UNITED STATES
DEPARTMENT OF THE INTERIOR

CIVILIAN CONSERVATION CORPS
Project Training

LUMBER

Prepared for and with the cooperation of the technical services
By
Guy B. Arthur, Supervisor, Project Training

P. T. SERIES NO. 8

UNITED STATES
DEPARTMENT OF THE INTERIOR
CIVILIAN CONSERVATION CORPS
Office of the Supervisor - Project Training

Washington

LUMBER

This text assembles information on the source of lumber, its characteristics, and the common forms in which it is prepared for use, with certain tables of practical information. Its purpose is to provide basic information for project training in the carpentry trade.

Most of the material has been drawn from the following sources, with only enough original writing to give it form and continuity.

Wood and Lumber	By A. C. Newell Manual Arts Press, Peoria, Illinois
Wood Handbook	Forest Products Laboratory
Engineer Training Manual	Appendix No. 4, United States Army
Mechanical Properties of Wood	Forest Service Bulletin, No. 556
Light Frame House Construction	Department of Commerce Trade and Industrial Series No.
The Forest, A Handbook for Teachers	Department of Agriculture Miscellaneous Circular No. 98
Selection of Lumber	Department of Agriculture Farmers' Bulletin No. 1756
Charting the American Lumber Industry	National Lumber Manufacturers Association

Prepared for, and with the cooperation of, the Technical Services.

September 1937

LUMBER

Table of Contents

LIST OF ILLUSTRATIONS

CHAPTER I

THE SOURCE OF LUMBER

Over one-fourth of our land---500 million acres---is in forests, and one of the most important uses of these forests is the production of lumber. We use 14 billion cubic feet of timber each year, and 2 billion cubic feet are destroyed, but we grow 7 billion cubic feet, so the available supply is reduced by 9 billion feet each year. In 1929 the forests and processing plants---lumber mills and pulp mills---gave employment to 1,300,000 workers. A large mill may cut a million board-feet a day, which is equivalent to 66 six-room houses, while many mills exceed 100,000 board-feet a day.

In reducing a tree to lumber there is considerable waste, varying with different sections and different kinds of wood. Two examples are given here, one for Douglas Fir, and the other for Longleaf Pine:

