia triacanthos*).
Locust Wood.

LOCUST, MESQUITE.

(*Robinia, Gleditsia, Prosopis.*)

The name Locust applies to species of three distinct genera, all of which belong to the family Leguminosæ. The black locust (*Robinia pseudacacia*), the honey locust (*Gleditsia triacanthos*), and the Mesquite or honey locust (*Prosopis juliflora*) are principal representatives of their respective kinds. The first-named genus is North American, the other two have species on both continents.

Black locust wood is tough, durable, unequalled for torsional strength and resilience, and is in every way in the first rank of American woods. It is fitted not only for exposed constructions, but for finer articles; hubs, pins, bolts, and trenails having no superiors. Trees develop rapidly when young, heart wood forming as early as the third year. Later growth and ultimate commercial value in the United States are much affected by insect borers, which practically limit the usefulness of the species. The black locust may be known by its clusters of large pea-blossom-shaped flowers, its bean-shaped pods, three to six inches in length, and by the prickles on the bark. The genus has six species, four of which are natives of the United States.* *Robinia* is from Robin, the name of an early French botanist.

BLACK LOCUST (*Robinia pseudacacia*).

* Three of the four United States species are trees; the other species of this genus grow in Mexico. No one is approximately as important or well known as the Black Locust.

The black locust has been extensively introduced into Europe, both for ornamentation and for wood.*

The wood of the honey locust resembles that of the black locust, but is seldom used or appreciated save for fencing and similarly unimportant purposes. Trees grow rapidly and are not subject to the attacks of insects, so that they frequently attain to normal proportions. The flowers are much smaller than those of the black locust, but the pods are several times as long (twelve to eighteen inches). These often curl in drying and are thus rolled to some distance by the wind. Thorns or spines are present on some individuals and are often from three to six inches in length. The foliage resembles but is more delicate than that of the black locust. There is at least one other American species. *Gleditsia* is from Gleditsch, the name of a botanist.

The mesquite is to its native desert as bamboo is to China and Japan. Its normal form resembles that of the apple-tree, but it can survive entirely covered with sand, so that above the surface, only small shoots appear. Such instances suggested the expression that in Arizona we must "dig for wood and climb for water." Roots develop greatly in their search for water, and are dug up in the absence of other fuel. There are pods filled with rich pulp, from which Indians made bread, cake, and a fermented drink. The beans are now greatly valued as fodder. A black dye is made from the sap, and a good mucilage from the gum. The hard, heavy wood is seen in many native houses in New Mexico and Arizona; and is almost indestructible when exposed. Sixteen or more species belong to this genus, Prosopis, of which one other, the screw-pod mesquite (*Prosopis odorata*), is found in the United States.

* Black locust was introduced into Europe early in the seventeenth century, being first cultivated by the son of Jean Robin, for whom the genus is named. Few American species have received such attention aboad.

Locust, Black Locust, Yellow Locust. *Robinia pseudacacia Linn.*

Nomenclature. (Sudworth.)

Locust, Black Locust, Yellow Locust (local and common names).
False Acacia (S. C., Ala., Tex., Minn.).
Pea-flower Locust, Post Locust (Md.).
Red Locust, Green Locust (Tenn.).
Honey Locust (Minn.).
White Locust (R. I., N. Y., Tenn.).
Acacia (La.).

Locality.

Southern Alleghany region, widely cultivated in United States east of Rocky Mountains.

Features of Tree.

Fifty to seventy feet in height, two to three feet or over in diameter. Leaves curl or close at night. Long spikes or briers on young branches.

Color, Appearance, or Grain of Wood.

Heartwood brownish, thin sapwood, light-greenish yellow. Close-grained and compact. Annual layers clearly marked.

Structural Qualities of Wood.

Heavy, very hard, strong, and durable under extreme conditions of wet and dry.

Representative Uses of Wood.

Long wooden bolts or pins called treenails. Posts, ties, construction, turnery, ship-ribs, ornamentations, fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

45.

Modulus of Elasticity.

1,830,000.

Modulus of Rupture.

18,100.

Remarks.

Often a low shrub. Extensively planted, particularly in West, but subject to attack by borers. One of the most valuable of American timber trees. Heartwood is formed very early in this species. Pseudacacia means false acacia or imitation of acacia.

Honey Locust. *Gleditsia triacanthos Linn.*

Nomenclature. (Sudworth.)

Honey Locust (local and common name).
Thorn or Thorny Locust Tree or Acacia (N. Y., N. J., Ind., Tenn., La.).
Three-thorned Acacia (Mass., R. I., La., Tex., Neb., Mich.).
Black Locust (Miss., Tex., Ark., Kans., Neb.).
Honey or Honeyshucks (R.I., N. J., Va., Fla., Iowa).
Honeyshucks Locust (Ky.).
Sweet Locust (S. C., La., Kans., Nebr.).
Piquant Amourette (La.).
Confederate Pintree (Fla.).
Locust (Nebr.).

Locality.

Pennsylvania to Florida, westward intermittently to Nebraska and Texas. Best in lower Ohio River basin.

Features of Tree.

Seventy to ninety feet or more in height, two to four feet in diameter. Frequent long thorns.* Light thin foliage. Brown pods contain sweet pulp.

Color, Appearance, or Grain of Wood.

Heartwood bright brown or red, sapwood yellowish, annual layers strongly marked, coarse-grained, medullary rays conspicuous.

Structural Qualities of Wood.

Heavy, hard, strong, very durable in contact with soil.

Representative Uses of Wood.

Fence-posts, rails, wagon-hubs, rough construction, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

42.

Modulus of Elasticity.

1,540,000.

Modulus of Rupture.

13,100.

Remarks.

Widely cultivated for landscape effect. Young trees used for forming hedges. One of the hardiest trees for planting on the uplands of Western Kansas. ("Forestry and Irrigation," August, 1903.)

* Thorns plentiful on some individuals, but absent on others.

Mesquite. *Prosopis juliflora* (*Swartz*) *de C.*

Nomenclature. (Sudworth.)

Mesquite (Tex., N. M., Ariz., Cal.).	Honey Pod or Honey Locust (Tex., N. M.).
Algaroba (Tex., N. M., Ariz., Cal.).	Ironwood (Tex.).

Locality.

Texas, west to San Bernardino Mountains, California. Also Colorado, Utah, and Nevada and northern Mexico.

Features of Tree.

Forty to fifty feet in height, one to two feet in diameter. Sometimes low shrub. Roots often very large. Pods with sweet pulp. Gums resemble gum arabic.

Color, Appearance, or Grain of Wood.

Heartwood rich dark brown, often red. Sapwood clear yellow. Close-grained, compact structure, distinct medullary rays. The heart resembles walnut.

Structural Qualities of Wood.

Weak, difficult to work, heavy, hard, very durable, receives polish.

Representative Uses of Wood.

Posts, fencing, ties, house-beams, fuel, charcoal.

Weight of Seasoned Wood in Pounds per Cubic Foot.

47.

Modulus of Elasticity.

820,000.

Modulus of Rupture.

6800.

Remarks.

A locally important tree. Trees sometimes stunted by fires have numerous roots. Large roots used for fuel. The easily agitated foliage cools the air to a surprising degree. The "cool shade of the mesquite" is a characteristic phrase. Large roots must not be confounded with trunks that are also often covered with sand. Trees stunted by fires sometimes have very large sub-surface developments. Such roots are often dug up and used for fuel. The mesquite has been acclimated in Hawaii.

Holsinger, "Forestry and Irrigation." Vol. VIII, No. 11, p. 447.

WHITEWOOD OR TULIP-TREE WOOD, POPLAR OR COTTONWOOD,

(*Liriodendron.*) (*Populus.*)

CUCUMBER-TREE WOOD, BASSWOOD.

(*Magnolia.*) (*Tilia.*)

These trees are not related, but are all noted for woods with soft, fine qualities, such as fit them for carvings, woodenware, and paper-pulp. No one of the woods is durable when exposed, and all are used for boxes because they nail without splitting. The names are commercially interchangeable.

The whitewood or tulip tree (*Liriodendron tulipifera*) is a native of America and an acclimated tree in Europe. It is the sole surviving species of its genus. The wood is soft, stiff, clean, fine, straight-grained, and obtainable in large-sized pieces. Much whitewood is made into lumber, the wood standing among those of the broadleaf series as white pine does among the conifers. Whitewood is particularly suitable for carvings. In spite of its name it is largely greenish yellow. It is often divided commercially, according to color, into "white poplar" and "yellow poplar." Trunks often attain to a very large size. Matthews mentions a specimen * thirty-three feet in circumference. The species may be known by its large tulip-shaped flower. *Liriodendron* is from two Greek words meaning lily and tree.

WHITEWOOD (*Liriodendron tulipifera*).

The poplars, sometimes called cottonwoods because of their seeds covered with a cotton-like down, are represented on both continents. The wood was made into shields by the

*F. Schuyler Matthews, "Familiar Trees" (Appleton, 1901), p. 39.

PLATE 16. WHITEWOOD OR TULIP TREE (*Liriodenaron tulipifera*).

ancients, because it was light and tough and would indent without breaking. The wood is often substituted for whitewood, but is less desirable, although valuable as a basis for paper-pulp. The trees may be known by the long drooping catkins that appear early in the spring before the leaves, and that are followed by white downy seeds that soon escape to whiten the surrounding ground. The poplars are noted for foliage more or less constantly in agitation. This peculiarity, so pronounced in the aspen (*Populus tremuloides*), is due to the very long petioles or leaf-stems. The cottonwoods abound in many otherwise arid regions of American Western deserts. The balsam poplar (*Populus balsamifera*) which thrives far into the North, was said, by Sir John Franklin, to form much of the drift seen by him upon the shores of the Arctic Sea. The balsam poplar must not be confused with the true balsam, Abies balsamea (pp. 162–163), although both are called Balm of Gilead. Sudworth enumerates twelve distinct species of the genus Populus that grow in the United States.

The cucumber trees are of the magnolia family and grow in many of the Eastern States. The wood resembles and is probably often mistaken for whitewood, for which it is a fair substitute. The trees may be known by their fruit, which resembles vegetable cucumbers. Magnolia is from Magnol, a botanist of the seventeenth century.

Basswood is a name applied to trees known in Europe and America as limes, lime trees, lind, linden, tiel, tiel trees, bass, and basswood trees. The trees and their wood were early esteemed, the first for their shade and appearance, and the last for their working qualities, which resemble, but are inferior to, whitewood.* The trees are characterized by their dense foliage and clusters of small cream-colored fragrant flowers, so attractive to bees as to have originated the further name bee-tree. *Tilia* arises from the ancient name for these trees.

* The carvings of Gibbons, a famous English artist, are said to have been made entirely of linden, no other available wood being so even-grained and free from knots.

Tulip Tree, Whitewood, Yellow Poplar. *Liriodendron tulipifera Linn.*

Nomenclature. (Sudworth.)

Tulip Tree, Whitewood, Yellow Poplar (local and common names).
Poplar (R. I., Del., N. C., S. C., Fla., Ohio).
Tulip Poplar (Del., Pa., S. C., Ill.).
Hickory Poplar (Va., W. Va., N. C.).
Blue Poplar (Del., W. Va.).
Popple (R. I.).
Cucumber Tree (N. Y.).
Canoewood (Tenn.).

Locality.

New England to Florida, westward intermittently to Michigan and Mississippi.

Features of Tree.

Ninety to one hundred and fifty feet in height, six to twelve feet in diameter. Tulip-shaped flowers in spring. Greenish cones dry and remain after leaves have fallen.

Color, Appearance, or Grain of Wood.

Heartwood light yellow or greenish brown, thin sapwood, nearly white. Close, straight-grained, compact structure, free from knots.

Structural Qualities of Wood.

Light, soft, moderately strong, brittle, easily worked, durable. Hard to split, shrinks little, resembles white pine, stands well.

Representative Uses of Wood.

Lumber, interior finish, shingles, boat-building, pumps, woodenware, shelves, the bottoms of drawers.

Weight of Seasoned Wood in Pounds per Cubic Foot.

26.

Modulus of Elasticity.

1,300,000.

Modulus of Rupture.

9300.

Remarks.

Very large trees formerly common. Indians hollowed logs into boats. "Some large enough to carry twenty or thirty persons" (Hough), whence name canoewood. Tulipifera, signifying turbans and to bear, refers to flowers. One of the largest as well as most useful of American deciduous trees.

Poplar, Largetooth Aspen. *Populus grandidentata Michx.*

Nomenclature. (Sudworth.)

Poplar, Largetooth Aspen (local and common names).
Largetooth Poplar (N. C.).
Large Poplar (Tenn.).
White Poplar (Mass.).
Popple (Me.).
Large American Aspen (Ala.).

Locality.

Nova Scotia and Delaware, westward intermittently to Minnesota, Alleghany Mountains to Kentucky and Tennessee.

Features of Tree.

Sixty to eighty feet high, two feet or more in diameter. Irregular points or teeth on margins of leaves. Smooth gray bark.

Color, Appearance, or Grain of Wood.

Heartwood brownish, sapwood nearly white, close-grained, compact structure.

Structural Qualities of Wood.

Soft, light, weak.

Representative Uses of Wood.

Paper-pulp and occasionally woodenware.

Weight of Seasoned Wood in Pounds per Cubic Foot.

28.

Modulus of Elasticity.

1,360,000.

Modulus of Rupture.

10,200.

Remarks.

The several "poplars" are much prized for paper-pulp. The quaking aspen (*P. tremuloides*) has long leaf-stalks flattened vertically to the leaf-surface, so that leaves tremble in slight winds, a characteristic peculiar throughout of the genus Populus.

Ailanthus (*Ailanthus glandulosa*). This sturdy, beautiful, very quick-growing, but short-lived tree was once popular in this country, particularly in city landscapes, but it was discarded because of the disagreeable, far reaching odor of its flowers. The tree has many merits and an odorless variety is fortunately available. The wood is used for wooden ware and charcoal in Europe and in China where certain silk worms feed upon the leaves. The Chinese call the *Ailanthus* the "tree of Heaven." American specimens have grown in excess of ten feet in length during the first year.

Cottonwood. { *Populus deltoides Marsh.* / *Populus monilifera Ait.*

Nomenclature. (Sudworth.)

Cottonwood (local and common name).
Carolina Poplar (Pa., Miss., La., N. M., Ind., Ohio).
Yellow Cottonwood (Ark., Ia., Neb.).
Big Cottonwood (Miss., Neb.).
Whitewood (Ia.).
Cotton Tree (N. Y.).
Necklace Poplar (Tex., Col.).
Broadleaved Cottonwood (Colo.).

Locality.

Canada to Florida, westward intermittently to Rocky Mountains.

Features of Tree.

Seventy-five to one hundred feet in height, four to five feet in diameter, occasionally much larger. Long catkins distribute cotton-like fibres.

Color, Appearance, or Grain of Wood.

Thin heartwood, dark brown, sapwood nearly white, close-grained, compact structure.

Structural Qualities of Wood.

Light, soft, weak, liable to warp, difficult to season.

Representative Uses of Wood.

Greatly valued in manufacture of paper-pulp, also packing-boxes, fence-boards, fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

24.

Modulus of Elasticity.

1,400,000.

Modulus of Rupture.

10,900.

Remarks.

Monilifera is from the Latin *monolinum*, a necklace, and *fero*, to bear, and refers to the long necklace or catkin.

Black Cottonwood. *Populus trichocarpa Torr. and Gr.*

Nomenclature. (Sudworth.)
Black Cottonwood (Oreg., Cal.).
Balsam Cottonwood, Balm (Oreg.).
Cottonwood (Oreg., Cal.).
Balm Cottonwood (Cal.).

Locality.
Pacific coast region, Alaska to California.

Features of Tree.
A large tree sometimes one hundred and fifty feet in height and four to six feet in diameter.

Color, Appearance, or Grain of Wood.
Heartwood light dull brown, sapwood nearly white, compact structure.

Structural Qualities of Wood.
Light, soft, weak.

Representative Uses of Wood.
Staves, woodenware (local).

Weight of Seasoned Wood in Pounds per Cubic Foot.

23.

Modulus of Elasticity.

1,580,000.

Modulus of Rupture.

8400.

Remarks.
Largest deciduous tree of Puget Sound district (Sargent).

The Cottonwood, Tacmahac, Balsam, Balsampoplar, or Balm of Gilead (*Populus balsamifera*) grows from Hudson Bay and Alaska south to Oregon and New England. It is a large upright tree, sometimes five or more feet in diameter. It is distinctly a northern species. It has whitish trunk, drooping catkins and other poplar characteristics. The very light, soft, white wood has been used in paper making. The gummy exudations on the twigs of this and related species have been substituted for other medicinal balsams. The Balm of Gilead (*Populus balsamifera candicans*) is cultivated in New England.

Professor Bessey believes that cottonwood timber culture would be remunerative in many parts of the middle west even for fuel. Cottonwoods have attained to sizes large enough for saw logs in twenty years. (Pinchot, U. S. Forestry Circular No. 27).

Cucumber Tree. *Magnolia acuminata Linn.*

Nomenclature. (Sudworth.)
Cucumber Tree (R. I., Mass., N. Y., Pa., N. C., S. C., Ala., Miss., La., Ark., Ky., W. Va., Ohio, Ind., Ill.). Mountain Magnolia (Miss., Ky.). Black Lin, Cucumber (W. Va.). Magnolia (Ark.).

Locality.
New York to Illinois, southward through Kentucky and Tennessee to Gulf (intermittently).

Features of Tree.
Fifty to occasionally one hundred feet in height, two to four feet in diameter. A large, handsome, symmetrical tree, with cones resembling cucumbers.

Color, Appearance, or Grain of Wood.
Heartwood brownish yellow, sapwood nearly white, close-grained, compact structure. Satiny, thin medullary rays.

Structural Qualities of Wood.
Light, soft, not strong, durable. Qualities similar to white-wood.

Representative Uses of Wood.
Cabinet-making, cheap furniture, flooring, pump-logs, troughs, crates, packing-boxes. Used similarly to L. tulipifera.

Weight of Seasoned Wood in Pounds per Cubic Foot.

29.

Modulus of Elasticity.

1,310,000.

Modulus of Rupture.

9500.

Remarks.
Wood resembles and is often sold for tulip-tree wood.

Basswood, Linn, Linden. *Tilia americana Linn.*

Nomenclature. (Sudworth.)

Basswood, Linn, Linden, American Linden (local and common names).
Limetree (R. I., N. C., S. C., Ala., Minn., La., Ill.).
Black or Smooth-leaved Limetree (Tenn.).
Whitewood (Vt., W. Va., Ark., Minn.).
Yellow Basswood, Lein (Ind.).
Beetree (Vt., W. Va., Wis.).
White Lind (W. Va.).
Wickup (Mass.).

Locality.

New Brunswick to Georgia, westward intermittently to Nebraska and Texas. Wide range.

Features of Tree.

Sixty to ninety feet in height, two to four feet in diameter, occasionally larger. Large smooth leaves.

Color, Appearance, or Grain of Wood.

Heartwood light or reddish brown, thick sapwood nearly similar, very straight and close-grained, compact structure.

Structural Qualities of Wood.

Light, soft, easily worked, tough, not strong nor durable.

Representative Uses of Wood.

Sides and backs of drawers, bodies of carriages, woodenware, paper-pulp.

Weight of Seasoned Wood in Pounds per Cubic Foot.

28.

Modulus of Elasticity.

1,190,000.

Modulus of Rupture.

8300.

Remarks.

Basswood refers to the inner bark or "bast," sometimes utilized for cordage. The flowers attract bees, whence the name beetree. White Basswood, (*Tilia heterophylla,*) is not distinguished commercially.

WILLOW.

(*Salix.*)

The willows are distributed over both continents. The ancients used willow wood for shields, because it would indent without breaking. Pliny writes that Brittons made voyages in boats of willow. The principal experience with the tough, light, workable, elastic wood has been in Europe, where it has been used for lapboards, cricket bats, keels, paddles, and water wheels. It resists splintering, heating and friction, and has been used for lining friction brakes and wagons. The charcoal ignites readily and is esteemed for finer kinds of gun-powder.

In America, willows are associated with the qualities of pliability and water endurance. Trees and saplings, rather than lumber, figure in American constructions. Trees are planted to protect and sometimes by eddies to recover land from water encroachment. Saplings up to three or four inches in diameter are made into matresses to prevent scour in Mississippi River improvement work. Some of these mattresses are three hundred feet wide and one thousand feet long.* Willow rods, whole or split, are used in basket making. Sap-peeled rods retain their white color, while steamed willows turn yellow.† Saplings are often known as osiers, and the term osier willow is often applied to any species that afford strong, slender shoots. The true osier, sandbar or longleaf willow (*Salix fluviatilis*) is widely distributed from the Arctic Circle southward into Mexico. Osiers are regularly cultivated in Europe.‡ Wilows grow very rapidly and have a characteristic and attractive appearance. The White, Crack, Bedford, and Goat Willows (*Salix alba*, *S. fragilis*, *S. russeliana*, and *S. caprea*) are said to afford good woods.

* Starling & Coppee, Papers Trans. Am. Soc. C. E., Correspondence Mr. Chas. Hunter West, M. Am. Soc. C. E, Chf. Eng'r., Miss, Levee Dist., Greenville, Miss.

† Correspondence, Chas. Zinn & Co., New York City.

‡ The Basket Willow, U. S. For. Bul. No. 46.

About 140 species and varieties of the willow family have been enumerated.

PLATE 17. WILLOW (*Salix*).

Black willow foliage (*Salix nigra*).

Black Willow. *Salix nigra Marsh.*

Nomenclature. (Sudworth.)

Black Willow (local and common name).
Swamp Willow (N. C., S. C.).
Willow (N. Y., Pa., N. C., S. C., Miss., Tex., Cal., Ky., Mo., Neb.).

Locality.

New Brunswick to Florida, westward intermittently to Dakota, Arizona, and California, Mexico.

Features of Tree.

Forty to fifty feet in height, two to four feet in diameter. Long narrow leaf, characteristic appearance.

Color, Appearance, or Grain of Wood.

Heartwood brown, sapwood nearly white, close-grained.

Structural Qualities of Wood.

Soft, light, weak, checks badly in drying, readily worked. Dents without splitting.

Representative Uses of Wood.

Lap-boards, basket-making, fuel, charcoal.

Weight of Seasoned Wood in Pounds per Cubic Foot.

27.

Modulus of Elasticity.

550,000.

Modulus of Rupture.

6000.

Remarks.

Prefers borders of rivers and bottom lands. Many varieties of willow grow in the United States. No one is used to any extent in construction. There are so many hybrids and peculiar species of willow that classification is often difficult (about one hundred and forty species and varieties of the willow family have been enumerated). Salix is said to be from the Celtic *Sal*, meaning "near," and *Lis*, meaning "water." Salicylic acid is present in the bark of some species.

White Willow (*Salix alba*), naturalized in America, is very hardy even in dry places. A valuable prairie wind-brake. Trees planted several feet apart from good posts to support barbed wire. European uses of the wood have been referred to. Salix alba has many botanical varieties.

CATALPA.

(*Catalpa.*)

Many kinds of wood that were formerly plentiful are now much less so. Attention is being turned to trees that give best results under artificial conditions. Catalpa, formerly but little known, now bids fair to become of some importance in this connection. The tree is one of which excellent results can be expected when the right conditions prevail. The Hardy Catalpa (*Catalpa speciosa*) is most desirable.

Catalpa trees grow readily and are often used in landscape effects. The trees may be planted along streams, since they are not seriously injured by occasional inundations. The soft, weak, brittle, smooth wood works well, and is fitted for many constructions. It is very durable and attractive. Catalpa wood can be used in indoor finish. Trees are being planted by railways, although some question exists as to whether ties will stand sufficiently under heavy traffic. Mr. John Brown* mentions specimens sixteen inches in diameter seventeen years after planting. Numerous examples could be given of an awakened interest in this species. The soft wood may require plates to resist cutting when in ties under heavy traffic, but no uncertainty exists as to durability. Sufficient tests have placed it in the front rank as resisting decay. Prof. von Schrenk states that final disintegration of weathered wood will not be due to the usual fungus causes, since no single fungus has yet been found to grow in the dead timber. The limited supply has restricted use. No wood is better for posts and poles.

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* *The Forester*, October, 1900, and November, 1902.
Kansas Agricultural College Experiment Station, Bulletin 108.
Forestry Quarterly, Vol. III, N. Y.

PLATE 18. CATALPA (*Catalpa*).

Catalpa Foliage.

Catalpa Tree (*Catalpa speciosa*), Wilsey, Kansas.

Young Catalpa Tree (*Catalpa catalpa*), Delaware County, New York.

Catalpa Wood (*Catalpa speciosa*). Specimen prepared by Mr. Geo. W. Tincher, Wilsey, Kansas.

Catalpa, Hardy Catalpa. *Catalpa speciosa Warder.*

Nomenclature. (Sudworth.)

Catalpa (R. I., N. Y., La., Ill., Ind., Mo., Wis., Ia., Neb., Minn.).
Hardy Catalpa (Ill., Ia., Kan., Mich.).
Western Catalpa (Pa., Ohio, Kans., Neb., Ill.).
Cigar Tree (Mo., Ia.).
Indian Bean, Shawneewood (Ind.).
Bois Puant (La.).

Locality.

Central Mississippi valley, naturalized in many localities.

Features of Tree.

Forty to sixty feet or more in height, three to six feet in diameter; well-formed trunks. Large, white, faintly mottled flower, long pod or bean.

Color, Appearance, or Grain of Wood.

Thick heartwood brown, thin sapwood lighter, nearly white, coarse-grained, compact structure, annual layers clearly marked. An attractive wood.

Structural Qualities of Wood.

Light, soft, not strong, durable in contact with soil.

Representative Uses of Wood.

Railway ties, fence-posts, rails, adapted for cabinet-work and interior finish.

Weight of Seasoned Wood in Pounds per Cubic Foot.

25.

Modulus of Elasticity.

1,160,000.

Modulus of Rupture.

9000.

Remarks.

Hardier and better formed trunks than afforded by C. catalpa. A rapid grower; sprouts vigorously from stumps. A valuable tree, promising to become better known. Foliage subject to attack by insects.

"Hardy Catalpa." Hall and von Schrenk. United States Forestry Bureau, Bulletin No. 37.

Paulownia (*Paulownia tomentosa*). This tree is of small importance. A native of Asia, it is now cultivated in central Atlantic and Southern State landscapes. It has catalpa-like leaves preceded by large pale blue or violet flowers. The persistent, woody, capsule-like fruit suggest hickory nuts. The species is not related to but is sometimes confused with catalpa.

Catalpa. { *Catalpa catalpa* (*Linn.*) *Karst.*
{ *Catalpa bignonioides Walt.*

Nomenclature. (Sudworth.)

Catalpa (local and common name).
Indian Cigar Tree (Pa.).
Smoking Bean (R. I.).
Cigar Tree (R. I., N. J., Pa., W. Va., Mo., Ill., Wis., Ia.).
Indian Bean (Mass., R. I., N. Y., N. J., Pa., N. C., Ill.).
Catawba, Catawba Tree (Del., W. Va., Ala., Fla., Kans.).
Bean Tree (N. J., Del., Pa., Va., La., Neb.).

Locality.

Naturalized in many localities east of Rocky Mountains.

Features of Tree.

Thirty to fifty feet in height, one to two or more feet in diameter. Trunks not well formed. A low, wide tree, large heart-shaped leaves, characteristic flower. Long slender pod or bean.

Color, Appearance, or Grain of Wood.

Thick heartwood is light pink brown; thin sapwood is nearly white. Coarse-grained, compact.

Structural Qualities of Wood.

Light, soft, not strong, durable in contact with soil.

Representative Uses of Wood.

Fence-posts, railway ties, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

27.

Modulus of Elasticity.

960,000.

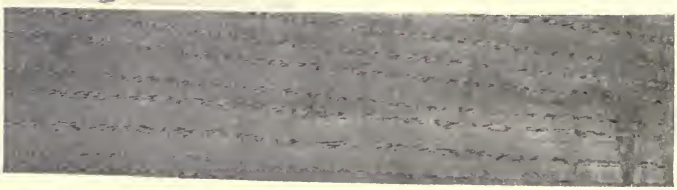
Modulus of Rupture.

8300.

Remarks.

Grows rapidly. Pods remain on tree after leaves fall. Sometimes used as cigars by children. Wood is less desirable than C. speciosa.

PLATE 19. SASSAFRAS (*Sassafras officinale*).



SASSAFRAS. MULBERRY.

(*Sassafras.*) (*Morus.*)

The sassafras was one of the first American trees to be described in Europe, where many fictitious properties were early credited to its aromatic essences. The wood is not distinguished by unusual qualities, but trees are cut for lumber as encountered with other and more valuable species in the forest. The mucilaginous leaves are of three separate shapes. Some have lobes on both sides of the central surface, others have one lobe at one side so as to resemble mittens, while yet others on the same branch have simple oval shapes. The dark-blue berries on bright-red stems are so eagerly devoured by birds as to be seldom seen. The characteristic flavor is most pronounced in the bark of the root.

The Red, White, and Black Mulberries are named from the color of their fruits. The former, which is the American species, has wood resembling that of the sassafras, only in that it is not distinguished by unusual qualities. Its leaves, like that of the sassafras, are of several shapes on the same tree. The very sweet fruit resembles blackberries in form. The leaves used in silkworm-culture are from the Russian mulberry, a cross between the white mulberry and black mulberry (M. alba and M. nigra).

The camphor tree (*Cinnamomum camphora*) is related to the sassafras. It has been acclimated in California and from Charleston to Florida on the Atlantic. In Asia, where the tree is native, it is the chief source of commercial camphor, but in this country and in some others, trees, while thrifty, do not appear to secrete the same quantities of camphor. The camphor tree is principally valued in the United States for its appearance. The beautiful trees with their shining, evergreen leaves are good to plant along sidewalks. The close-grained, aromatic, yellowish wood is used in cabinet work and insect-proof chests. The leaves have the odor of camphor which is however more widely diffused through the wood. Twenty to fifty pounds of wood yield one pound of gum. The roots of the Cinnamon tree (*Cinnamomum zeylanicum*) contain camphor (India and Ceylon); this is in addition to the uses of the bark as spice. The Cassia bark (*Cinnamomum cassia*) affords cassia (Burmah and China) but no camphor. These last two trees are sometimes seen in California, Florida and other Gulf States. Also see Dewey, U. S. Div. Botany, Circular No. 12, Revised, etc.

Sassafras. { *Sassafras officinale Nees and Eberm.*
{ *Sassafras sassafras* (*Linn.*) *Karst.*

Nomenclature. (Sudworth.)

Sassafras (local and common name).
Sassafac, Sassafrac (W. Va., Del.).
Saxifrax, Sasifrax Tree (Fla., Tenn.).
Gumbo file (La., negro).

Locality.

Vermont to Florida, westward intermittently to Michigan and Texas.

Features of Tree.

Thirty to fifty feet in height, one to three feet in diameter, sometimes larger, often low shrub, characteristic odor and leaves.

Color, Appearance, or Grain of Wood.

Thick heartwood, delicate brown, thin sapwood yellowish white, coarse-grained, annual rings clearly marked.

Structural Qualities of Wood.

Light, soft, not strong, brittle, checks in drying, very durable in contact with soil. Slightly aromatic.

Representative Uses of Wood.

Pails, buckets, ox-yokes, fence-posts, and rails.

Weight of Seasoned Wood in Pounds per Cubic Foot.

31.

Modulus of Elasticity.

730,000.

Modulus of Rupture.

8500.

Remarks.

Leaves and shoots mucilaginous. Bark of root rich in highly aromatic essences. Sassafras often forms thickets. There is a reddish appearance in the furrows of the thick bark that is on the trunk and larger branches. Monardes, a Spanish writer, described the sassafras about half a century after the landing of Columbus.

Red Mulberry, Mulberry. *Morus rubra Linn.*

Nomenclature. (Sudworth.)

Red Mulberry, Mulberry (local and common name).
Black Mulberry (N. J., Pa., W. Va.).
Virginia Mulberry Tree (Tenn.).
Murier Sauvage (La.).

Locality.

Massachusetts to Florida, westward intermittently to Nebraska and Texas. Best in lower Ohio and Mississippi River basins.

Features of Tree.

Fifty to sixty feet in height, two and one half to three feet in diameter. Sweet edible fruit. Dark brown broken bark, smooth gray branches.

Color, Appearance, or Grain of Wood.

Thick heartwood, light orange yellow, thin sapwood whitish, coarse-grained, compact structure, annual layers clearly marked.

Structural Qualities of Wood.

Light, soft, not strong, very durable in contact with soil, receives good polish.

Representative Uses of Wood.

Local ship-building, agricultural implements, fencing, cooperage.

Weight of Seasoned Wood in Pounds per Cubic Foot.

36.

Modulus of Elasticity.

11,700,000.

Modulus of Rupture.

11,000.

Remarks.

An ornamental tree. The leaves of this species are not adapted to silkworm culture. (See Annual Report, Chief U. S. Forestry Division, 1887; also Bulletins on Silk, published by the U. S. Department of Agriculture.)

BUCKEYE. HORSE CHESTNUT.

(*Æsculus.*)

The buckeye and horse chestnut are species of the same genus. The common horse chestnut (*Æsculus hippocastanum*) was once thought to have been a native of Asia, but it is now quite certain that it originated on the mountains of northern Greece. Trees have been cultivated in Europe for at least three centuries and are now extensively grown over the United States. The name buckeye is generally applied to such species as are natives of North America.

Horse Chestnut (*Æsculus hippocastanum*).

The woods resemble one another in that they are soft, straight-grained, easily worked, and decay rapidly when exposed. They are employed to some extent in woodenware, artificial limbs, and paper-making. The trees may be known by their round prickly pods, containing smooth chestnut-colored bitter nuts. The leaves of the buckeye are arranged in groups of five, while those of the horse chestnut are in groups of seven. The horse chestnut produces showy spotted flowers. There are thirteen species of this genus, eight of which are North American. The name "horse chestnut" may refer ironically to the coarse nuts, or may arise from the fact that they are occasionally eaten by cattle, or from a horse-shoe marking seen on young twigs. *Hippocastanum* is from *hippos*, a horse, and *castanea*, a chestnut. The name buckeye refers to the appearance of the brown nut through the paler husk partly separated when ripe, suggesting the eye of the common deer.

PLATE 20. HORSE CHESTNUT (*Æsculus hippocastanum*).

Ohio Buckeye, Fetid Buckeye. *Æsculus glabra Willd.*

Nomenclature. (Sudworth.)
Buckeye, Ohio Buckeye (local and common names).
Fetid Buckeye (W. Va.).
Stinking Buckeye (Ala., Ark.).
American Horse Chestnut (Pa.).

Locality.
Ohio River basin to Alabama, portions of Iowa, Kansas, and Indian Territory.

Features of Tree.
Twenty-five to forty-five feet in height. One to one and one-half feet in diameter. Yellowish-white flower, succeeded by round prickly pod or fruit.

Color, Appearance, or Grain of Wood.
Heartwood white, sapwood a little darker, close-grained, frequent dark lines of decay.

Structural Qualities of Wood.
Weak, light, soft, hard to split.

Representative Uses of Wood.
Artificial limbs, woodenware, paper-pulp, rarely lumber.

Weight of Seasoned Wood in Pounds per Cubic Foot.

28.

Modulus of Elasticity.

910,000.

Modulus of Rupture.

7000.

Remarks.

The nearly similar horse chestnut (*A. hippocastanum*) is forty to fifty feet or more in height and two to four feet in diameter. The light, weak wood is seldom used. The name horse may be applied to the coarse nuts ironically, or may refer to their occasional use by cattle, or a horseshoe marking seen on young twigs.

Buckeye, Sweet Buckeye. { *Æsculus octandra Marsh.* / *Æsculus flava Ait.*

Nomenclature. (Sudworth.)
Buckeye (N. C., S. C., Ala., Miss., La., Tex., Ky.).
Sweet Buckeye (W. Va., Miss., Tex., Mo., Ind.).
Yellow Buckeye (S. C., Ala.).
Large Buckeye, Big Buckeye (Tex., Tenn.).

Locality.
Alleghany Mountains, Pennsylvania to Georgia, westward intermittently to Iowa and Texas.

Features of Tree.
Forty to seventy feet in height, one to three feet in diameter, sometimes low shrub. Large mahogany-colored seed.

Color, Appearance, and Grain of Wood.
Heartwood, creamy white, sapwood similar, compact structure, close-grained, difficult to split.

Representative Uses of Wood.
Similar to those of Ohio Buckeye (*A. glabra*).

Weight of Seasoned Wood in Pounds per Cubic Foot.
26.64.

Modulus of Elasticity.

Modulus of Rupture.

Remarks.

The California Buckeye (*Æsculus californica*) or horse chestnut, which grows along the Pacific Coast from Mount Shasta to Los Angeles, is often quite small, but is sometimes, as to the north of San Francisco, a beautiful tree of thirty or forty feet in height and two or three feet in diameter. The soft, light, compact, close grained wood could probably be employed in turnery. Sap woods and heartwoods are of an even, ivory white color.

PLATE 21. SWEET GUM (*Liquidambar styraciflua*).

GUM.

(*Liquidambar, Nyssa.*)

The wood known as gum is afforded in the United States by three trees of two genera: Sweet or Red Gum (*Liquidamber styraciflua*), Sour or Black Gum (*Nyssa silvatica*) and Tupelo Gum (*Nyssa aquatica*). Gum woods were once of slight importance.

The woods afforded by trees of these two genera are distinct from one another, although both are referred to by the one name, gum. The softer Sweet Gum figures in carpentry. Selected pieces so resemble black walnut as to be cut into veneers and made up into furniture. Sour Gum is harder, it splits with difficulty, and is fitted for small work and implements, such as wagon-hubs and tool-handles. Both woods are close- and often cross-grained, besides being strong, heavy, tough, and difficult to season.

The Sweet Gum tree is characterized by rough, round balls, resembling those of the sycamore, by pointed star-like leaves, suggesting those of the sugar maple, and by corky ridges on the bark of younger branches. These latter cause the bark to resemble alligator-skin and give rise to the name alligator-wood. *Liquidambar* refers to gums excreted by the tree and sometimes used in medicine.

Sweet Gum (*Liquidambar styraciflua*).

The Sour Gum bears ovoid bluish-black sour drupes, or fruit containing single roughened seeds. The thick oval leaves are dark green above and dull or hairy below. The foliage of both species becomes brilliant in autumn.

Sweet Gum. *Liquidambar styraciflua Linn.*

Nomenclature. (Sudworth.)

Sweet Gum (local and common name).
Liquidambar (R. I., N. Y., Del., N. J., Pa., La., Tex., Ohio, Ill.).
Red Gum (Va., Ala., Miss., Tex., La.).
Gum, Gum Tree (Va., S. C., La.).
Alligatorwood, Blisted (N. J.).

Locality.

Connecticut to Florida, westward intermittently to Illinois and Texas, Mexico. Greatest development in basin of Mississippi River.

Features of Tree.

Eighty to one hundred feet or more in height, three to five feet in diameter. Tall straight trunk, corky ridges frequent on branches. Star-shaped leaves turn to brilliant scarlet in autumn, round balls on long stems.

Color, Appearance, or Grain of Wood.

Heartwood rich brown suggesting black walnut, sapwood nearly white, close-grained, compact structure.

Structural Qualities of Wood.

Heavy, rather soft, strong, stiff, durable when exposed,† shrinks and warps badly in seasoning, receives high polish.

Representative Uses of Wood.

Veneers, cabinet-work, substitute for black walnut, shingles, clapboards, paving-blocks, wooden plates, carpentry, boxes, staves.

Weight of Seasoned Wood in Pounds per Cubic Foot.

37 (U. S. Forestry Div.).*
36.

Modulus of Elasticity.

1,700,000 (average of 118 tests by U. S. Forestry Div.).*
1,220,000.

Modulus of Rupture.

9500 (average of 118 tests by U. S. Forestry Div.).*
9200.

Remarks.

Wood sometimes commercially known as satin walnut and sometimes as star-leaved gum. Large specimens often have hollow butts. Clear wood is obtained in large boards. The wood is tasteless and is used for barrels.

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* See page 8.

† E. C. Woodward, C. E., Division Engineer Texas & Pacific Ry., reports "gum" ties good after 5 years' service. They hold spikes well.

Sour Gum, Black Gum, Tupelo. *Nyssa sylvatica Marsh.*

Nomenclature. (Sudworth.)

Sour Gum, Black Gum, Tupelo (local and common names).
Pepperidge (Vt., Mass., R. I., N. Y., N. J., S. C., Tenn., Mich., Ohio, Ontario).
Wild Pear Tree, Yellow Gum Tree (Tenn.).
Gum (Md.).
Stinkwood (W. Va.).
Tupelo Gum (Fla.).

Locality.

Maine to Florida, westward intermittently to Michigan and Texas.

Features of Tree.

Forty-five to one hundred feet high, one and six inches to occasionally four feet in diameter. Ovoid, bluish-black, sour fruit, with seed. Horizontal branches, short spur-like lateral branchlets.

Color, Appearance, or Grain of Wood.

Heartwood light brown or yellow, often nearly white, sapwood hardly distinguishable, fine grain. Interwoven fibres.

Structural Qualities of Wood.

Heavy, not hard, fibres interlaced, therefore hard to work, strong, tough, checks unless carefully seasoned, not durable in contact with soil.

Representative Uses of Wood.

Wagon-hubs, rollers, ox-yokes, bowls, and woodenware.

Weight of Seasoned Wood in Pounds per Cubic Foot.

39.

Modulus of Elasticity.

1,160,000.

Modulus of Rupture.

11,800.

Remarks.

Limited usefulness because difficult to work. Larger specimen in South. Large trees often hollow at butts and sometimes higher. Grows on hillsides and the borders of swamps or waterways.

Cotton Gum, Tupelo Gum, Large Tupelo. *Nyssa aquatica Linn.*

Nomenclature. (Sudworth.)
Cotton Gum, Tupelo Gum, Large Tupelo (local and common names).
Sour Gum (Ark., Mo.).
Tupelo, Swamp Tupelo (N.C., S. C., La.).
Olivetree, Wild Olivetree (Miss., La.).

Locality.
Virginia and Kentucky, southward.

Features of Tree.
Sixty to eighty feet high, two to three feet in diameter. Blue oblong fruit one inch or more in length.

Color, Appearance, or Grain of Wood.
Heartwood light brown, often nearly white, sapwood nearly the same.

Structural Qualities of Wood.
Light, not strong, soft, compact, difficult to work, not durable when exposed.

Representative Uses of Wood.
Turnery, woodenware, roots used as net-floats instead of corks.

Weight of Seasoned Wood in Pounds per Cubic Foot.

32.

Modulus of Elasticity.

730,000.

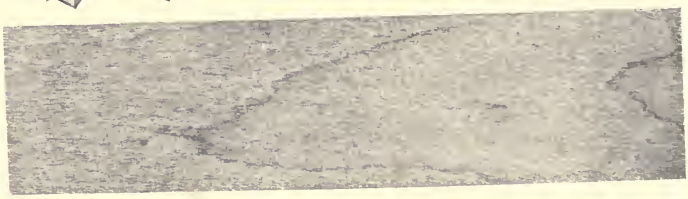
Modulus of Rupture.

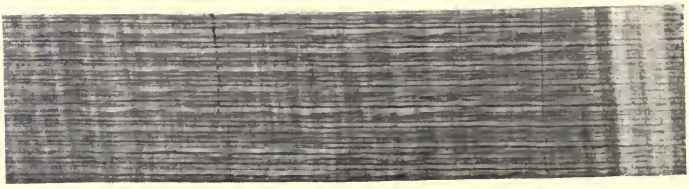
9300.

Remarks.
Butts of large trees are usually hollow. Parts above are usually sound. The light, strong, cheap wood is used in box making. The trees are found on rich bottom lands and in deep swamps, often associated with cypress. Aquatica refers to the fact that the tree tolerates quantities of water.

The Sour Gum (*Nyssa ogeche*) grows on wet lands along the Atlantic coast from South Carolina to Northern and Western Florida. Trees attain heights of thirty to fifty feet. The soft, compact, weak, brownish heartwood is hardly distinguishable from the brownish sapwood. The tree is also known as Ogeechee Lime, Wild Limetree, Limetree, Tupelo, Sour Tupelo and Gopher Plum.

PLATE 22. HOLLY, BOXWOOD, LIGNUMVIT.E (*Ilex*, *Buxus*, etc.).





Box Tree (*Buxus sempervirens*).
Holly Foliage (*Ilex opaca*).
Lignumvitæ Foliage (*G. sanctum*).

Dogwood Foliage (*Cornus florida*).
Dogwood Bark (*Cornus florida*).
Dogwood Wood.
Lignumvitæ Wood.

HOLLY.	BOXWOOD.	LIGNUMVITÆ.
(*Ilex.*)	(*Buxus, Cornus, etc.*)	(*Guajacum.*)

The woods afforded by these trees are all demanded in small and very perfect pieces to fill needs for which no others appear to be perfectly fitted. The holly (*Ilex*) grows in Europe and America, where the brilliant evergreen foliage and red berries have long been associated with the Christmas season. The name holly is probably a subversion of "Holy." * The true boxwood (*Buxus sempervirens*) attains to some size in Europe and Asia, but remains a small shrub in America, where it is seldom if ever cut for wood, but is placed as a decoration along the borders of walks and gardens. The wood called "boxwood" in America is not therefore derived from the "box." The Lignumvitæs grow in Florida, the West Indies, and on the northern coast of South America.

Holly-wood is noted for its fine, even grain, but chiefly for its smooth, ivory-white color, fitting it for the white of inlaid work, for carvings and other decorations where white color and fine qualities are required. The principal European source is the Ilex aquifolium, while in America it is the Ilex opaca. Inlaid work requires a design drawn or stencilled upon a thin sheet of light colored wood such as holly. This sheet is fastened over a similar one of darker wood and a sharp knife passed over the design cuts through both sheets alike. The figures of the lighter tinted wood are inserted within the spaces vacated by the corresponding figures of darker wood and *vice versa*. The sheet with insertions is then glued upon a "core" of seasoned wood as in the preparation of ordinary veneered work. (See pp. 75, 121.) Boxwood is, as stated, the name applied to several woods, all noted for their fine compact structure, rendering them suitable for very fine carvings such as are required in wood-engraving. The Eastern product as cut from the true box is so highly prized as to be sold by the pound. Many of

* "The German name Christdorn, the Danish name Christorn, and the Swedish name Christtorn seem to justify this conjecture."

the best pieces, of true boxwood in billets three to twelve inches across, are from Circassia and Odessa. It is hard to season boxwood so that it will not crack. Eastern turners are said to place it in dark cellars for several years before use. Boxwood is valued for mathematical instruments, and no other wood has ever proved so successful for fine engravings. American substitutes are coarser. American boxwood is chiefly derived from the Flowering Dogwood, the Mexican Persimmon, and the Rose Bay. In Australia several species of Eucalyptus are said to be used. Lignumvitæ is noted for great strength and hardness. Layers of fibres alternately cross one another so that the wood may be said to crumble rather than split. It has no superior for implements that must be fine, true, and strong, such as the sheaves of pulleys and handles of tools. The supply is obtained from two species (*Guajacum sanctum* and *Guajacum officinale*).

Holly may be known by its foliage and berries. Box (*Buxus*) has small, smooth, ovate, dark, evergreen leaves joining the stem so as to be opposite one another. The Dogwood is known by its flowers. The Lignumvitæ is a low gnarled tree.

Lignumvitæ ties, so hard that "holes must be bored for spikes," have lasted for thirty or forty years on the Panama Railway. These ties were finally removed because they had rubbed against the road covering until they were round, and also because some of them had from the first, been too small to afford proper bearing for the rails; but the wood had not rotted, even in that moist, hot district, nor had the rails cut far into the ties.* It is said that Lignumvitæ was introduced into Europe shortly after the discovery of America: it became noted for medicinal properties that are yet recognized, although of doubtful real value. A resin called Guajac or Guaiac, obtained by tapping trees or else warming billets of wood from perforations in which melted resins flow, has been employed, in tincture, as a reagent, for the detection of blood stains. The name Lignumvitæ originated from the supposition that extracts possessed extraordinary remedial powers.†

* Correspondence Mr. Gustave R. Tuska, A. Am. Soc. C. E., late Engineer Panama Railway. Also Trans. Am. Soc. C. E., Vol. 52, page 66.

† U. S. Dispensatory.

Holly, American Holly. *Ilex opaca Ait.*

Nomenclature. (Sudworth.)
Holly, American Holly (local and common names). White Holly (Va.).

Locality.
Massachusetts to Florida, westward intermittently to Indiana and Texas.

Features of Tree.
Occasionally fifty feet in height and three feet in diameter, frequently much smaller, particularly in North. Foliage is evergreen. Bright red berries remain until spring.

Color, Appearance, or Grain of Wood.
Heartwood cream-white, darkening or spotting on exposure. Sapwood similar or lighter. Very close-grained, compact structure.

Structural Qualities of Wood.
Tough, moderately hard and heavy, easily worked.

Representative Uses of Wood.
Inlaid work, carvings, scrollwork, turnery, moderately for furniture and decoration.

Weight of Seasoned Wood in Pounds per Cubic Foot.

36.

Modulus of Elasticity.

910,000.

Modulus of Rupture.

9700.

Remarks.
The wood resembles ivory, and is characteristically employed for the white of inlaid work. The more elaborate specimens of inlaid work are manufactured in Italy, but they are not always durable, at least when brought into the highly heated houses of the Northern States. Inlaid work manufactured in the United States, originally by imported workmen, may be less elaborate but is often more durable than the foreign product. This is because Americans employ more perfectly prepared materials.

Dogwood, Flowering Dogwood. *Cornus florida Linn.*

Nomenclature. (Sudworth.)

Dogwood, Flowering Dogwood (local and common names).
Boxwood (Conn., R. I., N. Y., Miss., Mich., Ky., Ind., Ont.).
False Box-dogwood (Ky.).
New England Boxwood (Tenn.).
Cornel, Flowering Cornel (Tex., R. I.).

Locality.

New England to Florida, westward intermittently to Minnesota and Texas, Sierra Madra Mountains, Mexico.

Features of Tree.

Twenty-five to thirty-five feet in height, one foot or more in diameter. Often low shrub, large white flowers precede foliage, red berry in fall. Rough blackish bark.

Color, Appearance, or Grain of Wood.

Heartwood rich brown, changing to green and red. Sapwood lighter, close-grained.

Structural Qualities of Wood.

Heavy, strong, tough, hard, receives high polish.

Representative Uses of Wood.

Wood-carving, engraving, bearings of machinery, turnery.

Weight of Seasoned Wood in Pounds per Cubic Foot.

50.

Modulus of Elasticity.

1,160,000.

Modulus of Rupture.

12,800.

Remarks.