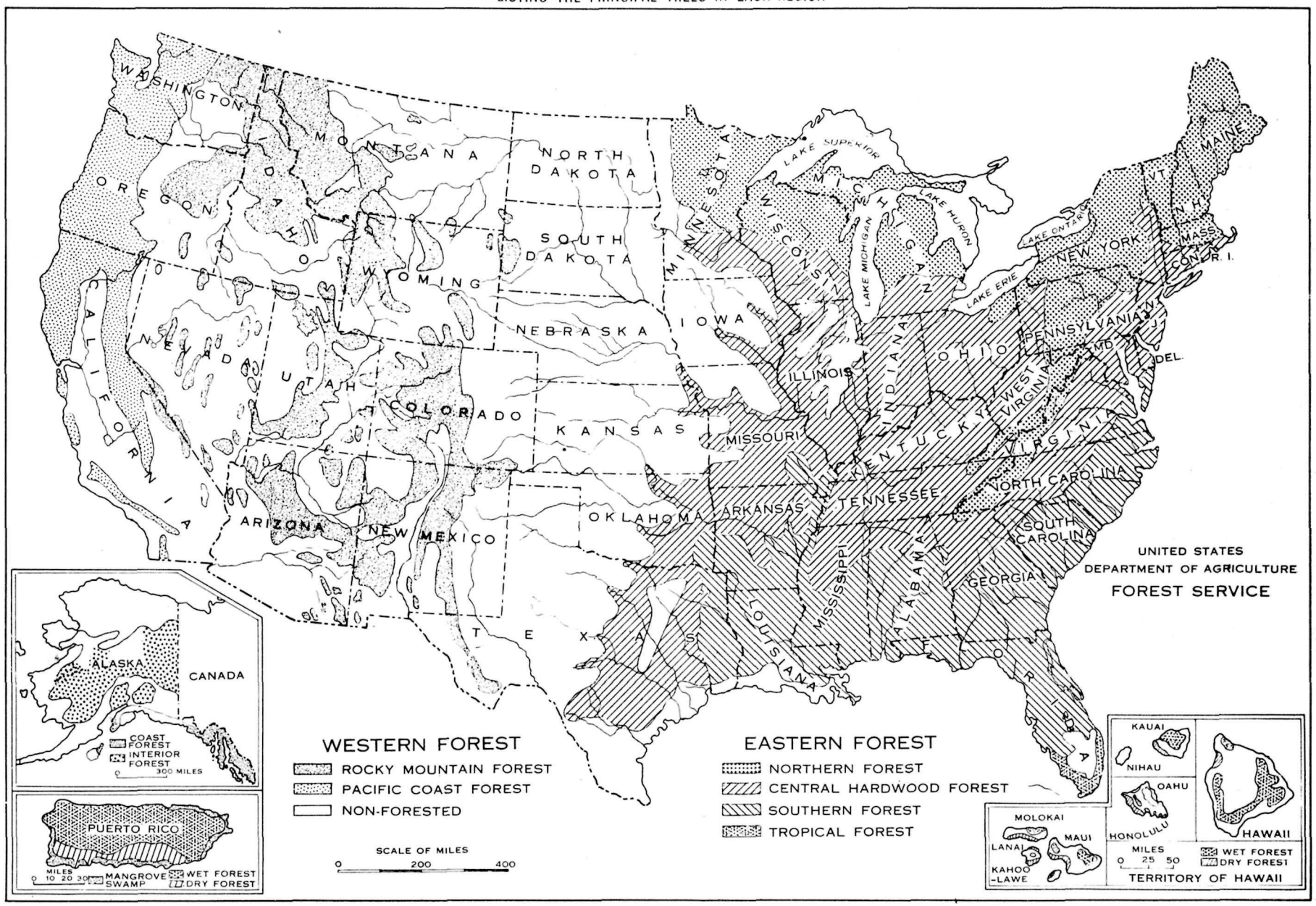
	Douglas Fir		Longleaf Pine	
Logging Waste:	Per Cent		Per Cent	
Stump	5.1		6.4	
Top	3.6		11.0	
Limbs	.1		4.7	
Breakage	1.1	10.0	6.6	28.7
Mill Waste:				
Sawdust	13.1		17.0	
Slabs	9.9		8.0	
Edgings	2.3		8.1	
Trims	.8	26.1	2.5	35.6
Total Waste		36.1		64.3
Total Lumber		63.9		35.7

This annual cut goes into the following uses:

35 billion board-feet of lumber; enough for 2,400,000 six-room houses.
150,000,000 railroad ties; enough for 46,875 miles of standard track.
4,000,000 cords of pulpwood. (We import 2,000,000 cords)
110,000,000 cords of fuel wood. About half of our people use wood for fuel.
500,000,000 fence posts; enough for 757,575 miles of fence, with the posts set 8 feet apart.
170,000,000 feet of round mine timber.
8,000,000 pieces of pole and piling. Without the wooden pole our telephone and telegraph system would be impossible.
1,500,000,000 barrel staves.
Waste is transformed into clothing and fibre containers.
Other requirements are for wooden vats and taps and for the handles of tools and utensils.

FOREST REGIONS OF THE UNITED STATES

LISTING THE PRINCIPAL TREES IN EACH REGION



The accompanying map shows the forested areas of the country, and the following lists give the trees which grow in these areas, in the order of their importance or abundance. Trees are classified in two ways; as evergreen--retaining their foliage, or deciduous--dropping their leaves in the fall; and as broad-leaved--like the oaks and maples, or needle-leaved like the pines and cedars:

PACIFIC COAST FOREST

Northern Portion (Western Washington and Western Oregon):

- Douglas Fir
- Western hemlock
- Lowland white, noble and silver firs
- Western red cedar
- Sitka and Engelmann spruces
- Western White pine
- Port Oxford and Alaska cedars
- Western and Lyall larches
- Lodgepole Pine
- Mountain hemlock
- Oaks, ash, maples, birches, alders, cottonwood, madrone