The Mexican or Black Persimmon and the Great Laurel (*Rhododendron maximum*) afford substitutes. Yellowwood (*Schaefferia frutescens*) is also known as boxwood. The names Dogwood and Poison Dogwood are often applied to the sumach. *Cornus* signifies horn and refers to hardness of wood.

Lignumvitæ. *Guajacum sanctum.*

Nomenclature. (Sudworth.)
Lignumvitæ (Fla.). Ironwood (Fla.).

Locality.
Semitropical Florida, Bahamas, San Domingo, Cuba, Puerto Rico.

Features of Tree.
Twenty-five feet high, one foot in diameter, a low gnarled tree.

Color, Appearance, or Grain of Wood.
Heartwood rich yellow-brown in younger specimens and almost black in older ones. Sapwood light yellow. Close-grained, compact structure.

Structural Qualities of Wood.
Very heavy and exceedingly hard, strong, hard to work, brittle. Lubricated by water, very durable.

Representative Uses of Wood.
Sheaves of ship-blocks, rollers, pulleys, tool-handles. Bearings for journals rotating in water.

Weight of Seasoned Wood in Pounds per Cubic Foot.

71

Modulus of Elasticity.

1,220,000.

Modulus of Rupture.

11,100.

Remarks.
Two other species, Guajacum officinale and Guajacum arborium, afford similar woods not commercially distinguished from the above. Ties of a kind of Lignumvitæ, so hard that holes had to be bored for spikes, have resisted thirty years exposure in moist, hot climate of the Isthmus of Panama.

Sissoo and Sabicu have attracted attention, but have given way to other timbers more plentiful, better located and as good.

Sabicu (*Lysiloma sabicu*). This West Indian wood is very heavy, hard, strong and plastic. It seasons and works well, is very durable and is good for keels frames and the like. The beautiful, dark brown color with figured satiny grain, together with the finishing qualities of this wood, have caused it to be used in furniture. It may be mistaken for rosewood.

Sissoo (*Dalbergia sissoo*) is a medium sized tree, native in Northern India and acclimated in California. The very hard, heavy, strong, elastic wood seasons well, lasts well, and is used in wheels, carriage frames, implements and furniture. It was once prized for gun carriages. The brownish tint suggests rosewood and much rosewood comes from a related species. (See page 122.) Sissoo is now scarce.

LAUREL.

(Magnolia, Rhododendron, Arbutus, etc.)

The name Laurel applies locally or botanically to a number of American plants, several of which attain to the dignity of trees.

The Big Laurel or Magnolia (*M. grandiflora*) is an ornamental tree of the highest rank, extensively planted in parks and gardens of American cities as far north as Washington, and also grown in Europe. The wood is suitable for interior finish and is also used for fuel. The California Laurel (*Umbellularia californica*) and the Madroña or Madroña Laurel (*Arbutus menziesii*) are Pacific coast species of beautiful appearance, the strong, heavy, hard woods of which are of economic importance. Professor Sargent considers * that the former is the most valuable interior or cabinet wood produced by the forests of the Pacific coast. The wood of the Madroña has little or no place in construction, but its charcoal is used in the manufacture of gunpowder. The wood of the Great Laurel or Rose Bay (*Rhododendron maximum*) has been used as boxwood. The gnarled roots of the Mountain Laurel or calico bush (*Kalmia latifolia*) are used for rustic hanging-baskets, seats, and the like.

All of the kinds here noted have evergreen foliage.

* Page 69, "Catalogue Jesup Collection," Sargent.

California and Florida are particularly rich in tropical and semi-tropical trees transplanted from many parts of the world. Most of them are landscape exhibits or experiments, rather than commercial successes or necessities, but some are specially noticeable. ("Olive," see footnote page 34, "Pepper," footnote page 115, "Orange," footnote page 34, "Camphor," footnote page 99, etc.)

Rubber Trees.—Commercial rubber is afforded by trees of several genera as Ficus, Hevea, and Castilla. The Assam rubber tree (*F. elastica*), a native of tropical Asia, is particularly valued for rubber. This species, as well as F. macrophylla, F. rubiginosa, F. glomerata and others, grows in Florida and California, where they are all valued only in landscape effects. Some American specimens are fifty or more feet in height. Small rubber plants are used in house decoration. Para rubber is afforded by H. braziliensis and related species, Mexican rubber by Castilla alba and related species. Rubber is secreted only under favorable conditions.—Also see Cook, U. S. Bureau Plant Industry, Bulletin 49, "India Rubber World," etc., etc.

California Laurel, Mountain Laurel. *Umbellularia californica Nutt.*

Nomenclature. (Sudworth.)
California Laurel, Mountain Laurel (Cal., Nev.).
California Bay Tree, Spice Tree (Cal., Nev., Oreg.).
Myrtle-tree, Cajeput, California Olive (Oreg.).
Californian Sassafras.
Laurel, Bay-tree, Oreodaphne (Cal.).

Locality.
California and Oregon.

Features of Tree.
Seventy-five to one hundred feet in height, three to five feet in diameter. Evergreen foliage, beautiful appearance.

Color, Appearance, or Grain of Wood.
Heartwood light rich brown, sapwood lighter brown. Close-grained, compact structure.

Structural Qualities of Wood.
Heavy, hard, strong, receives beautiful polish.

Representative Uses of Wood.
Ship-building, cabinet-work, cleats, crosstrees.

Weight of Seasoned Wood in Pounds per Cubic Foot.
40.

Modulus of Elasticity.
1,510,000.

Modulus of Rupture.
11,400.

Remarks.
A valuable Pacific coast cabinet wood. Foliage and wood are characterized by pungent oils, sometimes separated by distillation and used in medicine.

The Pepper, California Pepper or Peruvian Mastic (*Schinus molle*) was first introduced into California from Peru by the early Spanish missions and is now one of the most popular shade trees in many places south of San Francisco. It is an irregular tree thirty to fifty feet in height and from two to four feet in diameter. It suggests an apple tree with the drooping foliage of the willow. There is a mass of slender branchlets, light fern-like foliage and long sprays of red or rose tinted persistent berries the size of currants or *pepper corns*, whence the name. The berries contrast with bright, evergreen leaves and render this one of the most beautiful of all landscape trees. The leaves emit a pleasant, pungent odor and possess, to some degree, the quality of stopping dust, which does not however adhere to the leaves. There are gutta percha like exudations used in medicine. The soft, smooth, whitish woods that sometimes darken with age are not employed save for fuel. The pepper is the host of the "black scale" and is being replaced by the better, faster growing Longleaved Pepper (*Schinus terebinthifolius*) from Brazil. Fourteen of the seventeen species are South American. No one is important save as above. (Calif. Agricultural Exper. Station, Bul. 147. Correspondence U. S. Forestry Bureau. Also see Bailey, Cyclopedia Am. Horticulture..)

Madroña, Madroña Laurel. *Arbutus menziesii Pursh.*

Nomenclature. (Sudworth.)

Madroña, Madroña Laurel (Cal., Oreg.).
Laurel, Laurelwood, Madrone.
Madrone-tree, Manzanita (Oreg., Cal.).
Madrove (Cal.).

Locality.

Pacific coast from British Columbia to southern California.

Features of Tree.

Fifty to seventy-five feet in height, occasionally higher. Two to four feet in diameter. Straight well-formed trunk. Evergreen foliage. A shrub in the South.

Color, Appearance, or Grain of Wood.

Thick heartwood reddish, thin sapwood slightly pink. Close-grained; numerous and conspicuous medullary rays

Structural Qualities of Wood.

Heavy, hard, strong, checks badly in seasoning.

Representative Uses of Wood.

Largely for gunpowder, charcoal, also furniture.

Weight of Seasoned Wood in Pounds per Cubic Foot.

43.

Modulus of Elasticity.

1,190,000.

Modulus of Rupture.

12,000.

Remarks.

A beautiful ornamental tree. The attractive wood is seldom seen save locally. This tree has been confused with the Laurel, Madrona or Mexican Madrona (*Arbutus xalapensis*) also called the Manzanita, and with California species of the genus *Arctostaphylos* from which Manzanita wood is derived.

The name Manzanita is somewhat loosely used to designate a hard, heavy, close-grained, rich, reddish brown wood that lends itself to various trinkets, as cuff buttons, rulers, checkers and the like, seen in California curio stores. Large sized pieces are rare and long pieces practically unknown. Most Manzanita wood is probably derived from Arctostaphylos pungens, Arctostaphylos tomentosa and Arctostaphylos glauca.

The China or China-berry (*Melia azedarach*) of Louisiana and other southern States is sometimes, as in California, known as the Umbrella tree and elsewhere, as in Europe, as the Bead tree and Pride of India. The short, straight trunk merges abruptly into numerous branches radiating outward like the ribs of an umbrella. The peculiar form, rapid development and thick handsome foliage cause the tree to be used in southern landscapes. The pits of the white (china) berries are sometimes used as beads. The handsome wood suggests mahogany and could doubtless have place in furniture and decoration.

PLATE 23. PERSIMMON, OSAGE ORANGE, CHERRY
(*Diospyros*), (*Maclura*), (*Prunus*).

Osage Orange Trunk (*M. aurantiaca*). Wild Black Cherry Trunk (*P. serotina*).

Cherry Wood.

Osage Orange Wood.

Persimmon Wood.

PERSIMMON.	OSAGE ORANGE.	CHERRY.
(*Diospyros.*)	(*Maclura.*)	(*Prunus.*)

The Persimmon (*Diospyros virginiana*) grows in many of the central and southern United States and affords a hard, tough wood, resembling fine-grain hickory, that is used for implements and other small work. The plum-like fruit is remarkably astringent when green, but is sweet, rich, and palatable when ripe. The persimmon is a member of the ebony family (*Ebenaceæ*), and the extremely close-grained heartwood is almost black. The ebony of commerce is derived from tropical species of this genus.

The Osage Orange or Bois D'Arc (*Maclura aurantiaca*) is found in the Gulf and neighboring States, and has been cultivated in the North. The wood is unusually hard and strong, and is of a yellow color, which, however, darkens with age. It is in many ways a unique and serviceable product, widely utilized locally in the South, but almost unknown in the North, and nowhere sufficiently appreciated. The aborigines made bows and arrows of it, whence the name Bois D'Arc. The tree affords a useless fruit somewhat resembling the common orange in appearance.

The widely distributed Wild Cherry or Wild Black Cherry (*Prunus serotina*) supplies the cherry wood of commerce. This wood is strong, hard, fine-grained, red-colored, and one of the most popular decorative woods of the American forests. Sweet or Cherry Birch (*Betula lenta*) is often stained so as to imitate it, while it of itself is stained so as to resemble mahogany. The wood of the cultivated cherry is not used in the United States. The wild cherry bears purplish-black fruit somewhat larger than peas, sweetly bitter when ripe. The bark is also bitter. It should be noted of these woods that the thin heart of the persimmon is black, that of the Bois d'Arc is yellow, and that of the cherry is red. Each receives a high polish.

Persimmon. *Diospyros virginiana Linn.*

Nomenclature. (Sudworth.)
Persimmon (local and common name). Simmon, Possumwood (Fla.). Plaqueminier (La.).
Date Plum (N. J., Tenn.).

Locality.
Connecticut to Florida, westward intermittently to Missouri and Texas.

Features of Tree.
Occasionally seventy feet in height, one to two feet in diameter. Soft plum-like fruit, astringent when green, sweet when ripe.

Color, Appearance, or Grain of Wood.
Heartwood dark-brown or black, sapwood light-brown, often with darker spots. Very thin heartwood. Very close-grained, compact structure. Medullary rays conspicuous. Resembles hickory.

Structural Qualities of Wood.
Hard, heavy, strong.

Representative Uses of Wood.
Plane-stocks, shoe-lasts, etc. Prized for shuttles.

Weight of Seasoned Wood in Pounds per Cubic Foot.

49.

Modulus of Elasticity.

1,110,000.

Modulus of Rupture.

12,400.

Remarks.
The astringency of unripe fruit is due to tannic acid. The dried and roasted seeds have been used for coffee.* Heartwood is not greatly developed in trees under one hundred years of age.

* U. S. Dispensatory.

Ebony. This name applies to several hard, black woods, that are used in inlaid work, for the black keys of pianos and other special purposes. Ebony is derived from several species of the genus Diospyros that are native in Ceylon and Southern India. Jamaica ebony is afforded by *Byra ebenus*. There are other sources.

Osage Orange. { *Maclura aurantiaca Nutt.* / *Toxylon pomiferum Raf.*

Nomenclature. (Sudworth.)

Osage Orange (local and common name).
Bois D'Arc (La., Tex., Mo.).
Bodark, Bodock (Kans.).
Yellow-wood, Osage Apple Tree (Tenn.).
Hedge, Hedge-plant, Osage (Ill., Ia., Neb.).
Mock Orange (La.).
Bow-wood (Ala.).

Locality.

Southern Arkansas, Indian Territory, and Texas. Cultivated elsewhere, as in Massachusetts, Pennsylvania, and Michigan.

Features of Tree.

Twenty to fifty feet in height, rarely beyond one and one-half feet in diameter. Fruit resembles orange. Long thorns.

Color, Appearance, or Grain of Wood.

Heartwood bright orange, turns brown on exposure. Sapwood light yellow, close-grained, annual rings clearly marked.

Structural Qualities of Wood.

Hard, heavy, very strong, flexible, durable in contact with soil. Receives beautiful polish. Shrinks in seasoning.

Representative Uses of Wood.

Fence-posts, piles, telegraph poles, railway ties, paving-blocks, occasionally indoor decoration, carriage making, machinery.

Weight of Seasoned Wood in Pounds per Cubic Foot.

48.

Modulus of Elasticity.

1,300,000.

Modulus of Rupture.

16,000.

Remarks.

Indians used wood for bows, thus the name Bois D'Arc, corrupted into Bow Dark or Bodark. A valuable wood not enough appreciated. Often planted as hedges. The fruit is useless. The durability of some pieces of this wood is remarkable. The Kansas City, Ft. Scott and Memphis Ry. has a Bodark plantation at Farlington, Kansas.

OSAGE ORANGE.

Wild Black Cherry, Wild Cherry. *Prunus serotina Ehrh.*

Nomenclature. (Sudworth.)
Wild Black Cherry, Wild Cherry (local and common names).
Black Cherry (Me., N. H., Vt., R. I., N. Y., Miss., Ky., Mich., Wis., Ind., Neb.).
Rum Cherry (N. H., Mass., R. I., Miss., Neb.).
Whiskey Cherry (Minn.).
Choke Cherry (Mo., Wis., Ia.).

Locality.
Eastern to Central United States.

Features of Tree.
Forty to eighty feet in height. Two to three or more feet in diameter. Bitter bark, pea-sized fruit.

Color, Appearance, or Grain of Wood.
Heartwood reddish brown, sapwood yellow, fine straight grain, compact structure.

Structural Qualities of Wood.
Light, hard, strong, easily worked.

Representative Uses of Wood.
Cabinet-work, interior finish.

Weight of Seasoned Wood in Pounds per Cubic Foot.

36.

Modulus of Elasticity.

1,200,000.

Modulus of Rupture.

11,700.

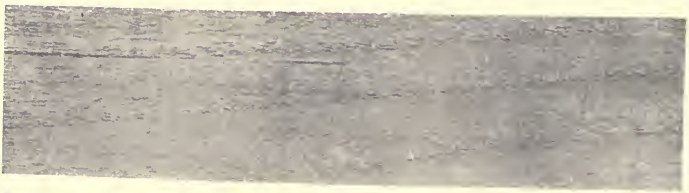
Remarks.
The bitter bark contains medicinal properties valued in bronchitis and other troubles. The fruit, agreeable when ripe, is also used in medicines and cordials.

WILD BLACK CHERRY (*Prunus serotina*).

Greenheart (*Nectandra rodiali*).

Teak (*Tectona grandis*).

Teak Tree.



Teakwood.
Greenheart.

TEAK. **GREENHEART.**

(*Tectona.*) (*Nectandra.*)

There are two Teaks; the principal one (*Tectona grandis*), a native of Asia, has been called the "Oak" of the Indian forests, the other (*Oldfieldia africana*) is an African tree.* The Greenheart (*Nectandra rodiali*) is of the laurel family and grows in South America. The woods, although foreign, are of such nature as to have widely established reputations, and each has at some time been used in construction.

Teak suggests oak, save that it is lighter and has a more uniform structure. It is very durable, and an oily secretion repels insects and preserves iron fastenings. During the supremacy of wooden vessels it was regarded as one of the best ship-building woods in existence. The grain fits it for carvings, and it is now known in North America chiefly because of this fact. Indian teak is the wood usually referred to.

Greenheart, a South American wood, was early placed among the first class of ship-building woods by Lloyd's Register, and is yet taken to Europe to some extent for dock- and ship-building and for implements, but is seldom found and but little known in the United States. It is strong, hard, durable, and extremely heavy, the latter quality being so pronounced as to limit its field of usefulness. It was hoped that such hard wood would resist attacks from marine borers, but this has not been the case. (See page 190.) Greenheart is suited for rollers, pins, and similar articles that require great strength and durability. Finished pieces of selected woods are so rich in appearance that it is surprising that they are not seen oftener. They are of wax-like, green-yellow or browns. A small quantity of Greenheart is used in American cabinet work.

* It was long supposed that African teak was supplied by the species *Swietenia senegalensis*. It is now known that the source is *Oldfieldia africana*, of the family *Euphorbiaceæ*. It is not impossible that wood passing as teak may be derived from yet other species.

Teak. *Tectona grandis.*

Nomenclature.
Teak. Teek.
Indian Oak. Sagwan.

Locality.
India, Burma, Siam, Ceylon.

Features of Tree.
Eighty to one hundred feet in height, three to four feet in diameter, sometimes larger. Straight trunk, large drooping deciduous leaves. Unsuccessful in California

Color, Appearance, or Grain of Wood.
Variable, brownish-yellow, straight, even-grained.

Structural Qualities of Wood.
Moderately hard, strong, easily worked, stands well, oily, fragrant, resists termites, preserves iron.

Representative Uses of Wood.
Furniture, ship-building, timbers, backing for armor-plates.

Weight of Seasoned Wood in Pounds per Cubic Foot.
50 (Laslett).

Modulus of Elasticity.
1,338,000 (Lazlett).
2,100,000 (Thurston).

Modulus of Rupture.
15,000 (Thurston).

Remarks.
The oil is thought to preserve iron and repel termites. Burma, Malabar, Rangoon, and other teaks take names from districts producing them. The distinct African teak (*Oldfieldia africana*) affords wood sometimes marketed as African mahogany and sometimes as African oak.

There are many rosewoods. African rosewood is derived from Pterocarpus erinaceus, Brazilian rosewood from Dalbergia nigra, Indian rosewood from Dalbergia latifolia, Jamaica rosewood from Amyris balsamifera and Linociera ligustrina, and Canary rosewood from Convolvulus scoparius. There is a faulty purplish Philippine wood as well as other botanical sources in each one of the districts noted. Commercial rosewood is hard, tough, very fine-grained and of compact structure. The colors vary from rich reds to chestnut, with frequent black streaks or purplish effects. The demand is small. The wood has been used in local constructions, but is normally seen in costly furniture, piano cases, burial caskets and panel work. Compartment cars sometimes have "rosewood rooms" associated with other rooms of Circassian walnut and English oak. There are other names for Rosewood, as Blackwood, Bloodwood, and African Teak. The name Rosewood is due to the rose scent, often faint, but sometimes very pronounced. An oil distilled from one species has been used to adulterate attar of roses. "California rosewood" seen in souvenirs is derived from stems of large rose bushes.

Greenheart. *Nectandra rodiæi.*

Nomenclature.
Greenheart (local and common name).

Locality.
British Guiana and adjacent portions of South America and the West Indies.

Features of Tree.
Twenty-five to sometimes seventy feet in height, two to four feet in diameter. A straight tree.

Color, Appearance, or Grain of Wood.
Heartwood dark green to chestnut or nearly black, sapwood similar. Clean, straight, compact structure, free from knots. Numerous pores, annual layers hardly distinguishable. Cabinet work.

Structural Qualities of Wood.
Exceptionally heavy, strong, and durable, tough, hard, elastic, receives high polish, breaks suddenly.

Representative Uses of Wood.
Ship-keels, frames, rollers, turnery, also beams, planks, and piles (Europe). In America tops of fishing-rods and very occasionally veneers.

Weight of Seasoned Wood in Pounds per Cubic Foot.
72 (Lazlett).

Modulus of Elasticity. 1,090,000 (Lazlett).

Modulus of Rupture. 10,000 (Thurston).

Remarks.
Excessive weight unfits it for many purposes. Greenheart lasts longer than steel in the sewage polluted waters of the Liverpool docks and it is more easily mended. Wood erected in 1856 was recently removed and found to be so sound that it could be re-used. Metal fastenings showed serious decay. (Also see Kenyon, Trans. Am. Soc. C. E., Vol. LII.

The Sandalwood of commerce is derived from many botanical sources. The genus *Santalum* alone includes twenty species. Until the eighteenth century, wood was obtained from China. The discovery of sources on the Pacific Islands led to lawless traffic and much bloodshed. The adventures associated with the collection of this wood equalled those encountered in whaling and in the search for ivory. The history of the wood dates before the Christian era. Sandalwood (*Santalum album*) is of a yellowish-brown color, close-grained, very fragrant, and weighing about fifty-eight pounds per cubic foot. Sandalwood was prized by the French nobility for medallions mounted on otherwise decorated surfaces and for rich furniture. It is now occasionally employed in fine carvings for small objects, as jewel-boxes and fan-handles. A fragrant oil is separated by distillation. Powdered wood is burned as incense. Sandalwood is associated with Buddhism in India and China. Red sandalwood or Saunder's wood (*Pterocarpus santalinus*) yields a red dye called santalin and is said to have been the almug tree of Solomon.

MAHOGANY.

(*Swietenia, Khaya, Soymida, Cedrela, etc.*)

There are three principal mahogany trees: the Central American or true mahogany (*Swietenia mahogani*), the African mahogany (*Khaya senegalensis*), and the Indian mahogany (*Soymida febrifuga*). There are also minor species called mahoganies.* American mahogany was originally divided by dealers into Spanish and Honduras wood, the former from the then Spanish-American possessions. A considerable supply now comes from Mexico, taking name from port of shipment; as, Frontera, Laguna, Santa Ana, Tecolutla, Minatitlan, and Tonala, desirability being much in the order named. The African field is the latest and probably most important, very large quantities of its wood being distributed through English markets.

Mahogany, placed among the second class of ship-building woods by Lloyd's Register, was once used to some extent in place of oak in naval architecture, but is now so greatly valued for decoration as to be employed for little else, save occasionally the hulls of small pleasure craft. The decorative value is due to a combination of beauty, working qualities, and durability. Beauty is influenced by both grain and warm red color. The latter is generally light, and although it subsequently darkens, in most cases, to a characteristic and rich reddish-brown, is usually induced immediately by stains. The grain is not only beautiful of itself, but is such as to receive those stains and finishing processes thus demanded. Different localities produce woods varying in tint and grain. Individual

* Mahogany and mountain mahogany are names applied in the United States to Rhus integrifolia, a native of Lower California and the coast islands, and to the following species of the Rocky Mountain Region (Idaho to Arizona):

Cercocarpus ledifolius,	Used for fuel.
Cercocarpus parvifolius,	Used for fuel.
Cercocarpus breviflorus,	Heavy, hard, not common.

trees also differ in desirability. No two are alike. Beautiful grain effects are often obtained in "crotches" or junctions between trunk and branch, and such pieces bring high prices. Mahogany is generally used as a veneer. Layers are glued either to some central piece or "core" or else to one another. The layers are arranged so as to cross one another's grain, and results are usually thought to be more desirable than those obtained from solid wood. Few woods glue better, and few shrink or distort less when in place.

"Spanish Cedar" (*Cedrela odorata*) is a broadleaf wood, and not a conifer as is usually supposed. It is nearly related to, and usually found and cut with, true mahogany. Lindley* divides Cedrelecæ into two sub-orders: Swieteniæ, including the true mahoganies, and Cedrelæ, with nine genera and twenty-five species distributed over tropical Asia and America.

Prima vera or white mahogany belongs to Bignoniaceæ, which also includes the catalpas. It grows in Mexico and Central America, associated with true or red mahogany. Prima vera resembles red mahogany even to the conspicuous pores so characteristic of the latter wood. It differs only in color, a light yellow that darkens with age. The characteristic color of finished wood is golden yellow. It is difficult to obtain large pieces of Prima vera free from worm holes. The wood is seen in car finish, house trim and fine furniture where red mahogany might otherwise be employed.

* John Lindley, Treasury of Botany, p. 243, Part I; also see Gifford, "Foresty and Irrigation," Vol. VIII, No. 4, p. 174; also Correspondence Messrs. Wm. E. Uptegrove & Brother, New York City.

Satinwood is hard, heavy, durable, close-grained, brittle and smooth like boxwood. The pale yellow or cream-colored heartwood has a peculiar, fine, satin-like appearance when polished. Trees are not large. The wood, which is very costly and seldom used save in fine cabinet work and odd sets of furniture, is derived from several genera and localities. East Indian satin wood is from Chloroxylon swietenia,* a relative of mahogany, and also Maba buxifolia, an ebenacious tree. Bahama satinwood is probably also from the genus Maba. Florida and West Indian satinwood come from Xanthoxylum caribæum. The botanical source of Tasmanian satinwood is unknown.

* "Indian Forester," Vol. 28, pp. 341–343 and 410–411.

Mahogany. *Swietenia mahogani Jacq.*

Nomenclature.

Mahogany (local and common name).
Spanish Mahogany (Cuba, San Domingo, West Indies).
Mexican Mahogany (Frontera, Laguna, Santa Anna, and other Mexican ports).
Honduras Mahogany (Honduras).
Baywood, Madeira, Redwood.