Southern Portion (California):

- Ponderosa and Jeffrey pines
- Sugar pine
- Redwood and bigtree
- White, red, lowland white & Shasta red firs
- Incense cedar
- Douglas fir
- Lodgepole pine
- Knobcone and digger pines
- Bigcone spruce
- Monterey and Gown cypresses
- Western and California junipers
- Singleleaf pinon
- Oaks, buckeye, laurel, alder, madrone

ALASKA FOREST

Coast Forest:

- Western hemlock (important)
- Sitka spruce (important)
- Western red cedar
- Alaska cedar ("yellow cedar")
- Mountain hemlock
- Lodgepole pine
- Black cottonwood
- Red and Sitka Alders
- Willows

Interior Forest:

- White (important) and black spruces
- Alaska white (important) and Kenai birches
- Black Cottonwood
- Balsam poplar (Balm-of-Gilead)
- Aspen
- Willows
- Tamarack

The Forest Land Area of the United States would cover all the States east of the Mississippi with a block of 120 million acres left over.

ROCKY MOUNTAIN FOREST

Northern Portion (Northern Idaho and Western Montana):

- Lodgepole pine
- Douglas fir
- Western larch
- Engelmann spruce
- Ponderosa pine
- Western white pine
- Western red cedar
- Lowland white and alpine firs
- Western and mountain hemlocks
- Whitebark pine
- Balsam poplar (Balm-of-Gilead)

Eastern Oregon, Central Idaho, and Eastern Washington:

- Ponderosa pine
- Douglas fir
- Lodgepole pine
- Western larch
- Englemann spruce
- Western red cedar
- Western hemlock
- White, lowland white and alpine firs
- Western white pine
- Oaks and junipers (in Oregon)

Central Montana, Wyoming, and South Dakota:

- Lodgepole pine
- Douglas fir
- Ponderosa pine
- Englemann spruce
- Alpine fir
- Limber pine
- Aspen and cottonwood
- Rocky Mountain red cedar
- White spruce

Central Portion (Colorado, Utah, and Nevada):