Locality.

Florida Keys, Bahamas, West Indies, Mexico, Central America, Peru.

Features of Tree.

Florida specimens forty-five feet in height and two or more feet in diameter. Foreign trees larger.

Color, Appearance, or Grain of Wood.

Light, rich reddish brown. Thin sapwood yellow. Smooth, fine uniform texture, inconspicuous rings, conspicuous pores, sometimes filled with white substance.

Structural Qualities of Wood.

Strong, brittle, durable, holds glue, takes stains and high polish, small distortion in seasoning, stands well.

Representative Uses of Wood.

Cabinet-work, veneers; formerly ship-building.

Weight of Seasoned Wood in Pounds per Cubic Foot.

45.

Modulus of Elasticity.

1,510,000.

Modulus of Rupture.

14,000.

Remarks.

Desirability varies with locality. Spanish mahogany ranks first, and harder Mexican woods next. Mahogany is usually stained. African mahogany is now successfully rivaling the American product.

White Mahogany. Prima vera. *Tabeuia Donnell-Smithii* (*Rose*).

Nomenclature.
White Mahogany, Prima vera (local and common names).

Locality.
Mexico and Central America.

Features of Tree.
Fifty to seventy-five feet in height, two to four feet in diameter. Tall, slender, a beautiful tree. Numerous golden-yellow flowers precede the leaves.

Color, Appearance, or Grain of Wood.
Cream-white. Beautiful, fine grain, resembles mahogany exactly save in color. Conspicuous pores.

Structural Qualities of Wood.
Works and stands well.

Representative Uses of Wood.
Cabinet-work, fine furniture, veneers.

Weight of Seasoned Wood in Pounds per Cubic Foot.

Modulus of Elasticity.

Modulus of Rupture.

Remarks.
Many twelve-foot logs imported through San Francisco and west. Named after discoverer. The wood of the butternut or white walnut is sometimes sold as white mahogany, but is seldom if ever confused with the true wood. Prima vera is appropriate where fine, light colored, cheerful effects are required. The appearance is practically identical with that of true mahogany, save in color.

See Botanical Gazette, Vol. XVII, 1892, p. 418; Contribution U. S. National Herbarium, p. 346, Vol. I, No. 9, U. S. Dept. Agriculture, Division of Botany.

Spanish Cedar, Mexican Cedar. *Cedrela odorata Linn.*

Nomenclature.
Spanish Cedar, Mexican Cedar, Cuban Cedar (local and common names).

Locality.
Mexico, Cuba, West Indies.

Features of Tree.
Fifty to eighty feet in height, two to five feet in diameter. Pale-yellow flowers. Pods resemble pecan-nuts. Tree suggests English walnut (*J. regia*).

Color, Appearance, or Grain of Wood.
Brownish red, straight, even, compact grain.

Structural Qualities of Wood.
Soft, fragrant, porous, durable. Resembles cedar woods derived from coniferous trees (page 167); also resembles mahogany.

Representative Uses of Wood.
Cigar-boxes, boats, fine cabinet-work. May be used in place of mahogany. The figured Australian Red Cedar (*C. australis*) is locally used for furniture, joinery, carriages, ceilings, door-frames, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

Modulus of Elasticity.

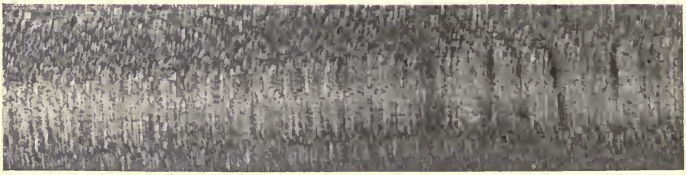
Modulus of Rupture.

Remarks.
Used for cigar-boxes, because its porous structure assists cigars to season, and its odor improves their flavor. The Cuban supply is practically exhausted. Mexico is now the chief American source. Trees grow rapidly.

The Toon Cedar (*Cedrela toona Roxburgh*) of the Orient is the same as the Red Cedar (*Cedrela australis F. v. M.*) of Australia. The Cedar (*Cedrela odorata Blanco*) is thought to be distinct Philippine species.

"Forestry and Irrigation," p. 173, Vol. VIII, No. 4; Writings Dr. Gifford; Correspondence Wm. E. Uptegrove & Brother, and others.

PLATE 25. MAHOGANY (*Swietenia mahagoni*).



Two Specimens of Wood.

EUCALYPTUS.

(*Eucalyptus.*)

These trees, locally known as Stringy-barks, Ironbarks, Mahoganies, Box and Gum Trees, are natives of Australia and the neighboring islands. Some species now grow on parts of each one of the continents, where they have often influenced conditions to a remarkable degree.* Most Eucalypts withdraw large quantities of water from the soil, but their upper portions require much warm, dry air and sunshine. Eucalyptus trees have not succeeded in the United States outside of California, Arizona, New Mexico, Texas and Florida, and their success, in the last three districts has not been remarkable. The Eucalypts have quite changed the appearance of many districts in California.† The Blue Gum (*Eucalyptus globulus*) is the species commonly referred to when the Eucalyptus is mentioned in North America, although other species have been successfully acclimated.

The Euclypts are noted for great size, rapid growth, tough, durable woods, and effect upon health.

Size is illustrated by the species Eucalyptus amygdalina, individuals of which have reached a height of over four hundred feet and are thus, probably, the tallest although not the largest trees known to man. Development is shown by specimens of Eucalyptus globulus that have lengthened in excess of two feet a month during the first year.‡ The working qualities of Jarrah, Karri, Tuart and Red Gum Woods (*E. marginata*, *E. diversicolor*, *E. gomphocephala*, and *E. rostrata*) are such as to have caused them to take high rank in local constructions. The first two have been preferred beyond all other materials for paving the streets of London and of Paris. Improvement in health has followed the introduction of Blue Gums (*E. globulus*) in malarial districts, such as those around Rome. Such results while possibly influenced by the presence of medicinal substances in the foliage are principally due to the fact that the leaves evaporate unusual quantities of water from the soil.§

* "Will sensibly affect the aspect of the country just as they have affected that of the Riviera, of the Campagnia, and of the Nilghiri hills in South India." —Bryce, Impressions of South Africa.

† The Florida climate is favorable most but not all of the time. That of Southern California and parts of Arizona is so equable that McClatchie details forty-one distinct species already growing. This district must be regarded as the only real American locality at this time.

‡ A Passadena blue gum was five feet thick at the end of twenty-five years. Others in Santa Barbara at the same age compared with oaks known to be two hundred or three hundred years old. A specimen three years from the seed measured about nine inches in diameter.—McClatchie.

§ The writer has seen long rows of California blue gums cut down because they "dried the soil."

The genus may thus be summarized from the point of view of the living tree and from that of the wood.

Trees grow rapidly; some grow where those of other species will not; some form wind-brakes and forest cover; some serve in landscape effects; some afford honey; * many yield oils.† The hard wood timbers present an unusual range of possibilities. McClatchie quotes twenty-five special purposes to which eucalyptus woods have been applied in Australia. Six species are valued for bridge timbers, five for piles, nine for paving, eight for posts, three for railway ties, four for car building, five for lumber and shingles, seven for carriage parts, two for cooperage, and two for handles. The American demands are thus far principally for fuel,‡ posts, parts of farm implements, and pins for insulators on long distance transmission cables. Blue gum piles have been successfully employed at Santa Barbara and Ocean-side.

Eucalyptus trees are characterized by leathery evergreen foliage of many tints, such as blue, gray and green. The leaves of young and old trees sometimes differ. Those of young blue-gums are bright blue, oval and stalkless, while older leaves have stems, are dark green and sickle-shaped. The characteristic odor is the only point in common between the young and old foliage of this species. It may be added that the foliage and young twigs of all species possess a more or less pronounced odor due to the presence of oils. The nomenclature is very confusing. There are eight "iron barks," nine "red gums," eleven "stringy-barks" and twelve "blue gums," so that botanical names must be preferred. Eucalyptus refers to portions of the flowers and means "well concealed." The nearly one hundred and fifty species are all evergreens.

* Trees blossom during droughts when other flowers are scarce. Some species blossom twice a year. Flowers are always seen on some of the species. The Red and Sugar Gums (*E. rostrata* and *E. corynocalyx*) are notably rich in honey.

† Oils differ with species and, as first separated, are mixtures. Six-tenths of the product from the Blue Gum is a substance known as *Eucalyptol*. E. citriodora yields a citron-scented oil, E. amygdalina is very prolific.

‡ The Blue, Manna and Red Gums and the Red Iron Bark are all systematically cultivated for fuel in Southern California. Blue Gum and Manna Gum are ready for cutting at the end of six or seven years.

Works of Baron von Muller; Report J. Ednie-Brown, Forest Commissioner Western Australia; Correspondence M. Francis Chapman, Esq., London; The Forester; Work of Abbot Kinney, Press Baumgardt & Co., Los Angeles, U. S. Forestry Bulletin No. 11. The useful American sources, "McClatchie, U. S. Forestry Bulletin No. 35," and Ingham, Calif. State Ag. Exp. Sta. Bul. No. 196, are particularly acknowledged.

Jarrah. *Eucalyptus marginata.*

Nomenclature.
Jarrah (local and common name).
Mahogany Gum (Australia).

Locality.
Western coast of Australia. Some specimens acclimated in California.

Features of Tree.
Ninety to one hundred or more feet in height, two to five feet in diameter. Fifty or more feet to lowest branch. Dull, sombre appearance. Branches concentrated at top. Few California specimens are over thirty feet in height.

Color, Appearance, or Grain of Wood.
Reddish, resembles mahogany, also Kauri wood.

Structural Qualities of Wood.
Heavy, non-absorbent, somewhat oily, durable in contact with the soil, receives good polish. Characteristic odor, wears thin evenly, not easily inflammable. Said to repel teredo and termite.

Representative Uses of Wood.
Marine work, exposed positions, ship-building, bridge timbers, street-paving (London and Paris).

Weight of Seasoned Wood in Pounds per Cubic Foot.
65 (Ednie-Brown).*

Modulus of Elasticity.
2,080,000 (Ednie-Brown).*

Modulus of Rupture.
8900 (Ednie-Brown).*

Remarks.
Chief timber tree of southwestern Australia. Often confused with Karri. Müller calls it the least inflammable of woods. Marginata refers to thick-edged leaves.

* Report Forests Western Australia, Presented to Parliament, 1896.

The Red Mahogany (*Eucalyptus resinifera*) has very limited local ranges. The hard, heavy, durable, rich-red wood resembles mahogany and is used for shingles, posts, piles and pavings. It can be used in furniture.

Manna Gum (*E. viminalis*) grows very rapidly, but the wood is not as serviceable as that from Blue Gum. Red Gum and Blue Gum are likely to grow wherever the Manna gum will grow.

The Victoria Stringy-bark (*E. macrorhyncha*) has a thick, dark-gray, fibrous, durable bark that is used in Australia for roofing out-buildings; strings are obtained from it. The hard, durable wood is used for lumber, shingles and fuel.

Karri. *Eucalyptus diversicolor.*

Nomenclature.
Karri (many localities). White Gum (Australia).

Locality.
Australia, New Zealand. Some specimens acclimated in California.

Features of Tree.
Two to three hundred and fifty feet in height, four to eighteen feet in diameter. A straight graceful tree, lower branches often one hundred and fifty feet from ground. Smooth yellow white bark.

Color, Appearance, or Grain of Wood.
Reddish brown, fibres interlaced, compact structure.

Structural Qualities of Wood.
Hard, heavy, tough and elastic, non-absorbent, durable, difficult to work, wears evenly, characteristic odor.

Representative Uses of Wood.
Construction, railway ties, piles, marine work, pavements (London and Paris). Masts, lumber (Australia).

Weight of Seasoned Wood in Pounds per Cubic Foot.
63 (Ednie-Brown).*

Modulus of Elasticity.
2,890,000 (Ednie-Brown).*

Modulus of Rupture.
8000 (Ednie-Brown).*

Remarks.
Once named Eucalyptus colossea because of great size. Distinct from Kauri Pine (*D. australis*). Diversicolor refers to leaves the upper and lower sides of which differ in color. A characteristic of other eucalypt also.

* Report Forests Western Australia, Presented to Parliament, 1896.

The Giant Eucalypt or Peppermint Tree (*Eucalyptus amygdalina*) is probably the tallest of all trees. The leaves smell like peppermint because of oils that are often separated and used in medicine. The light woods are outclassed by those of other species.

The Sugar Gum (*Eucalyptus corynocalyx*) now grows thriftily in California. It is one of the best species for desert culture. The profuse blossoms continue for several months. The very hard, durable woods season evenly, and have been used in wheels and utensils. Trees are planted along roads; they attain heights of sixty to ninety feet.

Tuart. *Eucalyptus gomphocephala.*

Nomenclature.

Tuart (local and common name).
Tewart (Australia).
Tooart (Australia).
White Gum (Australia).

Locality.

Australia. A few specimens have been acclimated in California.

Features of Tree.

One hundred to one hundred and fifty feet in height, four to six feet in diameter. Lower branches forty or more feet from ground. Bright, cheerful appearance, straight trunk, gray-white bark. Californian specimens have reached heights of eighty feet within twenty-four years.

Color, Appearance, or Grain of Wood.

Heartwood light yellow, compact appearance, fibres interlaced.

Structural Qualities of Wood.

Very hard, heavy, strong, tough, rigid, durable, seasons well. Difficult to split or work. Strength and durability are very pronounced. Tuart is one of the strongest of all woods.

Representative Uses of Wood.

Keels, buffers, stern-posts, frames, wheel-hubs, shafts.

Weight of Seasoned Wood in Pounds per Cubic Foot.

67 (Ednie-Brown).*

Modulus of Elasticity.

2,300,000 (Ednie-Brown).*

Modulus of Rupture.

9300 (Ednie-Brown).*

Remarks.

Highly prized locally. One of the strongest of woods. Gomphocephala refers to peculiarities in lid of calyx-tube.

The Red Gum (*Eucalyptus rostrata*) is one of the leading Australian species. Baron von Mueller considered it "perhaps the most important of the whole genus."* Trees are one hundred feet or more in height. The wood is of a rich red color that darkens with age. It has a close, complicated grain, so that it is difficult to split, and it is remarkably uniform, durable, strong and hard. Australians use it for ship-building, piles, posts, paving, curbs, poles, and house blocks. It is said to resist the attacks of marine life and termites. The flowers yield honey. There is a ruby-red exhudation known in medicine as "kino." The young bark is red, hence the name red gum. Rostratus refers to the beaked flower-bud coverings. Red gum bids fair to become one of the most successful eucalypts in America.

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* Report on Forests Western Australia, Presented to Parliament, 1896.

† "It is the tree which produces directly to the Colony by far the most revenue of all our trees."—Jos. H. Maiden, Director Botanical Garden, Sydney, N. S. W.

Blue Gum, Fever Tree. *Eucalyptus globulus.*

Nomenclature.

Blue Gum (local and common name).

Fever Tree (Australia).
Balluck (Australia).

Locality.

Native of Australia acclimated in southern California and elsewhere throughout the world.

Features of Tree.

Two hundred to sometimes three hundred or more feet in height. Three to six feet in diameter. Loose, shaggy, exfoliating bark.* Leaves sometimes twelve inches in length. Color varies with age. Characteristic odor.

Color, Appearance, or Grain of Wood.

Straw color. Sapwood lighter. Indistinct annual rings. Fibres interlaced so that it is hard to work, particularly when dry.

Structural Qualities of Wood.

Hard, heavy, durable, difficult to split, particularly when dry. For this reason trees are sawn into planks, if at all, as soon as they have been felled. The green wood works much more easily than the dry. Blue Gum is less elastic although it compares with ash and hickory.

Representative Uses of Wood.

Rollers, paving-blocks, ship-building, fuel, carriage-making. Small pieces boiled in water and then in linseed oil are used for insulator pins on telegraph poles, piles and mine timbers in California. A principal fuel in Southern California.

Weight of Seasoned Wood in Pounds per Cubic Foot.

43 to 69 (Mueller)
57 to 69 (Lazlett).

Modulus of Elasticity.

Modulus of Rupture.

Remarks.

The Eucalyptus of California. The species planted in malarial districts. Sanitary powers due to evaporation from large leaves or presence of essential oils, which are thought to have medicinal qualities. Grows very rapidly.

* The bark is variable. Some trees of nearly 1 foot diameter have smooth green bark resembling that on young willow saplings; most others have the shaggy bark, while from some this has dropped away, exposing a smooth grayish interior suggesting that of the sycamore. Planted more widely than other Eucalypts. The species used in malarial districts. The "Eucalyptus" of California; one of the fastest growing trees in the world. Trees eight or ten years old, will, if cut down, produce shoots seventy-five to one hundred feet high in six or eight years, and cuttings may be continued indefinitely. The common name Blue Gum is applied to eleven other distinct species, so that the botanical name should never be omitted. Globulus refers to the globular seed cases.

White Pine Foliage (*P. strobus*).

White Pine Tree (*P. strobus*).
(*Courtesy N. C. Geol. Survey.*)

Hard Pine Trunk (*P. palustris*).
(*Photograph by Edward J. Davison.*)

Hard Pine Wood (*P. palustris*).

Soft or Sugar Pine Wood (*P. lambertiana*).

NEEDLELEAF WOODS.

The trees affording these woods cover large areas in the natural forests of the Northern Hemisphere. They exist, but to an unimportant extent, in the South. Cedar, larch, and cypress figure in ancient history. Pine, spruce, hemlock, and other so-called soft woods are of this group, which has always been important in the United States.

Needleleaved woods are characterized by uniform fibre-conditions, presence of resins, and lighter weights. The vertical structure consists of simple, similar, elongated tubes or cells, tapering and finally closing at their ends, known as tracheids. These are arranged with more or less regularity, and woods are correspondingly easy to work. Pith-rays are scarcely visible, and sections do not show pores. Cavities known as resin-ducts, and which are not real vessels but rather simple intercellular spaces, secrete resins so important in making these woods durable and elastic. There are exceptions, such as the eucalyptus and tulip trees; but as a rule the greatest tree forms are in this group, their trunks affording large straight pieces eminently suited for construction. The properties of the woods are such that they are preferred in carpentry and heavy constructions, the total requirement has greatly exceeded that for hard woods.

The resinous, usually evergreen, leaves and the cones are sufficient to identify these trees. Needleleaf, softwood, coniferous, and evergreen trees are the same. The name evergreen is not strictly correct, since some species—larch and bald cypress—shed their needles every year.

PINE.

(*Pinus.*)

Pine trees afford woods that have been more used in carpentry and construction than any others. They are to the soft woods what the oaks are to the hard woods, and they stand, at present, with reference to all woods much as iron does to all metals. Pine is prized because of a combination of strength, elasticity, light weight, working qualities, and, until recently, wide spread availability, such as fits it for those constructions requiring the largest quantities of woods. Supplies are diminishing and some pines are already practically unattainable in many places. Pines are separated into soft-pines and hard-pines.

The pines have smooth, straight, solid trunks, usually destitute of branches for many feet from the ground. There are needle-shaped, more or less cylindrical, evergreen leaves from one to many inches in length, gathered in clusters of two, three, or five, their number and the fact that they are thus clustered being important bases of classification. There are also cones of woody overlapping scales. Pines reproduce with difficulty,* and mature so slowly that ultimate survival of modern conditions must probably be as cultivated trees.

Thirty-nine of the seventy known species of pine are found in the United States. These with their woods are separated into two groups known as *hard* and *soft* pines. The Dantzic or Northern pine (*Pinus sylvestris*) is the principal European species.

* The roots of most species die with cutting of trees. There is no power of producing new shoots. (The pitch pine (*Pinus rigida*) is an exception to this rule.) Seeds also have short-lived vitality. Trees are easily raised from fresh seeds.

SOFT-PINE.

Soft-pine is soft, clean, light, uniform, easily worked, not strong, free from knots and resins, and is yet obtainable in large and perfect pieces. The wood is whitish and the yearly rings are not pronounced. The supply is divided, as obtained from the white pine on the one hand, and from the sugar-pine and all other species on the other.

White pine (*Pinus strobus*) grows in the north, central, and eastern United States and was formerly the important tree of North America. It emphasized the forest industries of Maine and Michigan, and methods connected with harvesting it have influenced logging practices in many fields. It was long the only softwood seriously considered by Northern lumbermen. Thirty per cent of the sawn timber and lumber used in this country in 1899 was drawn from this species.* No wood known to man can apply in more places than white pine. There are no perfect eastern substitutes, but spruce, fir, and even whitewood are thus employed. Sugar pine and redwood are used on the Pacific Coast, where eastern pine has never seriously competed.

The Sugar Pine (*Pinus lambertiana*) of the Western States is a tree growing at high elevations and is so large as to take rank with the redwoods and other of the world's greatest trees. The tree produces a clean, soft, coarse wood that is upon the whole the best present substitute for true white pine. The geographical range of the tree, is, however, such as to limit the widest present usefulness of the woods.

Among other minor American sources are White Pine (*P. flexilis*), Rocky Mountain Region; White or Silver Pine (*P. monticola*), Pacific Coast Region; Whitebark Pine (*P. albicaulis*), Pacific Coast Region; Mexican White Pine (*P. strobiformis*), Arizona into Mexico; Parry's Pine (*P. quadrifolia*), Southern California; Nut Pine (*P. cembroides*), Arizona into Mexico.

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* Roth, U. S. Forestry Bul. No. 22, p. 73.

" White Pine Timber Supplies." U. S. S. Doc. 55-1, Vol. IV.

HARD-PINE.

Ordinary hard-pine differs from soft-pine in that it is hard, resinous, heavy, harder to work, and very strong. It also is obtainable in large pieces. The orange-yellow wood is more or less figured. The annual deposits are pronounced and are separated into two sharply divided rings. The supply is chiefly derived from the longleaf, shortleaf, Cuban, and loblolly pines of the South Atlantic States.

The longleaf pine (*Pinus palustris*) is distinctly the most important of its group. The wood is ideal for heavy constructions. Beams, docks, trestles, and frames of cars are formed of it. The trees afford the greater bulk of turpentine, tar, and resin, or "naval stores," produced in this country.* Cuban, shortleaf, and loblolly pine woods (*P. heterophylla*, *P. echinata*, and *P. tæda*) are nearly similar. Longleaf and Cuban pines are seldom separated, while shortleaf and loblolly pines are also mixed. Longleaf pine usually affords finer structure and more heartwood than Cuban pine. Strength and weight averages of both woods are in excess of those of shortleaf and loblolly pines. No method of invariably telling these four woods apart has as yet been determined. (Roth.) Any or all of them are practically liable to be delivered in response to a demand for Southern pine. Johnson considers shortleaf pine as good as longleaf pine of equal weight, and suggests environment as a means of identification.

Palustris, signifying "swampy," is misleading, since long leaf pine prefers dry, sandy soil and tracts known as "pine barrens." *Mitis* refers to the soft, delicate foliage of shortleaf pine. *Tæda* signifies "torch." The trees may be told by differences in their leaves and cones.

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* Manufacture of tar, pitch, etc. (See Report Chief U. S. Div. Forestry, 1892, p. 356; also U. S. Forestry Bulletin No. 13.)

Names.	Leaves.		Cones.	
	Number in Cluster.	Length.	Diameter (open).	Length.
Longleaf (*P. palustris*).....	3	10 to 15 in.	4 to 5 in.	6 to 10 in.
Cuban (*P. heterophylla*).....	2 or 3	8 to 12 "	3 to 5 "	4 to 7 "
Shortleaf (*P. echinata*).....	2 or 3	2 to 5 "	1 to 2 "	2 "
Loblolly (*P. tæda*).....	3	5 to 10 "	2 to 3 "	3 to 4 "

Hard pine is practically the strongest building wood commonly obtainable in large-sized pieces in the United States. Trees are usually cut down after having been tapped for two or three years. The Douglas Spruce or "Oregon Pine" (*Pseudotsuga taxifolia*), supplies much of the "hard pine" used on the Pacific Coast.

Tar, turpentine, resin and similar products included within the term "naval stores," are derived chiefly from the Longleaf and Cuban pines. This industry is one of the leading ones in the South Atlantic States. It used to be thought that the tapping or "bleeding" to which the trees were subjected, might influence the subsequent strength and durability of their woods, and so firm was this belief, that specfications often excluded "bled" lumber. Since most lumber has been "bled" and since mill men make no attempt to separate the "bled" from the "unbled" woods, some trouble has arisen.* An exhaustive investigation† proved that strength, weight and shrinkage are not influenced by bleeding, and that "bled" is as good as "unbled" lumber. The quantities of resin contained in hard pine vary greatly. Similar trees differ widely in this respect. The resin in heartwood varies between five and twenty per cent. of dry weight. Sapwood is much leaner, and since bleeding principally effects sapwood, durability as well as strength is not influenced to any very great extent. Pine resin is called rosin. The Louisville and Nashville Railroad originally specified "unbled" lumber. Some "bled" lumber was erroneously included and the mill offered to take it back if it could be separated from the rest. As the railway engineers were unable to distinguish it, the matter was dropped.

A confusion exists in the names of the pines. All Southern pines are commercially known as yellow pines. American white pine is known in Europe as Yellow Pine, and all hard pines are often there referred to as pitch pines. Spruce Pine, Bull Pine and Bastard Pine are names frequently used to hide ignorance. The species *palustris* has thirty local names. Botanical names should be used to describe the pines.

* U. S. Forestry Bulletin No. 8.

† U. S. Forestry Bulletins Nos. 8 and 10.

White Pine. *Pinus strobus Linn.*

Nomenclature. (Sudworth.)

White Pine (local and common name).
Weymouth Pine (Mass., S. C.).
Soft Pine (Pa.).
Northern Pine (N. C.).
Spruce Pine (Tenn.).
Pumpkin Pine.
Pattermaker's Pine.

Locality.

North-central and northeastern United States, northward into Canada, southward to Illinois, and along the Alleghanies into Georgia, intermittently.

Features of Tree.

Seventy-five to one hundred and fifty feet in height. Three to six feet in diameter, sometimes larger. Erect impressive form. Tufts of five soft, slender, evergreen leaves in long sheath. Cones four to six inches long, one inch thick, slightly curved.

Color, Appearance, or Grain of Wood.

Heartwood cream-white, sapwood nearly white. Close, straight grain. Compact structure. Comparatively free from knots and resin.

Structural Qualities of Wood.

Soft, uniform, seasons well, easy to work, nails without splitting, fairly durable. Lightest and weakest of eastern United States pines. Shrinks less than other pines. Paints well.

Representative Uses of Wood.

Carpentry, construction, matches, spars, boxes, numerous uses.

Weight of Seasoned Wood in Pounds per Cubic Foot.

24 (U. S. Forestry Div.).*
24.

Modulus of Elasticity.

1,390,000 (average of 130 tests by U. S. Forestry Div.).*
1,210,000.

Modulus of Rupture.

7900 (average of 120 tests by U. S. Forestry Div.).*
8900.

Remarks.

Formerly the chief lumber tree of the United States. The supply is rapidly diminishing. See remarks, next page.

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* See page 8.

"The White Pine." Spaulding. U. S Forestry Bul. No. 22.
"White Pine" a Study. Mr. Gifford Pinchot. (Century Co.)
"White Pine Timber Supplies." U. S. Doc. 40 Senate, 55-1, Vol. IV.

White Pine. *Pinus flexilis James.*

Nomenclature. (Sudworth.)

White Pine (Cal., Nev., Utah, Col., N. M.).
Pine (Utah, Mont.).
Limber Pine.
Rocky Mountain Pine.
Bull Pine (Col.).
Western and Rocky Mountain White Pine (Cal.).
Limber-twig Pine.
Arizona Flexilis Pine.

Locality.

Rocky Mountains, Montana to Mexico.

Features of Tree.

Forty to fifty feet in height, one to three feet in diameter. Tufts of five rather short, rigid leaves in sheaths.

Color, Appearance, or Grain of Wood.

Heartwood light, clear yellow, turning red from exposure. Sapwood nearly white. Close-grained, compact structure, numerous and conspicuous medullary rays.

Structural Qualities of Wood.

Light, soft. Saws, plains, nails and paints well. Fairly durable, similar to Pinus strobus.

Representative Uses of Wood.

Construction. Similar to Pinus strobus.

Weight of Seasoned Wood in Pounds per Cubic Foot.

27.

Modulus of Elasticity.

960,000.

Modulus of Rupture.

8800.

Remarks.

This tree forms mountain forests of considerable extent. Valued locally. All White Pine is quite durable even in exposed positions. White Pine stumps (notably *Pinus strobus*) outlast those of oak and many other harder woods. It often happens that settlers do not attempt to remove hard wood stumps, knowing that they will soon rot out, but pine stumps are best removed at once. White Pine sidewalks are very satisfactory, but the wood serves best when painted or in interiors.

Sugar Pine. *Pinus lambertiana Dougl.*

Nomenclature. (Sudworth.)

Sugar Pine (local and common name).	Little or Great Sugar Pine.
	Gigantic Pine.
Big Pine, Shade Pine (Cal.).	White Pine.

Locality.

Oregon and California. Best at high altitudes (above 4000 feet), central and northern California.

Features of Tree.

One hundred to occasionally three hundred feet in height, fifteen to sometimes twenty feet in diameter. Cones ten to eighteen inches in length, edible seeds. Sweetish exudations. A great tree.

Color, Appearance, or Grain of Wood.

Heartwood pinkish brown, sapwood cream-white. Coarse, straight-grained, compact structure. Satiny, conspicuous resin passages.

Structural Qualities of Wood.

Light, soft, easily worked, resembles white pine (*Pinus strobus*).

Representative Uses of Wood.

Carpentry, interior finish, doors, blinds, sashes, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

22.

Modulus of Elasticity.

1,120,000.

Modulus of Rupture.

8400.

Remarks.

Grows at as high elevations as five thousand feet or more above tide-water. Forms extensive forests with Balsam Fir (*Abies concolor*). This, the grandest tree-form of the genus, may be grouped, as to size, with Common Redwoods and other giant growths. The immense cones, sometimes exceeding eighteen inches in length, hang from the ends of the branches and are very striking. The sugar-like exudations form an active purgative known as "American false manna," and contains a peculiar saccharine principle known as pinite.

White Pine. *Pinus monticola Dougl.*

Nomenclature. (Sudworth.)
White Pine (Cal., Nev., Oreg.).
Mountain Pine, Finger Cone Pine (Cal.).
Silver Pine.
Little Sugar Pine, Soft Pine (Cal.).
Western White Pine.
Mountain Weymouth Pine.

Locality.
Montana, Idaho, Pacific States, and British Columbia.

Features of Tree.
Eighty to one hundred feet in height. Two to three feet in diameter, sometimes larger. Foliage resembles, but is denser than, white pine. Long smooth cones.

Color, Appearance, or Grain of Wood.
Heartwood light brown or red, sapwood nearly white. Straight-grained, compact, suggests white pine (*Pinus strobus*).

Structural Qualities of Wood.
Light, soft, not strong.

Representative Uses of Wood.
Lumber.

Weight of Seasoned Wood in Pounds per Cubic Foot.

24.

Modulus of Elasticity.

1,350,000.

Modulus of Rupture.

8600.

Remarks.
Found at elevations of seven thousand to ten thousand feet. Common and locally used in northern Idaho.

The Lodgepole Pine (*Pinus murrayana*) also called Tamarack, Tamarack Pine, Murray Pine, as well as Prickly, Black and White Spruce, is distributed from Alaska to California and New Mexico. Trees are often at altitudes of 6,000 to 11,000 feet. The remarkably tall, slender trunks lend themselves to ties, posts and poles. The light, straight-grained woods are hard to season, but easy to work. Trees are sensitive to fires which, however, do not normally kill seeds. The species re-establishes itself repeatedly after fires.—Also see Erickson, Forestry and Irrigation, p. 503, 1904.

The Spruce Pine (*Pinus glabra*) is the least common of the lower Southern States pines. It seldom forms pure forests and is of relatively small commercial importance. The wood resembles that from the Loblolly Pine. The name Spruce Pine is popularly applied to trees of ten other American species (*Sudworth*) two of which are not pines.

Georgia Pine, Hard Pine, Yellow Pine, Longleaf Pine.
Pinus palustris Mill.

Nomenclature. (Sudworth.)

Turpentine Pine.
Rosemary Pine.
N. Carolina Pitch Pine.
Southern Pine.
Longleaved Yellow Pine.
Longleaved Pitch Pine.
Long Straw Pine.
Pitch Pine.
Fat Pine.
Heart Pine.
Brown Pine.
Florida Yellow Pine.
Florida Pine.
Florida Longleaved Pine.
Southern Pitch Pine.
Southern Hard Pine.
Southern Heart Pine.
Southern Yellow Pine.
Georgia Pitch Pine.
Georgia Longleaved Pine.
Georgia Heart Pine.
Georgia Yellow Pine.
Texas Yellow Pine.
Texas Longleaved Pine.

Locality.

South Atlantic and Gulf States, Virginia to Alabama, intermittently.

Features of Tree.

Fifty to ninety feet or more in height, one to three feet in diameter. Tufts of three leaves, ten to fifteen inches long, in long sheath.

Color, Appearance, or Grain of Wood.

Heartwood orange, sapwood lighter. Compact structure, conspicuous medullary rays. Fine and even appearance in cross-section, quite uniform, narrow annual rings (20 or 25 per inch). Wide sapwood in young trees.

Structural Qualities of Wood.

Hard, heavy, tough, elastic, durable, resinous. The strongest and stiffest of Pines.

Representative Uses of Wood.

Heavy constructions, ship-building, cars, docks, beams, ties, flooring, house-trim, many uses.

Weight of Seasoned Wood in Pounds per Cubic Foot.

38 (U. S. Division of Forestry).*
43.

Modulus of Elasticity.

2,070,000 (average of 1230 tests by U. S. Forestry Div.).*
2,110,000.

Modulus of Rupture.

12,600 (average of 1160 tests by U. S. Forestry Div.).*
16,300.

Remarks.

Finer and has less sapwood than Cuban pine. One of the best woods for car-building. Principal lumber tree of the Southeast.

* See page 8.

Cuban Pine. *Pinus heterophylla Sudw.*

Nomenclature. (Sudworth.)
Cuban Pine, Slash Pine (local and common names).
Pitch Pine, She Pine, She Pitch Pine (Ga., Fla.).
Swamp Pine (Fla., Miss.).
Bastard Pine, Meadow Pine, Spruce Pine.

Locality.
Coast region, South Carolina to Florida and Louisiana.

Features of Tree.
Fifty to eighty feet in height, one to two feet in diameter.

Color, Appearance, or Grain of Wood.
Resembles loblolly pine. Dark straw with tinge of flesh color. Variable and coarse appearance in cross section. Annual rings are usually wide (10 or 20 per inch).

Structural Qualities of Wood.
Similar to those of longleaf and of selected pieces of loblolly pine. Sometimes more resinous than longleaf pine.

Representative Uses of Wood.
Similar to those of longleaf pine, from which it is seldom separated.

Weight of Seasoned Wood in Pounds per Cubic Foot.

39 (U. S. Forestry Div.).*

Modulus of Elasticity.

2,370,000 (average of 410 tests by U. S. Div. of Forestry).*

Modulus of Rupture.

13,600 (average of 410 tests by U. S. Div. of Forestry).*

Remarks
Resembles and is marked longleaf pine (*Pinus palustris*), no distinction being made in the lumber. The Cuban Pine supplies large pieces of perfect wood, thus rivaling Loblolly Pine (*Pinus tæda*) with which it has probably been confused. The structure of the wood closely resembles that of Loblolly Pine. Trees reproduce rapidly, those forty years old are often large enough to be tapped; this is important, because of the fact that Longleaf Pine from which "naval stores" are principally obtained is being destroyed so rapidly. The very heavy, fresh wood shrinks considerably, although with small injury, during seasoning. The Cuban Pine grows in the subtropical regions of the United States and in Hondurus and Cuba, whence the name.

* See page 8.

Shortleaf Pine, Yellow Pine. { *Pinus echinata Mill.* / *Pinus mitis Michx.*

Nomenclature. (Sudworth.)

Common Yellow Pine, Hard Pine.
Spruce Pine (Del., Miss., Ark.).
Bull Pine (Va.).
Shortshat Pine (Del.).
Pitch Pine (Mo.).
Poor Pine (Fla.).
Shortleaved Yellow Pine (N. C.).
Rosemary Pine (N. C.).
Virginia Yellow Pine.
North Carolina Yellow Pine.
North Carolina Pine.
Carolina Pine.
Slash Pine.
Old Field Pine.

Locality.

Connecticut to Florida, westward intermittently to Kansas and Texas.

Features of Tree.

Sixty to sometimes ninety feet in height, two to sometimes four feet in diameter. A large erect tree; small cones have minute weak prickles. Leaves usually in twos from long sheaths.

Color, Appearance, or Grain of Wood.

Resembles longleaf and loblolly pines. Variable appearance in cross section, wide annual rings near heart.

Structural Qualities of Wood.

Variable, usually hard, tough, strong, durable, resinous, lighter than longleaf and loblolly pines.

Representative Uses of Wood.

Lumber, construction, similar to longleaf pine.

Weight of Seasoned Wood in Pounds per Cubic Foot.

32 (U. S. Forestry Div.).*
30.

Modulus of Elasticity.

1,680,000 (average of 330 tests by U. S. Forestry Div.).*
1,950,000.

Modulus of Rupture.

10,100 (average of 330 tests by U. S. Forestry Div.).*
14,700.

Remarks.

Affords considerable pitch and turpentine, and is the principal species of Northern Arkansas, Kansas, and Missouri.

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* See page 8.

"Southern Pine." Mohr U. S. Forestry Circular No. 12.
"Timber Pines of Southern States." U. S. Forestry Bul. No. 13. (Mohr.)

Loblolly Pine. *Pinus tæda Linn.*

Nomenclature. (Sudworth.)

Old Field Pine.
Torch Pine.
Rosemary Pine.
Slash Pine.
Longshat Pine.
Longshucks.
Black Slash Pine.
Frankincense Pine.
Shortleaf Pine.
Bull Pine.
Virginia Pine.
Sap Pine.
Meadow Pine.
Cornstalk Pine (Va.).
Black Pine.
Foxtail Pine.
Indian Pine.
Spruce Pine.
Bastard Pine.
Yellow Pine.
Swamp Pine.
Longstraw Pine.
North Carolina Pine.

Locality.
Delaware to Florida and westward intermittently to Texas.

Features of Tree.
Fifty to one hundred feet or more in height, two to sometimes four feet in thickness. Leaves in twos and threes. Scales or cones have short straight spines. A large tree.

Color, Appearance, or Grain of Wood.
Resembles longleaf pine, but is variable. Coarse cross sections. Very wide annual rings (3 to 12 per inch).

Structural Qualities of Wood.
Resembles shortleaf pine. Selected pieces rank with longleaf pine.

Representative Uses of Wood.
Used with other Southern pines, inferior in uniformity, strength and durability.

Weight of Seasoned Wood in Pounds per Cubic Foot.
33 (U. S. Forestry Div.).*
33.

Modulus of Elasticity.
2,050,000 (average of 660 tests by U. S. Forestry Div.).*
1,600,000.

Modulus of Rupture.
11,300 (average of 650 tests by U. S. Forestry Div.).*
12,500.

Remarks.
Grows naturally on deforested land, whence the name of Old Field Pine. A source of abundant and cheap material. A vigorous, prolific grower, probably one of the pines of the future.

* See page 8.

Bull Pine, Yellow Pine, Western Yellow Pine.

Pinus ponderosa Laws.

Nomenclature. (Sudworth.)

Big Pine.
Longleaved Pine.
Red Pine.
Pitch Pine.
Southern Yellow Pine.
Heavy-wooded Pine.
Western Pitch Pine.
Heavy Pine (Calif.).
Foothills Yellow Pine.
Montana Black Pine.

Locality.

Rocky Mountains, westward intermittently to Pacific Ocean.

Features of Tree.

One hundred to sometimes three hundred feet in height, six to sometimes twelve feet in diameter. Thick, deeply furrowed bark. Leaves in tufts of threes.

Color, Appearance, or Grain of Wood.

Thin heartwood is light red, sapwood nearly white. Rather coarse grain, compact structure.

Structural Qualities of Wood.

Variable, heavy, hard, strong, brittle, not durable.

Representative Uses of Wood.

Lumber, railway ties, mine timbers, fuel, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

29.

Modulus of Elasticity.

1,260,000.

Modulus of Rupture.

10,200.

Remarks.

Ponderosa, signifying "heavy," refers to great size. Trees are often killed by beetles (*Dendroctonus ponderosæ*) and the wood of such trees later assumes a bright blue color, due to fungi introduced or enabled by the beetles. These "blue woods" can be used for some purposes. (Also see von Schrenk, U. S. Bureau Plant Industry No. 36.)

Pond Pine (*Pinus serotina*) is the Marsh Pine of the woodsman, but it is not distinguished at the mills where it really furnishes much of the lumber that is marked North Carolina Pine. The Pond Pine grows along the Atlantic Coast from Albermarle Sound south to Florida. It is almost constantly in sight of the railway trains. The six or eight inch long leaves are in tufts of three. The cones sometimes remain on the trees for several years. The trees are now bled for turpentine. Other names are Meadow, Loblolly, Spruce, Bastard, and Bull Pine. (Also see Roth Forestry Bulletin No. 13.)

Norway Pine, Red Pine. *Pinus resinosa Ait.*

Nomenclature. (Sudworth.)
Norway Pine, Red Pine (local and common names). Hard Pine (Wis.). Canadian Red Pine (Eng.).

Locality.
Southern Canada, northern United States from Maine to Minnesota, Pennsylvania.

Features of Tree.
Sixty to ninety feet in height, one to three feet in diameter. Reddish blossoms and bark on branchlets. Leaves in twos from long sheaths. A tall, straight tree.

Color, Appearance, or Grain of Wood.
Thin heartwood light red, sapwood yellow to white. Numerous pronounced medullary rays.

Structural Qualities of Wood.
Light, hard, elastic, not durable; resinous.

Representative Uses of Wood.
Piles, telegraph poles, masts, flooring, and wainscoting.

Weight of Seasoned Wood in Pounds per Cubic Foot.
31 (U. S. Forestry Div.).*
30.

Modulus of Elasticity.
1,620,000 (average of 100 tests by U. S. Forestry Division).*
1,600,000.

Modulus of Rupture.
9,100 (average of 95 tests by U. S. Forestry Div.).*
12,500.

Remarks.
Sometimes commercially handled with white pine. Unimportant as regards turpentine and resin, in spite of specific name, which signifies resinous. Long sheaths enable children to make chains of leaves.

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* See page 8.

The Monterey Pine (*Pinus radiata*) is best developed near Monterey, California, where it is often 100 feet high, symmetrical or distorted according to exposure. It is widely transplanted for landscape effects. The wood is occasionally cut into lumber.

The Digger, Grayleaf, Gray or Sabine Pine (*Pinus sabiniana*) of northern and central Californian foothills affords a poor and seldom-used wood. The nuts were prized by Digger Indians, whence the name. The tree-form is unusual; trunks are forked or divided, and the sparse grayish foliage is, for the most part, near the ends of the branches. The tree yields a turpentine used in medicine. (See "abietene," U. S. Dispensatory.)

The Scrub or Jack Pine (*Pinus divaricata*) of the North Central and Atlantic States yields a wood classed among lighter "hard pines" and chiefly used for ties and fuel. The species is hardy in some semi-arid regions where other pines will not grow. The Scrub or Jersey Pine (*Pinus virginiana*) grows from Manhattan Island south and west to Alabama and Tennessee. The inferior wood is used for fuel, water pipe and coarse lumber.

Pitch Pine. *Pinus rigida Mill.*

Nomenclature. (Sudworth.)

Pitch Pine (local and common name).
Longleaved Pine, Longschat Pine (Del.).
Hard Pine (Mass.).
Yellow Pine (Pa.).
Black Pine (N. C.).
Black Norway Pine.
Rigid Pine, Sap Pine.

Locality.

Atlantic coast, Canada to Georgia, Kentucky.

Features of Tree.

Forty to sometimes eighty feet in height, one to sometimes three feet in diameter. Rigid flattened leaves in threes from short sheaths.

Color, Appearance, or Grain of Wood.

Heartwood light brown or red, thick sapwood yellow to nearly white. Coarse conspicuous grain, compact structure, very resinous.

Structural Qualities of Wood.

Light, soft, not strong, brittle.

Representative Uses of Wood.

Coarse lumber, fuel, charcoal.

Weight of Seasoned Wood in Pounds per Cubic Foot.

32.

Modulus of Elasticity.

820,000.

Modulus of Rupture.

10,500.

Remarks.

Rigida refers to rigid leaves. The name "Pitch Pine" is sometimes applied to all of the Southern pines. The name is yet more widely applied in foreign markets. Sometimes called Fat Pine. The tree is hardy. It sometimes grows on rocks and sometimes over sea sands, binding them together. It will survive occasional overflows of sea water. Resins present to saturation, injure wood for constructions, while not themselves so good as resins from other species. Young trees sprout from stumps but do not always live long. The resistance to forest fires is surprisingly great.

Northern Pine, Scotch Pine, Dantzic Pine. *Pinus sylvestris Linn.*

Nomenclature.

Dantzic Fir (from place of shipment).
Rigi Fir (from place of shipment).
Memel Fir (from place of shipment).
Stettin Fir (from place of shipment).
Swedish Fir.
Scots or Scottish Fir.
Northern Fir.
Redwood, Yellowwood.
Deal (Local).

Locality.

Widespread in Europe, as Scotland, Germany, and Russia; also Asia. Naturalized in United States.

Features of Tree.

Fifty to one hundred feet in height, two to five feet in diameter; sometimes larger.

Color, Appearance, or Grain of Wood.

Heartwood reddish white to yellowish white, sapwood similar. Even straight grain (varies with locality).

Structural Qualities of Wood.

Moderately light, hard, tough, and elastic, easily worked (varies with locality).

Representative Uses of Wood.

Carpentry, construction, planks, beams, masts, heavy timber.

Weight of Seasoned Wood in Pounds per Cubic Foot.

34 (Lazlett *) (varies with locality).

Modulus of Elasticity.

1,680,000 (Lazlett) (varies with locality).
1,800,000 (Thurston).

Modulus of Rupture.

7000 (Thurston) (varies with locality).

Remarks.

Principal soft wood of Europe. Widely distributed; local peculiarities once thought to denote different species. Fields tributary to Dantzic and Rigi afford best wood. Wood "equal to Dantzic Fir" sometimes specified. The best European equivalent for White Pine is the Stone Pine (*Pinus cenbra*), said to best developed in Switzerland. It affords a smooth, fine-grained wood that is often seen in carving. The Bhotan Pine (*Pinus excelsa*) of the Himalayan region is the best representative in Asia. This wood resembles true white pine very closely, and the trees are similar in size and habit.

* Table CLXVII, p. 418.

KAURI PINE.

(*Dammara.*)

This New Zealand tree affords an excellent substitute for northern pine. Although not true pine, it belongs to the same family as the pine and other conifers. The light, strong, durable, elastic wood is obtainable in large-sized pieces suitable for masts. The tree is described as tall and very handsome. The tough leather-like leaves, about one inch in length, suggest those of the box. Fresh exudations resemble venice-turpentine. A fossil found on Martha's Vineyard has been quite positively identified as that of a Kauri Pine tree.

This species is universally noted for a resin that possesses the quality of uniting with linseed oil more perfectly at lower temperatures than most others employed in the manufacture of varnish. Kauri resin is thus one of the most valuable constituents of good varnish, and has sold for as much as one thousand dollars to fifteen hundred dollars a ton. The best resin occurs as a fossil, and is collected by digging over areas known to be fruitful, but from which trees have long since disappeared. The deposits of resins exist a few feet below the surface. The pieces, which vary in size from small pebbles to lumps as large as eggs, are scraped or otherwise cleansed by natives in the field. One mass of two hundred and twenty pounds weight has been reported.* There are also fresh-product and semi-fossil resins.

* This large mass is mentioned by R. Ingham Clark, F.R.G.S., in "Notes on Fossil Resins," published by C. Letts & Co., London.

Kauri Pine. *Dammara australis.*

Nomenclature.
Kauri Pine (local and general). Cowdie Pine (New Zealand and many localities).

Locality.
New Zealand.

Features of Tree.
Ninety to one hundred feet in height, three to four feet in diameter, occasional specimens much larger Small leaves resembling those of box. A tall handsome tree.

Color, Appearance, or Grain of Wood.
Heartwood straw-colored, fine, straight grain, with silky lustre suggesting satinwood. "Mottled kauri" is separated and used for cabinet work.

Structural Qualities of Wood.
Moderately hard, light, elastic, strong, seasons well, works readily, receives high polish, is quite free from knots, it stands well, wears evenly, and has an agreeable odor.

Representative Uses of Wood.
Carpentry, masts.

Weight of Seasoned Wood in Pounds per Cubic Foot.
33 (Lazlett *) (varies with locality).

Modulus of Elasticity.
1,810,000 (Lazlett).

Modulus of Rupture.

Remarks.
The species is widely known by reason of its resin.

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* Table CLXXI, p. 426.

A true gum dissolves in water, whereas a true resin yields to oil or spirit. The name resin is seldom used by varnish makers, and the name gum applies commercially to many substances that are actually resins. Varnish resins may be roughly divided as they unite with oil or spirit. Oil varnish differs from spirit varnish in that oil takes permanent place as part of the whole, whereas spirit simply dissolves the varnish ingredients and then evaporates from them. Kauri is one of the best of the oil-varnish resins. Shellac is an equally useful spirit-varnish resin. A varnish differs from a paint in that a varnish is a solution, whereas a paint is a mechanical mixture.

SPRUCE.

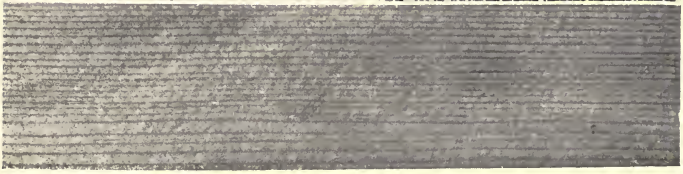
(*Picea.*)

The spruces form forests in Europe and North America. The black spruce (*P. nigra*) and the white spruce (*P. alba*) predominate in eastern United States, while the white spruce (*P. engelmanni*) is important in the West. The Norway spruce, or white fir (*P. excelsa*), is the chief European species. American trees prefer Northern ranges characterized by short summers and long winters. The red spruce (*Picea rubens*) is now, by reason of the diminution of the supply of white pine in northern New England, the most important timber tree of that district.

The soft, clean, light, close-grained, satiny woods resemble, and are the best Eastern substitutes for, white pine. Spruce is the principal structural wood in many places in New England. It is also used for paper pulp. The valuable western spruces are less familiar because of their distances from the best markets and because of other woods for which considerable demands have already been established. The eastern product is divided commercially and according to appearance, but irrespective of species, into white and black spruce. These terms depend sometimes, at least, on the wide and narrow rings of the black spruce (*P. nigra*). It should be remembered that spruce and fir woods are often confused with one another, and that there are trees, as the Douglas spruce and Kauri pine or spruce, that are called, but are not, true spruces. European spruce is often locally known as white deal.

Spruce trees have single, sharp-pointed, short leaves, pointing everywhere, and keeled above and below so as to appear four-sided; the cones hang down. Spruce may be distinguished from the pines, firs, and hemlocks by the fact that pine leaves are longer and in clusters, that hemlock leaves are flat, blunt, and two-ranked, and that fir cones point upward. The genus picea has twelve species, five of which are North American. The resins of the black and red spruce are used as confections.

PLATE 27. BLACK SPRUCE (*Picea nigra*).



The insect and fungus enemies of spruce trees cause great losses, and have received much attention.* Dead and fallen trunks are sometimes so numerous as to obstruct passage through the forest.† The largest and best trees seem most liable to attack. Dr. Hopkins states that the "spruce-destroying beetle" (*Dendroctonus piceaperla*) is accountable for much of this damage as accomplished in the East. These beetles gain entrance through crevices in the bark and cut grooves upon the sensitive outer sapwood. The resins that collect in the freshly cut tunnels are ejected by the beetle, and form what are known as "pitch tubes." These, together with the wood particles, serve to mark trees that have been recently attacked. There is an intimate connection between the attacks of insects and those of fungi. Fungi may lodge in and infect wounds that have been caused by insects. Von Schrenk associates many species of fungi with living and dead spruce trees. Much wood remains sound for some time after the physical death of the tree, and is clearly available for lumber and paper pulp.

The following table sets forth the primary distinctions between the spruces and the pines, firs, and hemlocks:

Names.	Arrangement of Leaves.	Shape of Leaves.	Cones.
Pines (*Pinus*).....	In tufts or clusters.	Comparatively long.	
Spruce (*Picea*)....	Single, scattered, point in all directions.	Short, sharp ends, keeled above and below. Somewhat four-sided.	Hang down, 1 to 6 inches long.
Fir (*Abies*).....	Single, scattered, appear somewhat as in two ranks.	Short, blunt ends, flat.	Stand erect, 2 to 4 inches long.
Hemlock (*Tsuga*)..	Single, scattered, appear as in two ranks.	Short, blunt ends, flat.	Hang down, ⅜ to 1 inch long.

* "Insect Enemies of Spruce in the Northeast" and "Insect Enemies of the Forests of the Northwest."—Hopkins, U. S. Div. Entomology, Bulletin 28 and 21; also "Diseases New England Conifers," von Schrenk, U. S. Div. Vegetable Physiology and Pathology, Bulletin No. 25.

† "Windfalls" may result from insects, fungi, age, or tornadoes. Trees are piled upon one another like jackstraws. Trunks and limbs intermingle and are sometimes penetrated by wiry, second-growth saplings. Passage through such a district is made by cautiously walking back and forth, up and down, over trunks and limbs. It is sometimes impossible to proceed more than two or three miles daily in a straight line. The writer was within sound of the creation of one windfall by tornado. Snow, "Transactions Am. Inst. Mining Engineers, 1899," also Pa. Dept. Agriculture, Third Annual Report. The term "Blow-down" is sometimes used.

Black Spruce. { *Picea nigra Link.* / *Picea mariana Mill.*

Nomenclature. (Sudworth.)

Spruce (Vt.), Yew Pine, Spruce Pine (W. Va.). Double Spruce (Me., Vt., Minn.). Blue Spruce (Wis.). White Spruce (W. Va.). He Balsam (Del., N. C.). Water Spruce (Me.).

Locality.

Pennsylvania to Minnesota, Alleghany Mountains to North Carolina. Best in Canada.

Features of Tree.

Forty to eighty feet in height, one to two feet in diameter. Conical shape with straight trunk. Dark foliage. Cones remain for several years, being thus distinct from white spruce.

Color, Appearance, or Grain of Wood.

Heartwood reddish, nearly white; sapwood lighter. Straight grain, compact structure.

Structural Qualities of Wood.

Light, soft, not strong, elastic, resonant. Not durable when exposed.

Representative Uses of Wood.

Lumber, flooring, carpentry, ship-building, piles, posts, railway ties, paddles, oars, "sounding-boards," paper-pulp.

Weight of Seasoned Wood in Pounds per Cubic Foot.

28.

Modulus of Elasticity.

1,560,000.

Modulus of Rupture.

10,600.

Remarks.

A substitute for soft pine. Resin is used as a confection.

The red spruce (*Picea rubens*) is the principal lumber spruce of northern New England. It is fifty to eighty feet high, and two or three feet in diameter. Large quantities of the light, close-grained, reddish, satiny wood are cut into lumber or used in the manufacture of paper pulp.

White Spruce. { *Picea alba Link.* / *Picea canadensis Mill.*

Nomenclature. (Sudworth.)

Single Spruce (Me., Vt., Minn.).
Bog Spruce, Cat Spruce (N. Eng.).
Skunk Spruce (Wis., New Eng.).
Spruce, Double Spruce (Vt.).
Pine (Hudson Bay).

Locality.

Northern United States, Canada to Labrador and Alaska.

Features of Tree.

Fifty to one hundred feet in height, one to two feet in diameter, occasionally larger. Compact, symmetrical, conical shape. Foliage lighter than black spruce. Cones fall sooner than those of black spruce. Whitish resin.

Color, Appearance, or Grain of Wood.

Heartwood light yellow, sapwood similar. Straight-grained, numerous prominent medullary rays. Compact structure.

Structural Qualities of Wood.

Light, soft, not strong (similar to Black Spruce).

Representative Uses of Wood.

Lumber, flooring, carpentry, etc. (similar to Black Spruce).

Weight of Seasoned Wood in Pounds per Cubic Foot.

25.

Modulus of Elasticity.

1,450,000.

Modulus of Rupture.

10,600.

Remarks.

Notable as resident of high latitudes. Chief tree of arctic forests. Wood, used similarly to black spruce, is substituted for white pine.

It is often difficult to distinguish between black and white spruce trees. The foliage of the former is darker as a whole, and there are differences in shape and persistence of cones. The names double spruce and single spruce are without evident foundation. Woods exhibit similar qualities and are classed together by lumbermen.

White Spruce. *Picea engelmanni Engelm.*

Nomenclature. (Sudworth.)
White Spruce (Ore., Col., Utah, Idaho).
Balsam, Engelmann's Spruce (Utah).
White Pine (Idaho), Mountain Spruce (Mont.).

Locality.
Rocky Mountain region, Montana to Mexico, Washington, Oregon, and British Columbia (high elevations).

Features of Tree.
Frequently seventy-five to one hundred feet in height and sometimes higher, two to three feet in diameter, sometimes low shrub.

Color, Appearance, or Grain of Wood.
Heartwood pale reddish yellow, sapwood similar. Close, straight grain, compact structure, conspicuous medullary rays.

Structural Qualities of Wood.
Light, soft, not strong.

Representative Uses of Wood.
Lumber, charcoal, fuel. Bark rich in tannin, sometimes used for tanning.

Weight of Seasoned Wood in Pounds per Cubic Foot.

21.

Modulus of Elasticity.

1,140,000.

Modulus of Rupture.

8100.

Remarks.
Notable as resident of high altitudes, extensive forests occurring at eight to ten thousand feet above sea-level. A valuable tree of the central and southern Rocky Mountain region.

Sitka Spruce. *Picea sitchensis Trautv. and Mayer.*

Nomenclature. (Sudworth.)

Sitka Spruce (local and common name).	Menzies Spruce.
Tideland Spruce (Cal., Oreg., Wash.).	Western Spruce.
	Great Tideland Spruce.

Locality.
Pacific coast region, Alaska to central California. Extends inland about fifty miles; prefers low elevations.

Features of Tree.
One hundred and fifty feet or more in height, three feet or more in diameter. Flat-pointed pyramidal needles, oval cylindrical cones, thick scaly reddish-brown bark.

Color, Appearance, or Grain of Wood.
Heartwood light reddish brown, sapwood nearly white. Coarse-grained, satiny.

Structural Qualities of Wood.
Light, soft, not strong.

Representative Uses of Wood.
Construction, interior finish, fencing, boat-building, cooperage.

Weight of Seasoned Wood in Pounds per Cubic Foot.

2626.

Modulus of Elasticity.

Modulus of Rupture.

10,400.

Remarks.
A giant among spruces. Forms an extensive coast-belt forest.

DOUGLAS FIR, DOUGLAS SPRUCE OR RED FIR.

(*Pseudotsuga.*)

This species affords the "hard pine" of the Pacific Coast. The trees, among the most important of the West, form almost pure forests in western Washington and Oregon where they are best developed. They grow at high altitudes, as in Colorado: specimens are found in Texas and Mexico, and isolated experiments have succeeded in the Adirondacks.

The wood suggests true hard pine or larch in properties, appearance and applications. It is almost wholly heartwood, with pronounced yearly rings, and is of a yellow or light red color. It is strong, stiff, durable, and often difficult to work; it is the heavy construction wood of its vicinity; while the possibility of easily obtaining such material in pieces two feet square and one hundred feet long renders it one of the principal dimension timbers of the world. Douglas fir is employed in heavy constructions for posts, poles, piles, masts, railway ties, lumber, flooring, finish and fuel. Lumbermen recognize "red" and "yellow" varieties. The former, derived from younger trees, is coarser and less valuable. Douglas fir wood is marketed under the names of Oregon, hard and Pacific pine, red fir, red spruce, yellow fir, etc. The trees, among the greatest known to man, are said to have reached heights of three hundred and fifty feet and diameters of ten or twelve feet. They are very hardy, and, like redwoods, likely to survive commercial extinction. The bark, which is sometimes two feet thick, is rich in tannin.

The tree, although known as Oregon Pine and Douglas Fir, is neither true pine nor fir but a sort of bastard hemlock. The name pseudotsuga is from *pseudo* or false and *tsuga* or hemlock. The species was earlier classed as Pinus taxifolia and Abies taxifolia. Some notes respecting the difficulties connected with the nomenclature of this species are on pages 23 and 24 of Sudworth's Check List. The genus has three species. The much less important Big Cone Spruce (*Pseudotsuga macrocarpa*) of California yields inferior wood.

PLATE 28. DOUGLAS SPRUCE (*Pseudotsuga taxifolia*).

Douglas Spruce, Douglas Fir. { *Pseudotsuga taxifolia Lam.* / *Pseudotsuga Douglasii Carr.*

Nomenclature. (Sudworth.)

Oregon Pine (Cal., Wash., Oreg.).
Red Fir, Yellow Fir (Oreg., Wash., Idaho, Utah, Mont., Col.).
Douglas Tree, Cork-barked Douglas Spruce.
Spruce, Fir (Mont.).
Red Pine (Utah, Idaho, Col.).
Puget Sound Pine (Wash.).

Locality.

Pacific coast region, Mexico to British Columbia. Best in western Oregon and Washington.

Features of Tree.

One hundred and seventy-five to sometimes three hundred feet in height, three to five and sometimes ten feet in diameter. Older bark rough-gray, often looking as though braided.

Color, Appearance, or Grain of Wood.

Heartwood light red to yellow, scant sapwood nearly white. Comparatively free from resins, pronounced variable rings (four to forty per inch).

Structural Qualities of Wood.

Variable, usually hard, strong, difficult to work, durable. Splits easily.

Representative Uses of Wood.

Heavy construction, dimension timbers, railway ties, piles, fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

32 (U. S. Forestry Div.).*
36 (average of 20 specimens by Soulé).†
32.

Modulus of Elasticity.

1,680,000 (average of 41 tests by U. S. Forestry Div.).*
1,862,000 (average of 21 specimens by Soulé).†
1,824,000.

Modulus of Rupture.

7,900 (average of 41 tests by U. S. Forestry Div.).*
9,334 (average of 21 specimens by Soulé).†
12,500.

Remarks.

Used similarly to hard pine. Lumbermen divide into red and yellow woods, the former dark and coarse, the latter fine, lighter, and more desirable. These distinctions probably due to age. One of the world's greatest trees.

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* See page 8.

† Professor Frank Soulé, University of California. Trans. Am. Inst. M. E., p. 552, Vol. XXIX.

FIR.

(*Abies.*)

Several of the fir-trees of the western United States attain to very great size. The silver fir (*Abies grandis*) and the white fir (*Abies concolor*) supply much wood in the section in which they grow. The balsam fir (*Abies balsamea*) of the Eastern States is of some commercial importance.

Fir wood resembles spruce in appearance and in structural qualities. It may be told from spruce as well as from pine and larch by the fact that fir has no resin-ducts. The balsam fir is distinguishable by clear liquid resin which appears in blisters in the bark. The coarse, weak wood is cleaner than the bark would indicate. Spruce and fir woods are often confused in the United States, while pine, spruce, and fir are similarly confounded in Europe. The great sizes often attained by Western Species rank them with Redwoods, Douglas Firs and Giant Cedars as needing special logging methods.* Platforms are arranged so that large trees can be cut through, far up from the ground, where defects common near the roots are excluded. Trees are felled so as to strike uniformly along most of their lengths as otherwise the wood would break or splinter. These large logs are gathered or "yarded" by engines so powerful as to operate against all usual obstructions, and the logs finally leave the forests, moved by endless cables, over roads termed skidways. Steam is employed and the processes involve many features not usual in Eastern fields.

BALSAM FIR (*Abies balsamea*).

Fir trees have flat, scattered, evergreen leaves, and cones that stand erect (see footnote under spruce).

* Bishop, "Engineering Magazine," Vol. XIII, p. 70; Gannett, "National Geographic Magazine," Vol. X, No. 5, May, 1899.

Balsam Fir, Common Balsam Fir. *Abies balsamea Mill.*

Nomenclature. (Sudworth.)
Balsam (Vt., N. H., N. Y.).
Fir Tree (Vt.).
Balm of Gilead (Del.).
Canada Balsam (N. C.).
Balm of Gilead Fir (N. Y., Pa.).
Blister Pine, Fir Pine (W. Va.).
Single Spruce, Silver Pine (Hudson Bay).

Locality.
Minnesota to Virginia, northward intermittently into Canada.

Features of Tree.
Fifty to seventy feet in height, one to two feet in diameter. Sometimes low shrub. Blisters in smooth bark contain thick balsam. Erect cones.

Color, Appearance, or Grain of Wood.
Heartwood white to brownish, sapwood lighter. Coarse-grained, compact structure, satiny.

Structural Qualities of Wood.
Soft, light, not durable or strong, resinous, easily split.

Representative Uses of Wood.
Occasionally used as inferior lumber.

Weight of Seasoned Wood in Pounds per Cubic Foot.

23.

Modulus of Elasticity.

1,160,000.

Modulus of Rupture.

7300.

Remarks.
Scattered throughout Northern pineries. Cut when of sufficient size and sold with pine or spruce. Cultivated in gardens. Exudations known as Canada Balsam used in medicine. The poplar (P. balsamifera) is also called Balm of Gilead.

Great Silver Fir, White Fir. *Abies grandis Lindl.*

Nomenclature. (Sudworth.)
Silver Fir (Mont., Idaho). Yellow Fir (Mont., Idaho).
Oregon White Fir, Western White Fir (Cal.). Lowland Fir.

Locality.
Vancouver region, northwestern United States. Best in west Washington and Oregon.

Features of Tree.
Two hundred to sometimes three hundred feet in height, two to five feet in diameter. Leaves deep green above, silvery below, usually curved. A handsome tree.

Color, Appearance, or Grain of Wood.
Heartwood light brown, sapwood lighter. Coarse-grained, compact structure.

Structural Qualities of Wood.
Light, soft, not strong.

Representative Uses of Wood.
Lumber, interior finish, packing-cases, cooperage.

Weight of Seasoned Wood in Pounds per Cubic Foot.

22.

Modulus of Elasticity.

1,360,000.

Modulus of Rupture.

7000.

Remarks.
Forms important part of local mountain forests and furnishes much lumber locally. Best on rich bottom lands, but found at altitudes of five thousand and six thousand feet. The balsam secreted in blisters on young bark is used in medicine. Grandis refers to the great stature of the tree.

White Fir, Balsam Fir. *Abies concolor Parry.*

Nomenclature. (Sudworth).

Silver Fir, Balsam (Cal.).
California White Fir (Cal.).
Black Gum, Bastard Pine (Utah).
White Balsam (Utah).
Balsam Tree (Idaho).
Colorado White Fir, Concolor White Fir.

Locality.

Rocky Mountains and coast ranges, high elevations.

Features of Tree.

Seventy to one hundred and fifty feet in height, three to five feet in diameter. Pale green or silvery foliage. Bark blisters filled with clear pitch.

Color, Appearance, or Grain of Wood.

Heartwood light brown to nearly white, sapwood same or darker. Coarse-grained, compact structure.

Structural Qualities of Wood.

Light, soft, not strong, without odor.

Representative Uses of Wood.

Butter-tubs, packing-boxes, lumber.

Weight of Seasoned Wood in Pounds per Cubic Foot.

22.

Modulus of Elasticity.

1,290,000.

Modulus of Rupture.

9900.

Remarks.

Not always distinguished from the species Abies grandis.

Red Fir. *Abies magnifica Murr.*

Nomenclature. (Sudworth.)
California Red Fir, California Red-bark Fir (Cal.). Magnificent Fir, Golden Fir (Cal.). Shasta Fir (Cal.).

Locality.
California, vicinity of Mount Shasta.

Features of Tree.
One hundred to two hundred and fifty feet in height, six to ten feet in diameter. Large erect cones. Beautiful form.

Color, Appearance, or Grain of Wood.
Heartwood reddish, sapwood distinguishable. Rather close-grained, compact structure.

Structural Qualities of Wood.
Light, soft, not strong, durable when exposed, liable to injury in seasoning.

Representative Uses of Wood.
Construction, sills, lumber, fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

29.

Modulus of Elasticity.

940,000.

Modulus of Rupture.

9900.

Remarks.
Magnifica or magnificent refers to appearance and size of tree.

Red Fir, Noble Fir. *Abies nobilis Lindl.*

Nomenclature. (Sudworth.)
Noble Silver Fir, Noble Red Fir. Bigtree, Feather-cone, Red Fir (Cal.).
Larch (Oreg.).

Locality.
Northwestern United States. Cultivated in East.

Features of Tree.
One to two hundred feet in height, six to nine feet in diameter. Leaves curved. Large, beautiful tree.

Color, Appearance, or Grain of Wood.
Heartwood reddish brown, sapwood darker. Rather close-grained, compact structure.

Structural Qualities of Wood.
Light, hard, strong, elastic.

Representative Uses of Wood.
Fitted for house-trimmings.

Weight of Seasoned Wood in Pounds per Cubic Foot.

28.

Modulus of Elasticity.

1,800,000.

Modulus of Rupture.

22,200.

Remarks.
Grows at high elevations (3000 and 4000 feet). With other fir forms extensive forests. Sold as larch.

Peters, "Forestry and Irrigation," Vol. VIII, No. 9 (Sept. 1902), pp. 362, 366.

HEMLOCK.

(*Tsuga.*)

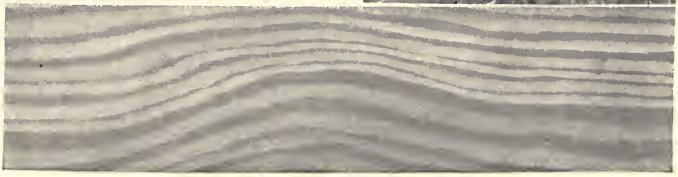
The hemlocks are distributed over northern United States from Maine to Michigan, in the Rocky Mountains, and on the Pacific coast. They generally mingle with broad-leaved and other needle-leaved species, but occasionally form pure forests by themselves.

The wood is coarse, often crossed-grained, perishable, brittle, liable to wind-shakes, hard to work, and apt to warp and splinter. It holds nails firmly and is used for coarse lumber, dimension pieces, paper-pulp, and latterly for cheap finish. It should not be relied upon to receive shocks. The bark is used in tanning. A prejudice has existed against hemlock. This is because hemlock was originally compared with white pine, spruce and fir. The decrease in the supply of better woods has increased the importance of hemlock.

Western hemlock (*Tsuga heterophylla*) has suffered because of the reputation of Eastern hemlock (*Tsuga canadensis*). It is a better wood, stronger and quite free from warp and shake. Western hemlock is sometimes effected by black streaks about three fourths of an inch broad and three inches long. These are with the grain, and are therefore very evident save in cross sections. Hemlock discolored in this way is sometimes known as "Black Hemlock." True Black or Alpine hemlock (*Tsuga mertensiana*) grows at high altitudes (around 10,000 feet), and in the far north and has not yet been cut. Western hemlock is made into boxes, floors, mill frames and paper pulp. It has a pronounced odor and is seldom attacked by insects or rodents; it is good for grain bins. The wood is seldom sold under its true name, but is marketed as second grade "red fir" or the like. The name "Alaska pine" has been suggested to avoid the influences of prejudice. Trees are very vigorous and it is probable that the wood will become better known.

Hemlock trees may be known by their blunt, flat, evergreen leaves, appearing two-ranked and whitened beneath (see footnote under spruce) and by the red inner bark.

PLATE 29. HEMLOCK (*Tsuga*).



Hemlock Tree (*Tsuga canadensis*). Western Hemlock Tree (*T. heterophylla*)
Hemlock Foliage (*Tsuga canadensis*). (6500 feet above sea-level.)
Hemlock Wood (*Tsuga canadensis*).

Hemlock. *Tsuga canadensis.*

Nomenclature. (Sudworth.)

Hemlock (local and common name).
Spruce (Pa., W. Va.).
Hemlock Spruce (Vt., R. I., N. Y., Pa., N. J., W. Va., N. C., S. C.).
Spruce Pine (Pa., Del., Va., N. C., Ga.).

Locality.

Eastern and central Canada, southward to North Carolina and Tennessee.

Features of Tree.

Sixty to eighty or more feet in height, two or three feet in diameter. Short leaves, green above and white beneath. Straight trunk, beautiful appearance.

Color, Appearance, or Grain of Wood.

Heartwood reddish brown, sapwood distinguishable. Coarse, pronounced, usually crooked grain.

Structural Qualities of Wood.

Light, soft, not strong or durable, brittle, difficult to work, retains nails firmly, splintery.

Representative Uses of Wood.

Coarse lumber, joists, rafters, plank walks, laths, railway ties.

Weight of Seasoned Wood in Pounds per Cubic Foot.

26.

Modulus of Elasticity.

1,270,000.

Modulus of Rupture.

10,400.

Remarks.

Canadensis refers to Canada, the locality where tree excels.

The Southern or Carolina Hemlock (*T. caroliniana*) resembles Hemlock. The Western Hemlock (*T. heterophylla*, Alaska to California) attains height of 180 feet, diameter of 9 feet, and is said to afford heavier and better wood. This tree is known by the following names (Sudworth):

Western Hemlock, Hemlock Spruce (Cal.).
Hemlock (Oreg., Idaho, Wash.).
Alaska Pine (Northwestern Lumberman).
Prince Albert's Fir, Western Hemlock Fir, California Hemlock Spruce (England).

"The Western Hemlock." Allen, U. S. Forestry Bureau Bulletin No. 33.

LARCH. TAMARACK.

(*Larix.*)

Larch was well known in the olden time, and was prized in Europe and the Orient. The two principal American species are also called tamarack and hackmatack. The Eastern larch or tamarack (*L. americana*) prefers peculiar low, wet areas known as tamarack swamps. The Western tree (*L. occidentalis*) resembles the European species and prefers dry places. Although trees can exist in very wet swamps they do not do as well as where moisture conditions are less excessive. A tree required forty-eight years to reach a diameter of two inches under the first condition, while another tree was eleven inches thick at the end of thirty-eight years, where there was less water.

Larch wood has always been regarded as very durable. It is noted by Pliny and other ancient authors.* Vitruvius mentions a bridge that, having burned, was replaced by one of larch, because that wood would not burn as readily.† The foundation-piles of Venice are said to be of larch.‡ It should be remembered that the identities of ancient woods are not always beyond question. American larch resembles, if it does not equal, true foreign wood. The trees are tall and straight, but so slender as to be seldom cut into lumber, almost the entire supply being demanded for posts, ties, and poles. The exceedingly durable wood resembles spruce in structure, and hard pine in weight and appearance.

Larch trees are marked by the fact that their foliage is deciduous. The little leaves, gathered in tufts or bundles, are of a bright pea-green when fresh in the springtime. The appearance of tamarack trees when divested of foliage in the winter is very gloomy. All larch trees tolerate less water than occurs in most larch swamps. Trees are vigorous growers. The genus deserves more attention. Larix is from a Celtic word *Lar*, meaning fat.

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* Pliny, XVI, 43–49 and XVI, 30.

† Vitruvius, II, 9.

‡ Encyclopædia Britannica, Vol. XIV, p. 310. Also Forestry in Minn., Green.

Larch Trees in Winter.

Tamarack, Larch. { *Larix americana Michx.* / *Larix laricina* (*Du Roi*) *Koch.*

Nomenclature. (Sudworth.)

Tamarack, Larch, American Larch (local and common names).
Hackmatack (Me., N. H., Mass., R.I., Del., Ill., Mich.)
Black Larch, Red Larch (Minn., Mich.).
Juniper (Me., Canada).

Locality.

Northern United States and southern Canada, east from Great Lakes.

Features of Tree.

Seventy to ninety feet high, one to three feet in diameter. Short pea-green deciduous leaves in tufts. A slender tree, winter aspect gloomy.

Color, Appearance, or Grain of Wood.

Heartwood light brown, sapwood nearly white. Coarse conspicuous grain, compact structure, annual layers pronounced.

Structural Qualities of Wood.

Heavy, hard, very strong, durable, resembles spruce.

Representative Uses of Wood.

Railway ties, fence-posts, sills, ship timbers, telegraph poles, flagstaffs, etc.

Weight of Seasoned Wood in Pounds per Cubic Foot.

38.

Modulus of Elasticity.

1,790,000.

Modulus of Rupture.

12,800.

Remarks.

Practically all (tall thin) trunks required for railway ties, posts, masts, etc.: seldom cut into lumber in consequence. Grows in light swamps often extensive and known as tramarack swamps. (Trans. Am. Inst. Mining Engineers, Vol. XXIX, page 157.) Lumbermen note two varieties, red and white Tamarack. The distinction, based upon the color of the heartwood, is probably due to differences in age. Red-hearted logs make the more durable lumber.

Tamarack, Larch. *Larix occidentalis.*

Nomenclature. (Sudworth.)

Tamarack, Larch (local and common names).
Hackmatack (Idaho, Wash.).
Western Larch, Great Western Larch, Red American Larch.
Western Tamarack (Cal.).

Locality.

Washington and Oregon, intermittently to Montana.

Features of Tree.

Ninety to one hundred and twenty-five feet high, two and one-half to four feet in diameter. A large tree.

Color, Appearance, or Grain of Wood.

Heartwood light red, thin sapwood lighter. Coarse-grained, compact structure, annual rings pronounced.

Structural Qualities of Wood.

Hard, heavy, strong, durable.

Representative Uses of Wood.

Posts, railway ties, fuel, limited quantity of lumber, similar to L. americana.

Weight of Seasoned Wood in Pounds per Cubic Foot.

46.

Modulus of Elasticity.

2,300,000.

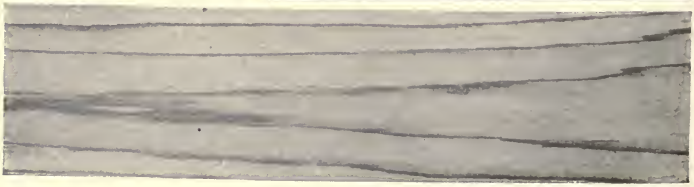
Modulus of Rupture.

17,400.

Remarks.

A valuable tree of the Columbian basin. Differs from L. americana in that it grows on dry ground, often at high elevations.

The European Larch (*Larix europæa*) is a native of Central Europe. The trees thrive upon dry soil and are used in American landscape work. They are good needleleaf trees to plant near houses because they lose their leaves during the winter. The wood is similar to that obtained from American species. The European larch yields the Venice turpentine of commerce. This substance, once collected through Venetian markets, is now largely drawn from America.



Cedar of Lebanon (*Cedrus libani*).
Red Cedar Bark (*Juniperus virginiana*).
White Cedar Wood (*Thuya occidentalis*).
Foliage of White Cedar (*T. occidentalis*).
Foliage of Red Cedar (*J. virginiana*).
Tree of Red Cedar (*J. virginiana.*).

CEDAR.

(*Cedrus, Thuya, Chamæcyparis, Libocedrus, Juniperus.*)

Cedar was a name first applied to the true or Lebanon cedars (*Cedrus*) of the Eastern continent, but later to certain Arborvitæs (*Thuya*), Junipers (*Juniperus*), and Cypresses (*Chamæcyparis*), and other trees (see "Spanish Cedar," page 128) from which durable, fine-grained, more or less fragrant woods, known as cedar, are obtained. Cedar was highly prized by the ancients, who employed it in costly constructions, such as the temples of Solomon and of Diana at Ephesus.*† Woods known as cedar are divided into so-called Red and White Cedars.

Red Cedar is very fine-grained, soft, light, durable, fragrant, and of a pinkish-red color. Much wood is derived from the Red Cedars, *Juniperus virginiana*, *Juniperus scopulorum*, and *Juniperus barbadensis*, of the Eastern, Western, and Southern States respectively. Although seen in construction, red cedar is chiefly used in chests, closets, lead-pencils, and cigar-boxes. One hundred and twenty-five thousand trees (125,000)‡ are annually required for lead-pencils alone. The waste is often converted into shavings and used instead of camphor to protect woolens. The demand is greater than the supply. Trees are easily grown on almost any soil. Trees and wood are subject to fungus diseases which apparently cease after trees have been felled; the wood is then durable.§

White Cedar is best defined as all cedar that is not "red

* It is probable that the ancients also used the word Cedar somewhat generally.

† Pliny, 16, 213 and 16, 216.

‡ Notes on Red Cedar, Mohr. Bul. 31, U. S. Division Forestry (Gifford Pinchot, Forester).

§ Several of the fungoid parasites cause swellings known as "cedar apples." The branches usually die. Professor von Schrenk recognizes two diseases of the wood, white rot (*Polyporus juniperus* Schrenk) and red rot (*Polyporus carneus*). (Bulletin No. 21, Division Vegetable Physiology and Pathology, U. S. Dept. Agriculture.)

cedar," and is obtained from several valuable trees.* The arborvitæs (*T. occidentalis*) vary in size from large bushes used in hedging and ornamentation to small-sized trees gathered for wood. They are most vigorous on cold, wet areas known as cedar swamps.† The giant arborvitæ (*T. gigantea*), noted for its great girth, and the yellow and Lawson Cypresses, are important Pacific coast species. The incense cedar, while much subject to fungus trouble, is also prized.‡ White cedar wood is durable, plentiful, and employed in exposed positions as ties and shingles.

Arborvitæs (*Thuya*) have very small overlapping leaves that form flat rods or fan-like sprays. The cones are oblong, less than one-half inch in length, and all of their six or eight scales separate or open when ripe. The cypresses (*Chamæcyparis*) exhibit similar foliage, but their tiny cones are simple, roughened, close, or solid globules. The Junipers (*Juniperus*) often, but not always, bear bluish-black berries powdered with a whitish-blue bloom. The true cedars (*Cedrus*) differ from the others in that they have simple needle leaves, an inch, more or less, in length, together with cones erect and several inches in length. The Deodar or cedar of India is of this genus. The principal American red and white cedars are as follows:

Red Cedar.	White Cedar.
Red Cedar (*Juniperus virginiana*).	Arborvitæ (*Thuya occidentalis*).
Red Cedar (*Juniperus scopulorum*).	Canoe Cedar (*Thuya gigantea*).
Red Cedar (*Juniperus barbadensis*).	White Cedar (*Chamæcyparis thyoides*).
	Port Orford Cedar (*Chamæcyparis lawsoniana*).
	Yellow Cedar (*Chamæcyparis nutkaensis*).
	Incense Cedar (*Libodecrus decurrens*).

Spanish Cedar. (See page 128.)

* Heartwood often light grayish brown.

† Trunks of considerable size often grow surrounding, but apart from, such swamps. Vigorous lower branches impede progress through swamps, which are often as thick as to resemble immense cultivated hedges. (Trans. Am. Inst. M. E., Vol XXIX, p. 157.)

‡ Von Schrenk, Contribution No. 14, Shaw School of Botany, St. Louis.

Red Cedar. . *Juniperus virginiana Linn.*

Nomenclature. (Sudworth.)

Red Cedar (local and common name).
Cedar (Conn., Pa., N. J., S. C., Ky., Ill., Ia., Ohio).
Pencil Cedar, Cendre (La.).
Savin (Mass., R. I., N. Y., Pa., Minn.).
Juniper, Red Juniper, Juniper Bush (local).

Locality.

Atlantic coast, Canada to Florida, westward intermittently to Mississippi River in the North, and Colorado River in the South.

Features of Tree.

Fifty to eighty feet in height, two to three feet in diameter. Sometimes low shrubs. Dark-green foliage, loose ragged outer bark.

Color, Appearance, or Grain of Wood.

Heartwood dull red, thin sapwood nearly white. Close, even grain, compact structure, annual layers easily distinguishable.

Structural Qualities of Wood.

Light, soft, weak, brittle, easily worked, durable, fragrant.

Representative Uses of Wood.

Ties, sills, posts, interior finish, pencil-cases, chests, cigar-boxes.

Weight of Seasoned Wood in Pounds per Cubic Foot.

30.

Modulus of Elasticity.

950,000.

Modulus of Rupture.

10,500.

Remarks.

Fragrance of wood utilized as insecticide. The Western Red Cedar (*J. scopulorum*) and the Southern Red Cedar (*J. barbadensis*) afford similar wood. Live trees (*Juniperus virginiana*) are sometimes attacked by fungi similar to those associated with living cypress and incense cedar trees. The disease stops with felling, and pitted boards have been known to last for over fifty years.—Also see von Schrenk, Contribution 44, Shaw School of Botany, also Two Diseases of Red Cedar, U. S. Division Vegetable Physiology and Pathology, Bul. 21, Mohr, U. S. Forestry Bulletin No. 31.

Juniper. *Juniperus occidentalis Hook.*

Nomenclature. (Sudworth.)
Juniper (Oreg., Cal., Col., Utah, Nev., Mont., Idaho, N. M.). Cedar, Yellow Cedar, Western Cedar (Idaho, Col., Mont.). Western Red Cedar, Western Juniper (local).

Locality.
California, Washington, and Oregon.

Features of Tree.
Twenty-five to fifty feet in height, two to four feet in diameter, often smaller. Long straight trunk in West.

Color, Appearance, or Grain of Wood.
Heartwood reddish-brown, sapwood nearly white. Very close-grained, compact structure.

Structural Qualities of Wood.
Light, soft, durable, receives high polish.

Representative Uses of Wood.
Fencing, railway ties, posts, and fuel.

Weight of Seasoned Wood in Pounds per Cubic Foot.

35.

Modulus of Elasticity.

Modulus of Rupture.

Remarks.
Rarely found below an altitude of 6000 feet. Fruit said to be eaten by Indians.

The California Juniper (*Juniperus californica*) occurs intermittently in some districts near the California coast. It is often small, but is sometimes as much as thirty or forty feet in height and one or two feet in diameter. The bark is shaggy and gray. There are wide, gnarled branches. It is said that the berries are edible. The soft, close-grained, fragrant, durable wood has been applied to minor purposes.

White Cedar, Arborvitæ. *Thuya occidentalis Linn.*

Nomenclature. (Sudworth.)

White Cedar, Arborvitæ (local and common names).
Cedar (Me., Vt., N. Y.).
Atlantic Red Cedar (Cal.).
Vitæ (Del.).

Locality.

Northern States eastward from Manitoba and Michigan. Northward, also occasionally southward, as in mountain region of North Carolina and eastern Tennessee.

Features of Tree.

Thirty to sixty feet high, one to three feet or more in diameter, often smaller. Bruised leaves emit characteristic pungent odor, rapidly tapering trunk.

Color, Appearance, or Grain of Wood.

Heartwood light brown, darkening with exposure, thin sapwood, nearly white. Even, rather fine grain, compact structure.

Structural Qualities of Wood.

Soft, light, weak, brittle, durable, inflammable. Permits spikes to work loose.

Representative Uses of Wood.

Railway ties, telegraph poles, posts, fencing, shingles, and boats.

Weight of Seasoned Wood in Pounds per Cubic Foot.

19.

Modulus of Elasticity.

750,000.

Modulus of Rupture.

7200.

Remarks.

Trunks so shaped as to be seldom sawn for lumber. Often used for telegraph or other poles, or else thin upper ends are used for posts, and lower section flattened into ties. The wood is remarkably durable. Hough mentions a prostrate cedar tree, over the trunk of which, a hemlock, exhibiting one hundred and thirty yearly rings had taken root. The cedar had been in contact with the ground for at least that time. Much of the wood of this tree was yet sound and much was eventually cut into shingles.

Canoe Cedar, Arborvitæ, Giant Arborvitæ. { *Thuya plicata Don.* / *Thuya gigantea Nutt.*

Nomenclature. (Sudworth.)
Canoe Cedar, Giant Arborvitæ (local and common names). Red Cedar, Giant Red Cedar, Pacific Red Cedar (Wash., Oreg., Cal., Idaho). Cedar, Giant Cedar, Western Cedar (Oreg., Cal.). Shinglewood (Idaho).

Locality.
Coast region, California to Alaska, Idaho to Montana.

Features of Tree.
One hundred to two hundred feet in height, two to eleven feet in diameter. Four-sided leaves closely overlapping in sprays.

Color, Appearance, or Grain of Wood.
Heartwood dull reddish brown, thin sapwood nearly white. Coarse-grained, compact structure, annual layers distinct.

Structural Qualities of Wood.
Soft, weak, light, brittle, easily worked, very durable.

Representative Uses of Wood.
Shingles, fencing, cooperage, interior finish, canoes (coast Indians).

Weight of Seasoned Wood in Pounds per Cubic Foot.

23.

Modulus of Elasticity.

1,460,000.

Modulus of Rupture.

10,600.

Remarks.
Large trees are often hollow at the bottom.

White Cedar. *Chamæcyparis thyoides L.*

Nomenclature. (Sudworth.)

White Cedar (local and common name). Post Cedar, Swamp Cedar (Del.). Juniper (Ala., N. C., Va.).

Locality.

Maine to Florida, Gulf coast to Mississippi, best in Virginia and North Carolina.

Features of Tree.

Sixty to eighty feet in height, three to four feet in diameter. Shaggy rugged bark. A graceful tree.

Color, Appearance, or Grain of Wood.

Heartwood pinkish to darker brown, sapwood lighter. Close-grained, compact structure, conspicuous layers.

Structural Qualities of Wood.

Very light, soft, not strong, extremely durable in exposed positions, fragrant, easily worked.

Representative Uses of Wood.

Boats, railway ties, fencing, poles, posts, shingles.

Weight of Seasoned Wood in Pounds per Cubic Foot.

23 (U. S. Forestry Div.).
20.

Modulus of Elasticity.

910,000 (average of 87 tests by U. S. Forestry Div.).
570,000.

Modulus of Rupture.

6310 (average of 87 tests by U. S. Forestry Div.).
6400.

Remarks.

Grows chiefly in swamps. "White cedar posts" last many years. Thyoides is from Thuya meaning arborvitæ and eidos, the Greek for "resemblance."

The shallow-water timber swamp is very formidable. The "white cedar swamp" of the Lake Superior region, for example, is covered by growth with vigorous branches close down by the ground. These meet and cross so that passage resembles progress through a cultivated hedge. The roots lie partly out of water and, while apparently sound, are slippery and sometimes decayed, so that pedestrians stepping or springing from one to another, encumbered by burdens and obstructed by wiry branches, are apt to slip and fall. The constant use of arms and limbs with shocks caused by the shifting of "packs" during falls and the annoying insects, require strength and patience. Such northern swamps can best be penetrated during winter. The so-called tamarack swamp of the north differs in that there is an absence of under branches. The cypress is the characteristic swampland tree of the South.

Port Orford Cedar, Lawson Cypress.

Chamæcyparis lawsoniana Murr.

Nomenclature. (Sudworth.)
White Cedar, Oregon Cedar (Oreg., Cal.). Ginger Pine (Cal.).

Locality.
Pacific coast, California and Oregon.

Features of Tree.
One hundred to sometimes two hundred feet in height, four to twelve (?) feet in diameter. Leaves overlapping in sprays, very small cones one-fourth inch in diameter.

Color, Appearance, or Grain of Wood.
Heartwood yellowish white, sapwood similar. Very close-grained.

Structural Qualities of Wood.
Light, hard, strong, durable, easily worked, fragrant, resinous.

Representative Uses of Wood.
Lumber, flooring, interior finish, ties, posts, matches, ship-building.

Weight of Seasoned Wood in Pounds per Cubic Foot.

28.

Modulus of Elasticity.

1,730,000.

Modulus of Rupture.

12,600.

Remarks.
Resin employed as insecticide.

Yew (*Taxus*) is a close-grained wood that suggests cedar, but it is tough like hickory. It was one of the "fighting woods" of the Greeks. The early Celtic races associated the trees with funerals. The best yew bow-staves come from Italy, Turkey and Spain, and were once distributed through the Venetian markets. The Spanish staves were so important that they were controlled by the Spanish Government. Later, European bows were backed with other and more plentiful woods. Yew is now occasionally employed for chairs, canes and whips.

Pacific Coast Indians prized the Western, Oregon or California yew (*Taxus brevifolia*) for bows, paddles and fish hooks. The Florida yew (*Taxus floridana*) is another United States species. Ernest Thompson Seton classes American woods suitable for bows in order of excellence as follows: "Oregon Yew, Osage Orange, White Hickory, Elm, Cedar, Apple, etc."

Yellow Cedar, Yellow Cypress, Sitka Cypress. } { *Chamæcyparis nootkatensis (Lamb) Spach.* *Chamæcyparis nutkaënsis Spach.*

Nomenclature. (Sudworth.)
Nootka Cypress, Nootka Sound Cypress (local). Alaska Cypress, Alaska Ground Cypress (local).

Locality.
Oregon to Alaska.

Features of Tree.
One hundred feet or more in height, three to five feet or more in diameter. Sharp-pointed, overlapping leaves, small globular cones.

Color, Appearance, or Grain of Wood.
Heartwood clear light yellow, thin sapwood nearly white. Close-grained, compact structure.

Structural Qualities of Wood.
Light, not strong, brittle, hard, durable in contact with soil, easily worked, receives high polish, fragrant.

Representative Uses of Wood.
Ship-building, furniture, interior finish.

Weight of Seasoned Wood in Pounds per Cubic Foot.

29.

Modulus of Elasticity.

1,460,000.

Modulus of Rupture.

11,000.

Remarks.
Valuable Alaska timber tree. Commercially not distinguished from Pacific Arborvitæ.

Incense Cedar, White Cedar. *Libocedrus decurrens Torr.*

Nomenclature. (Sudworth.)
Post Cedar, California Post Cedar (local). California White Cedar (local).
Bastard Cedar, Red Cedar, Juniper (Nevada).

Locality.
California and Oregon.

Features of Tree.
Ninety to one hundred and twenty-five feet in height, occasionally higher, three to six feet in diameter.

Color, Appearance, or Grain of Wood.
Heartwood brownish, sapwood lighter. Close-grained, compact structure. Heartwood often pitted. Fragrant.

Structural Qualities of Wood.
Light, brittle, soft, durable.

Representative Uses of Wood.
Flumes, shingles, interior finish.

Weight of Seasoned Wood in Pounds per Cubic Foot.

25.

Modulus of Elasticity.

1,200,000.

Modulus of Rupture.

960,000.

Remarks.
Subject to attack by fungus, causing the large oval pits in the heartwood. Disease ceases upon the felling of trees. The wood between the decayed spaces is apparently sound, even in living trees, and when seasoned is durable so that it can be used for posts or for purposes where appearance is unimportant. Some dealers charge as much for defective as for sound wood. This disease is similar to the ones associated with cypress and red cedar (pages 175 and 184). About half of the standing supply is effected. The disease is called "pin rot." Also see von Schrenk, Contribution No. 14; Shaw, School Botany, St. Louis.

Monterey Cypress (*Cupressus macrocarpa*).
(*Courtesy Doubleday, Page & Co.*)

Cypress (*Taxodium distichum*).
(*Photograph by Edward J. Davison.*)

"Peggy" Cypress Wood.

CYPRESS.

(*Cupressus and Taxodium.*)

The name cypress has been chiefly applied to trees of the genera Chamæcyparis, Cupressus, and Taxodium. Most species of the genus Chamæcyparis are now called cedars (see page 173). The Cupressus, while true cypresses and important in Europe, have no significance in America. The single species of the genus Taxodium is not a cypress, but supplies the "cypress" wood of American commerce. It is perhaps best to confine the name cypress to the true cypress (*Cupressus*) and to the commercial cypress (*Taxodium*).

The true cypress (*Cupressus*) was once important in the East, and is thought by some to have given the gopher wood of which the Ark was built.* Pliny mentions cypress doors good after four hundred years, and a statue good after six hundred years. Herodotus and other ancient authors † speak of it. Authorities in the middle ages thought that it would never decay. The cypress gates of the early St. Peter's, removed after one thousand years of service, were found to be in perfect condition.‡ Cypress was much prized for mummy-cases. Living trees long figured as funeral emblems, and are yet planted over graves in Italy and Turkey.§ The common or evergreen cypress is the chief European species. The eight or nine American representatives are of little note save as they are sometimes used for hedges and ornamentation. The Monterey and Gowan cypresses (*Cupressus macrocarpa* and *Cupressus goveniana*) are thus employed. There are small evergreen scale-like leaves.

The Monterey cypress (*Cupressus macrocarpa*) is noted throughout the entire California region because of a clump of trees, frequently visited, that include the only original specimens

* Funk & Wagnalls' Standard Dictionary, quoting Horace Smith, "Gayeties and Gravities," Chapter VII, p. 57.

† Pliny 16, 214 and 16, 215; Herodotus 4, 16; Virgil, Georgics, 2, 443.

‡ Encyclopædia Britannica, B. 6, p. 745.

§ Brockhaus, Konversations-Lexikon, B. 4, p. 654.

surviving in the United States. The famous "Seventeen-Mile Drive" near Monterey, California, passes through the district in which this group is located. The weird forms, with gnarled wind-beaten branches, are very unusual. Some of the individual trees are distinguished by names. The species grows readily in many areas from Washington to Mexico; a fact not easily reconciled with the few individuals in the one original group. The transplanted monterey cypress is locally popular in hedges and other landscape effects.

The American or Bald Cypress (*Taxodium distichum*) is a tree of considerable importance. It grows in the South Atlantic and Gulf States, on submerged lands or in deep swamps where unusual logging methods are necessitated. The seasoned wood resembles white cedar in that it is soft, light, and very durable. It has been called by many names. Pieces were once called black or white cypress according as they sank or floated. All dark pieces are now called black cypress. The tinted woods of some localities are called red or yellow cypress. The name bald cypress was caused by the leafless appearance of the trees in winter. The living trees are subject to a peculiar fungous disease, causing numerous cavities in the wood. These so resemble perforations made by small pegs that the wood is termed "peggy." The trouble ceases as the trees are cut, and the wood is then as durable as that from perfect trees. About one third of the standing supply is thus affected.* The roots frequently project upward above the surface in what are known as cypress knees. The single species of this genus may easily be recognized by its deciduous foliage; the little leaves are separated and are not in tufts as with the tamaracks.

BALD CYPRESS (*Taxodium distichum*).

* U. S. Forestry Circular No. 19 (Dr. B. E. Fernow, Chief).

Cypress, Bald Cypress. *Taxodium distichum Rich.*

Nomenclature. (Sudworth.)

White Cypress (N. C., S. C., Fla., Miss.).
Black Cypress (N. C., S. C., Ala., Tex.).
Red Cypress (Ga., Miss., La., Tex.).
Swamp Cypress (La.).
Deciduous Cypress (Del., Ill., Tex.).
Southern Cypress (Ala.).

Locality.

South Atlantic and Gulf States, Maryland through Florida to Texas, Mississippi Valley from southern Illinois to the Gulf. Occasional in North, as New York. Forms forests in swamps and barrens.*

Features of Tree.

Seventy to one hundred and fifty feet in height, four to ten feet in diameter. Knees on roots often hollow in old age. Flat deciduous leaves.

Color, Appearance, or Grain of Wood.

Heartwood brownish, sapwood nearly white. Close, straight grain. Frequently pitted by disease.

Structural Qualities of Wood.

Light, soft, not strong, durable. Green wood often very heavy.

Representative Uses of Wood.

Carpentry, construction, cooperage, railway ties.

Weight of Seasoned Wood in Pounds per Cubic Foot.

29 (U. S. Forestry Div.).†
28.

Modulus of Elasticity.

1,290,000 (average of 655 tests by U. S. Forestry Div.).†
1,460,000.

Modulus of Rupture.

7900 (average of 655 tests by U. S. Forestry Div.).†
9600.

Remarks.

Wood commercially divided into "white" and "black" cypress because of differences in age and environment. Fungus disease pits much wood, but stops with felling of trees.‡

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* See Trans. Am. Inst. M. E., Vol. XXIX, page 157.

† See page 8.

‡ Von Schrenk, Contribution No. 14, Shaw School Botany, St. Louis; also U. S. Forestry Circular No. 19.

REDWOOD.

(*Sequoia.*)

These trees grow only in California. There are two species: the common redwood (*S. sempervirens*), noted for its lumber, and the big or mammoth tree (*S. washingtoniana*), so remarkable for its great size. Geological evidence indicates that the genus was once represented by many species on both hemispheres, but that all disappeared during the glacial period save the two here noted.

The common redwood is a large and perfect tree and supplies a wood suggesting good red cedar. This soft, light, clean, reddish-brown, durable wood works and stands well, does not easily take fire, and is obtainable in large-sized pieces for use in large constructions. Coffins and shingles are made of it, also large quantities of wooden water-pipe employed for irrigation purposes. The average wood is seen in cheaper forms of indoor finish, while occasional pieces, in which the grain is distorted, are classed as curly redwood and used for costlier decorations. See plate 33. Redwood resists fire to a remarkable degree, as was evidenced in the original City of San Francisco, where, in the absence of other materials, it was largely employed for building. Redwood is so durable that fallen trunks that have remained many years on the ground have been sawn and used as lumber. Redwood resists many forms of insect life. Redwood pipe employed in irrigation work is not usually attacked by "ants" or other insects while wet and in use. Staves have sometimes been injured while lying piled upon the ground, but such instances are probably exceptional and the injury not great. Redwood does not resist attacks by marine life. The wood of Sequoia washingtonia is seldom commercially distinguished from that of Sequoia sempervirens. The unusual size of redwood trees cause logging operations to be difficult and costly. (See page 162.)

PLATE 33. REDWOOD (*Sequoia*).

Giant Redwood Tree (*S. washingtoniana*). (*Courtesy Doubleday, Page & Co.*)

Redwood Foliage (*Sequoia sempervirens*).

"Curly" Redwood Wood (*dissection*).

Big or Mammoth trees have been measured up to three hundred and twenty feet in height and thirty-five feet in diameter (Sargent). They are thus the largest of American trees and the most massive, although not the tallest, of all trees. Specimens twenty-five feet in diameter have been estimated as thirty-six hundred years old, and it is thought that under favorable conditions trees can survive for five thousand years, or even longer. The oldest trees are sound throughout. The almost incombustible bark is nearly two feet in thickness; the wood is brittle, but otherwise resembles ordinary redwood. It should be noted that large exceptional trees are all known, and that most of them have names such as the "Pride of the Forest," the "Grizzly Giant," and the "U. S. Grant." These, with younger trees, are grouped in the Mariposa, Calavaras, and other groves. Many sawmills are unfortunately engaged on the trees of this species, the notably large specimens of which do not exceed several hundred.

The history of a Redwood tree, dating from two hundred and seventy-one years before the Christian era, was reported by Prof. Dudley to the United States Senate, through the late Honorable O. H. Platt of Connecticut, on February 11, 1904. The record, obtained by counting the concentric layers of growth on the cross-section of the felled tree, showed that forest fires had occurred during the years 245, 1441, 1580, and 1797 A.D. The last fire was locally severe, since it charred a space thirty feet high and eighteen feet broad. Recovery from such wound is evidence as to the vitality of the species, and it is interesting to note that the new tissue was full, even, and continuous, as deposited above the wound.

The vitality of the redwood is remarkable. Its ability to reproduce by sprouts from the parent stump is almost phenomenal. The redwood tree resists forest fires as well as any other known species,* and repairs wounds that would destroy many other trees. The thick roots project downward so sharply as to suggest inverted funnels, and are so vigorous that trees are seldom uprooted by the winds. Growth is rapid, trees having been known to develop heights of eighty feet and diameters of sixteen inches within thirty years. The genus is thus unusually important, first, because of the present value of the wood, and, second, because the quick-growing healthy trees are likely to resist commercial extinction.

Redwood trees may be known by their size, locality, and fine, dull, evergreen foliage. The name Sequoia is that of an Indian chief. The two species must be distinguished. Common redwoods are nearer the coast; they "follow the fogs." Some of the trees are so great as to be confused with other "giant" redwoods (*S. Washingtonia*).

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* This is because the thick bark resists fire, and also, to some extent, because trees (*Sequoia sempervirens*) thrive in moist places

Reference: "The Big Trees of California," U. S. Forestry Division, Bulletin No. 28. Also Mr. Jas. Horsburgh, Jr., Southern Pacific Railway.

Redwood. *Sequoia sempervirens Endl.*

Nomenclature. (Sudworth.)
Redwood (local and common name). Sequoia, California Redwood, Coast Redwood (local).

Locality.
Central and North Pacific coast region.

Features of Tree.
Two hundred to three hundred feet in height, sometimes higher, six to eight and sometimes twenty feet in diameter. Straight, symmetrical trunk. Low branches rare.

Color, Appearance, or Grain of Wood.
Thick heartwood red, changing to reddish brown when seasoned; Thin sapwood nearly white. Coarse, straight grain, compact structure, very thick bark.

Structural Qualities of Wood.
Light, not strong, soft, very durable, not resinous, easily worked. Does not burn easily, receives polish.

Representative Uses of Wood.
Timber, shingles, flumes, fence-posts, coffins, railway ties, water-pipes, interior decoration. Bark made into souvenirs.

Weight of Seasoned Wood in Pounds per Cubic Foot.
26 (census figure, see page 8).

Modulus of Elasticity.
790,000 (average of 8 Humboldt specimens).†
1,140,000 (average of 7 Humboldt specimens).†
960,000 (census figure, see page 8)

Modulus of Rupture.
4920 (average of 9 Humboldt specimens).†
7138 (average of 7 Mendocino specimens).†
8400 (census figure, see page 8).

Remarks.
Pacific coast chief construction wood. Curled or distorted grain adds value for cabinet purposes.

The Big or Mammoth Tree or Giant Redwood (*S. washingtoniana* Sudworth and *S. gigantea*) is the largest tree known. The wood resembling that of *S. sempervirens* is used locally, see U. S. Forestry Bul. No. 28.

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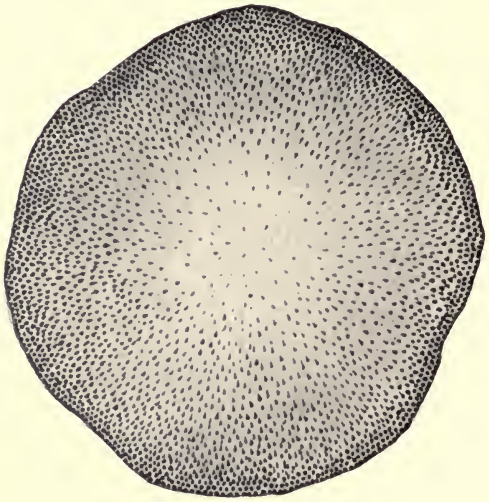
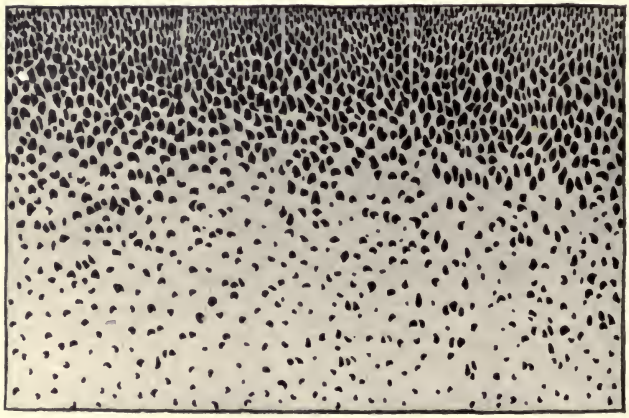
† Professor Frank Soulé, Trans. Am. Inst. M. E., California Meeting, 1899. There are several trees of this species near New York City.

PLATE 34. ENDOGENOUS STRUCTURE IN WOOD.



A section through a Palm Tree.



A cross-section of Palm wood. (Natural size.)

ENDOGENOUS TREES.

(*Monocotyledons.*)

Endogenous trees are those that increase from within. Their elemental parts are similar to those of exogenous trees but the arrangement of such parts differs in that the newer fibres of the Endogen intermingle with the old, pass through a pith-like tissue, and cause cross-surfaces to appear as dotted, whereas the new material of the Exogen is deposited altogether and upon the outside of the old, their sections exhibiting rings or layers. The Palms, Yuccas, Cornstalks, and Bamboos are of the endogens. Bark is unusual on trees of the series.

Endogenous woods are hardest and most compact at circumferences. The stems of palm trees are solid, but those of some of the grasses, particularly those that grow quickly, are hollow.* The tube or canal, when existing, is due to sluggishness on the part of the central pith, which, developing more slowly than the outer tissues, finally ruptures and disappears at the center. There are also more or less permanent joints or knots,† such as are made familiar by the canes and bamboos. The stems of Endogenous plants are seldom cut up into lumber, but are used in segments, or else entire, as for troughs or piles.‡ The use of Palm wood must be more or less

* The Bamboo, which is a grass, is hollow, while the cornstalk, which is also a grass, is not.

† The knots of endogens correspond to the nodes of exogens. Spaces between the nodes, known as internodes, mark the annual lengthening. Knots are places whence leaves have emerged.

‡ See "Marine Wood Borers," Trans. Am. Soc. C. E., Vol. XL, pages 195 and 204.

limited to the neighborhoods in which such trees flourish, but it is probable that the Bamboo can be much more generally employed. Palmwood shrinks generally in drying, principally in the pith-like tissue that surrounds the fibres. These fibres are then closer together than in fresh wood. Palm apparently repels the teredo in many positions. Teredoes are not "worms" but true mollusks. They line their tunnels with calcareous deposits, along the smooth surfaces of which they can glide, expanding or contracting at will. This lining, which is distinct from the boring shell, is preferably, if not always, deposited upon solid wood, cracks and other imperfections being normally avoided. Boards nailed over woodwork afford perfection during their own existence, because the teredo will not willingly cross the lines of separation. Some think that this explains why Palm wood often remains uninjured in localities where the hardest of hard woods easily fail. Palm trees are cultivated at Southern coast resorts, where they add greatly to the beauty and novelty of the landscape. The Washington or Fanleaf Palm is popular in Southern California. The Royal Palm (*Oreodoxa regia*) is native in Florida, but is best developed in Central America and the West Indies; its wood is hard and heavy, with large, dark, fibre-bundles, contrasting sharply with their surrounding tissue, as shown in the lower picture of plate 34.

The Endogens include numerous families and many thousand species.* The grasses, including wheat, rye, and Indian corn at the North and sugar-cane and bamboo at the South, belong to this group. Most Endogens are herbs; comparatively few furnish material for structural purposes. The Palms, including the palmetto, rattans, cane palms, and others, the Yucca, including the Joshua tree, Spanish bayonet, and others, and the Bamboos, representatives of the grasses, are thus useful. Endogens are also known as Monocotyledons.

* Bastin ("College Botany," p. 379) divides into about fifty natural orders distributed among seven divisions. Warming ("Systematic Botany," pp. 277, 278) divides into seven families corresponding with Bastin's seven divisions. A. Gray divides into twenty-one orders or families. Coulter ("Plants," p. 237) divides into forty families, including twenty thousand species.

Cabbage Palmetto.
(*Courtesy N. C. Geological Survey.*)

Washington Palm (untrimmed).
(*Messrs. Doubleday, Page & Co.*).

Washington Palm
(trimmed).
(*Los Angeles Chamber Commerce.*)

PALM.

PALMACEÆ.

This is one of the largest and most important orders of plants known to man. The one thousand * or more known species are distributed over the tropical and semitropical regions of the entire world. Only a few species, including the palmettos of the Gulf States and the fan palms of Calfornia, are native in the United States.

Palms have tall, columnar trunks without branches, but with crowns of large leaves at their summits. Their forms and proportions are often magnificent. The wood is soft, light, more or less porous, difficult to work, and not strong. The shapes of trunks sometimes cause them to be locally prized for piles, while the porous qualities of the wood are such as to repel teredo † There are many by-products, as fruit, nuts, oil, etc. The rattan or cane palms of India and the Malayan Islands sometimes grow to a height of two hundred feet and are imported into Europe and America for chair-bottoms and the like. Thus far, the palm is almost exclusively valued in the United States for landscape effects. Most palms seen at pleasure resorts are not native. They have been transplanted.

Sudworth ‡ enumerates the following as attaining to the dignity of trees in the United States:

Cabbage Palmetto (*Sabal palmetto*).
Silvertop Palmetto (*Thrinax microcarpa*).
Silktop Palmetto (*Thrinax parviflora*).
Mexican Palmetto (*Sabal mexicana*).
Sargent Palm (*Pseudophœnix sargentii*).
Fanleaf Palm (*Washingtonia filifera*).
Royal Palm (*Oreodoxa regia*).

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* Coulter, "Plants," p. 241.

† "Marine Wood Borers," Trans. Am. Soc. C. E., Vol. XL, pp. 195 and 204.

‡ "Check List," U. S. Forestry Bul. No. 17.

A. L. Wallace, "Palm Trees of Amazon and their Uses," London, 1853.

Cabbage Palmetto. *Sabal palmetto Walt.*

Nomenclature. (Sudworth.)
Cabbage Palmetto, Palmetto (N. C., S. C.). Cabbage Tree (Miss., Fla.). Tree Palmetto (La.).

Locality.
Southern Atlantic and Gulf coast, United States (intermittently). Rare at northern limit. Best on Florida southwest coast.

Features of Tree.
Medium size, thirty to forty feet in height, one to two and one-half feet in diameter.

Color, Appearance, or Grain of Wood.
Light-brown tint. Characteristic coarse fibre arrangement. As a whole, wood is soft and light, but fibro-vascular bundles are hard to work.

Structural Qualities of Wood.
Light, soft, difficult to work; durable in marine work; repels teredo.

Representative Uses of Wood.
Piles, wharf-work, etc. Used locally for small marine works.

Weight of Seasoned Wood in Pounds per Cubic Foot.
27.

Modulus of Elasticity.

Modulus of Rupture.

Remarks.
Scrubbing-brush "bristles" are made in considerable quantities in Florida from the sheath of young leaves. The inner part of young plant is edible.

The following Palmettoes also grow in the United States. (Sudworth) Silktop Palmetto, Silver Thatch (*Thrinax parviflora*). Silvertop Palmetto, Prickly Thatch, Brittle Thatch (*Thrinax microcarpa*), Mexican Palmetto (*Sabal mexicana*). The first two grow in Florida and the Bahamas. The last in Southwestern Texas and old Mexico.

Date Palm (*Phœnix dactylifera*). Conditions seldom favor the development of commercial dates save in Arizona, where the industry is likely to prove a permanent one. Other species of *Phœnix*, cultivated for decorative purposes and known as date palms, are distinct. "Phœnix" refers to Phœnicia. "Dactylus" and "dates" are derived from the Hebrew "dachel." * The date plam affords fruit, syrup and vinegar. The wood is used to make beds, tables, chairs, cradles and boats. "The leaves are formed into fans, baskets, cord, and paper. The light, porous, but durable, trunk is used in carpentry. The fibres on the trunk are made into rope." "Arabia," S. M. Zweimar.

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* Swingle (Year Book, Dept. Agriculture, 1900, pp. 453, 490), Toumey (Ariz. Experiment Station Bulletin No. 29).

Washington Palm.
Fanleaf Palm.
Washingtonia filifera Wendl.
Neowashingtonia filamentosa Wendl.

Nomenclature. (Sudworth.)
Fanleaf Palm, Washington Palm, Desert Palm (Cal.). California Fan Palm, Arizona Palm, Wild Date (Cal.).

Locality.
California.

Features of Tree.
Thirty to sixty feet in height, one and one-half to three feet in diameter. Fan-shaped leaves rising yet farther in tuft from summit; edible fruit.

Color, Appearance, or Grain of Wood.
Light greenish yellow to dark red, conspicuous grain.

Structural Qualities of Wood.
Soft, light, shrinks in seasoning, difficult to work.

Representative Uses of Wood.
Ornamental purposes.

Weight of Seasoned Wood in Pounds per Cubic Foot.
32.

Modulus of Elasticity.

Modulus of Rupture.

Remarks.
The largest of the United States Palms. Much used for landscape effects in California.

These trees, native in the deserts, are probably the most popular of the palms transplanted in the cultivated districts of Southern California. "Desert" refers to the original ranges of the trees. "Fanleaf" refers to the large fan-like leaves, while "filifera" and "filimentosa" allude to the filaments hanging from the leaves.

The trunks are of no more importance than those of other local palms, but the leaf-stalks exhibit strength and characteristics as follows:—Fresh stalks are light, tough, stringy and flexible. They are of a gray green color and resemble bamboo in that they harden and turn yellow as they dry. They differ from bamboo in the form of their cross sections and in that rods 10 feet or more in length have no joints. Many thousand of these leaf stalks are annually pruned from growing trees in Southern California and are at present burned as waste.

Two roughly cured stalks were tested, the central portions of each specimen broke, leaving edges which stripped without sign of fracture. One piece resisted tension up to 11,370 pounds per square inch, while the other broke at 10,150 pounds per square inch. These figures, that must be considered with the light weight of the wood, were averaged for entire sections including those parts that stripped without breaking. Strength would doubtless be increased by selection and seasoning.

The "wild date" must not be confused with the true date Palm (*Phœnix dactylifera*) as naturalized in Florida, Arizona, and California. (See page 194.)

YUCCA.

(*Yucca.*)

The eighteen species constituting this genus are all American. Twelve of them are found in the southern and western United States, and eight of these are mentioned by Sudworth * as arborescent. Several of the Yuccas are cultivated because of their beautiful lily-like flowers. The Tree Yucca or Joshua-tree affords wood.

This last named species produces a short stout trunk, peculiar in that it is covered by thick bark. The soft, spongy wood is sometimes sawn into lumber, made into souvenirs and lately into artificial limbs. An attempt to manufacture it into paper-pulp † is said to have failed because of high cost made necessary by the remote position of the industry. Hough notes ‡ that trees are sometimes attacked by borers that impregnate the walls of their tunnels with hardening antiseptic solutions, causing such parts to remain after the disappearance of the others. And that these parts are described as "petrified wood," and are prized for fuel since they burn with "little smoke and great heat." Yucca wood fibres interlace much as in cloth. The wood has practically no cleavage. This is well shown in pieces that have been steamed and then stretched. Sheets of yucca wood peeled from around the billet (see footnote, page 13) are as roughly pliable as felt of twice the thickness.

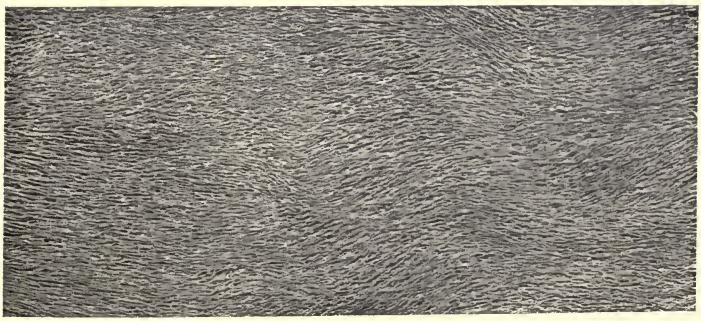
The eight species noted by Sudworth are as follows:

Yucca arborescens (Joshua tree).
Yucca treculeana (Spanish Bayonet).
Yucca gloriosa (Spanish Dagger).
Yucca mohavensis (Mohave Yucca).
Yucca aloifolia (Aloë-leaf Yucca).
Yucca macrocarpa (Broadfruit Yucca).
Yucca brevifolia (Schott Yucca).
Yucca constricta.

* "Check List," U. S. Forestry Bul. No. 17.
† South of Mohave Desert in California about twenty years ago.
‡ American Woods, Part VII, p. 57.

PLATE 36. YUCCA (*Yucca arborescens*).

By courtesy of Messrs. Doubleday, Page & Co. Photograph by Conaway.



Wood of Yucca.

Joshua-tree, Yucca. { *Yucca arborescens Torr.* / *Yucca brevifolia Engelm.*

Nomenclature. (Sudworth.)
Joshua-tree, The Joshua, Yucca, Yucca Tree (Utah, Ariz., N. M., Cal.). Yucca Cactus (Cal.).

Locality.
Central and lower Rocky Mountain region.

Features of Tree.
Twenty-five to forty feet in height, six inches to two feet in diameter.
Thick outer cover or bark.*

Color, Appearance, or Grain of Wood.
Light brown to white, porous grain, interlaced fibre structure.

Structural Qualities of Wood.
Light, soft, spongy, flexible in thin sheets, such as are developed by the rotary cut.

Representative Uses of Wood.
Paper-pulp, souvenirs, boxes, book covers, and other small articles, artificial limbs.

Weight of Seasoned Wood in Pounds per Cubic Foot.

23.

Modulus of Elasticity.

Modulus of Rupture.

Remarks.
Bark is unusual in the case of endogeneous trees. Arborescens refers to fact that *it* is a tree. Artificial arms and legs are made by bending veneers of yucca wood over moulds of the stumps of amputated members. Shells are made up by the aid of strong cements, and the "limbs" that result are strong, tough, and very light. The processes are protected by patents which include the methods by which the wood is artificially toughened.†

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* See paragraph Bark, Endogenous Trees, page 189.

† Yucca Limb Co., Los Angeles, California.

BAMBOO.

(*Bambusæ*.)

The bamboos are giant members of a group (grasses *), the other individuals of which, while widely distributed, valued, and very numerous, are for the most part insignificant as to bulk, height, and structural characteristics. The canes and bamboos are exceptions in that they form what may well be called forests, and produce woods used in construction. The Bamboos, included in about twenty genera and two hundred species,† are distributed unevenly over the tropical zone. Some are hardy when transplanted in California and the Carolinas.

Some bamboo plants with numerous stalks and delicate foliage resemble plumes of giant ostrich feathers. Stems often attain heights of seventy feet and diameters of four and six inches (see Fig. 3 plate). Knots or joints are at first close together, but are later one or two feet apart. Growth is surprisingly rapid. A Philippine specimen, which when measured was eighteen inches high and four inches in diameter, grew two feet in three days.‡ Florida stalks have reached heights of seventy-two feet in a single season.§ The plants are apt to take complete possession of the ground on which they grow. Those who use bamboo value it highly. It is employed entire or else split into segments. Some can be

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* Grasses, "one of the largest and probably one of the most useful groups of plants. . . . If grass-like sedges be associated, . . . there are about 6000 species, representing nearly one third of the Monocotyledons." (Coulter, "Plants," pp. 240–241.) The various pasture-grasses, cereals, and sugar-canes are here included. Bamboos and canes are distinct in that they afford structural materials.

† B. E. Fernow notes (p. 29, Forestry Bulletin No. 11): "In addition to the genus bambusa, the genera Arundinaria, Arundo, Dendrocalamus, and Guadua are the most important." All of tribe Bambusae.

‡ Frederic H. Sawyer. Memb. Inst. C. E., "Inhabitants of the Philippines," Chas. Scribner's Sons, 1900 (p. 5).

§ Page 29, U. S. Forestry Bulletin No. 11.

Bamboo Grove, Philippines.
By the courtesy of the Manila P. I. Forestry Bureau.

Bamboo Grove, China.
Bamboo sections, 5¼ inches diameter.

opened and flattened into rough boards, splitting everywhere but holding together.* For vessels it is cut off with reference to the partitions. The subject is thus summarized by Dr. Martin:† "The Chinese make masts of it for their small junks, and twist it into cables for their larger ones. They weave it into matting for floors, and make it into rafters for roofs. They sit at table on bamboo chairs, eat shoots of bamboo with bamboo chop-sticks. The musician blows a bamboo flute, and the watchman beats a bamboo rattle. Criminals are confined in a bamboo cage and beaten with bamboo rods. Paper is made of bamboo fibre, and pencils of a joint of bamboo in which is inserted a tuft of goat's hair."

Bamboos have hard silicious exteriors, rendering them nearly impervious to water. Their development may be rightly compared to that of asparagus, in that both are at first brittle and tender. Stems grown in a few weeks require three or four years to harden. The fresh uncured stems can be curved or bent to many uses. In Japan, bamboo is said to have developed into one of the most profitable of crops. (Fairchild, U. S. Dept. Agri., Bureau Plant Industry, Bulletin No. 43.)

The manipulation of this valuable material is not yet understood in America. Prof. Johnson notes‡ that the wood of "bamboo is just twice as strong as the strongest wood in cross-bending, weight for weight, when the wood is taken in specimens, with a square and solid cross-section." Dr. Fernow considers the bamboo worthy of more extensive trial throughout the Gulf region.

---

* Prof. Isaac F. Holton, "New Granada," Harper Bros., New York, 1857 (p. 109).

† "Cycle of Cathay," Fleming H. Revell Co., 1899 (p. 172).

‡ Materials of Construction, 1897, p. 689.

Henry G. Hubbard, U. S. Forestry Bulletin No. 11. A. B. Mitford, "The Bamboo Garden," Macmillan, 1896. Kurz, "Bamboo and its Uses," Calcutta, 1876.

"Bamboo as Substitute for Wood," Fernow, p. 203, 6th Annual Report.

"Japanese Bamboos," Fairchild, U. S. Dept. Agriculture. Bureau Plant Industry, Bulletins 42 and 43.

Bamboo. *Bambusa vulgaris.*

Nomenclature.
Bamboo (local and common name).

Locality.
Florida (acclimated).

Features of Tree.
Seventy-five feet in height, four to six inches in diameter. Delicate branches and leaves. Greenish glazed jointed stem, extensive roots.

Color, Appearance, or Grain of Wood.
Yellowish brown, conspicuously fibrous, moderately thin walls, central canal broken by joints.

Structural Qualities of Wood.
Light, elastic, works easily.

Representative Uses of Wood.
Posts, poles, utensils, troughs, pipes, roofing, paper.

Weight of Seasoned Wood in Pounds per Cubic Foot.
Variable.

Modulus of Elasticity.

2,380,000 (Johnson's "Materials of Construction," p. 689).

Modulus of Rupture.

27,400 (Johnson's "Materials of Construction," p. 689).

Remarks.
It must be remembered that bamboos while large as trees are not trees, but wood-producing grasses. The woods have been used in balloon frames and were formerly employed in incandescent electric lamps. A stem attains full height in a single year, but must then stand for three or four years in order to season or harden.

Rattan is obtained from several sources. Species of Calamus, as C. rudentum, are pre-eminently climbers. Stalks not over an inch thick are sometimes three hundred or more feet in length, ascending and falling in festoons from tall trees. Species of Rhapis, as R. flabelliformis, are, on the contrary, erect canes growing in thick tufts. The former are known as climbing and the latter as ground rattans. Both are characterized by toughness, length, lightness and pliability. Natives make houses, bridges, matting, hats, and baskets of it. They also make many kinds of cordage, from fine sewing fibres to thick cables. Rattan, which is usually split, is superceding willow, in most civilized countries, for furniture, fancy carriage bodies, chair bottoms and the like. The best rattan comes from Borneo.

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