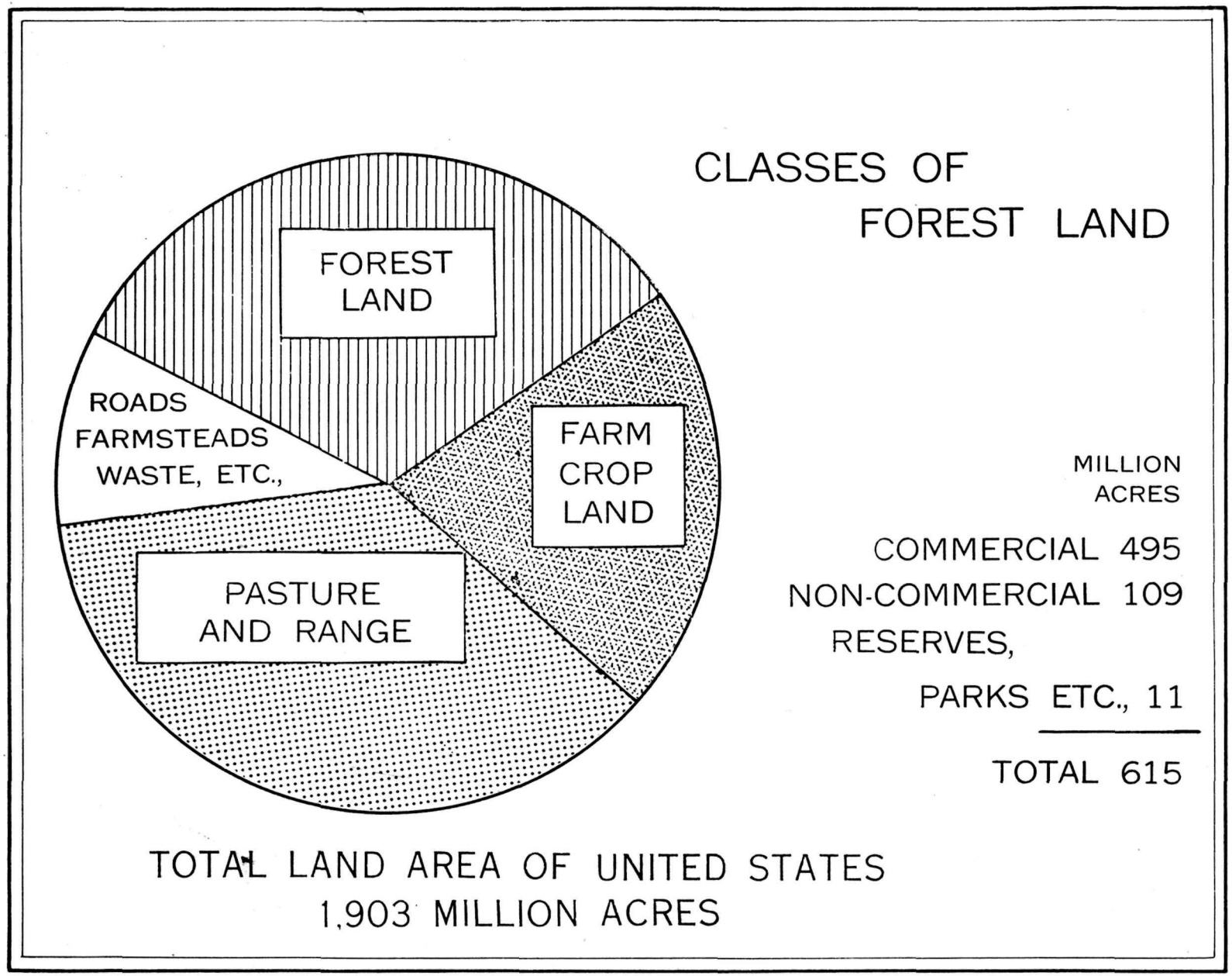
- Lodgepole pine
- Engelmann and blue spruces
- Alpine and white firs
- Douglas fir
- Ponderosa pine
- Aspens and cottonwood
- Pinon and singleleaf pinon
- Rocky Mountain red cedar and Utah juniper
- Bristlecone and limber pines
- Mountain mahogany

Southern Portion (New Mexico and Arizona):

- Ponderosa pine
- Douglas fir
- White, alpine and corkbark firs
- Engelmann and blue spruces
- Pinon and Mexican pinon
- One-seeded and alligator junipers and Rocky Mountain red cedar
- Aspen and cottonwoods
- Limber, Mexican white, and Arizona pines
- Oaks, walnut, sycamore, alder, boxelder
- Arizona and smooth cypresses

TROPICAL FOREST

- Mangrove
- Royal and thatch palms
- Florida yew
- Wild fig
- Pigeon-plum
- Loblolly
- Wild tamarind
- Gumbo-limbo
- Poisonwood
- Inkwood
- Buttonwood
- Mastic ("Wild Olive")
- Jamaica dogwood



Glassification of Land Areas and Glasses of Forest Land in the United States.

PUERTO RICO FOREST -- TROPICAL

Wet Forest:

- Roble
- Moca (cabbage bark)
- Guaraguao (musk-wood)
- Guava
- Guama
- Tabonuco (incense tree)
- Palma de Sierra (Mountain palm)
- Granadillo
- Laurel sabino (laurel)
- Capa blanco
- Capa prieto (Spanish elm)
- Algarrobo
- Ausubo (bullet wood)

Dry Forest:

- Ucar
- Almacigo (West Indian birch)
- Moca (cabbage bark)
- Guacima (West Indian elm)
- Tea (candle wood)
- Albarillo (wild quinine)
- Jobo (hog plum)

Mangrove Swamps:

- Mangle (mangrove) four species

SOUTHERN FOREST

Pine Lands:

- Longleaf, shortleaf, loblolly, and slash pines
- Southern red, turkey, black, post, laurel, and willow oaks
- Red gum
- Winged, American, and cedar elms
- Black, red, sand, and pignut hickories
- Eastern and Southern red cedar
- Basswood
- Sand pine

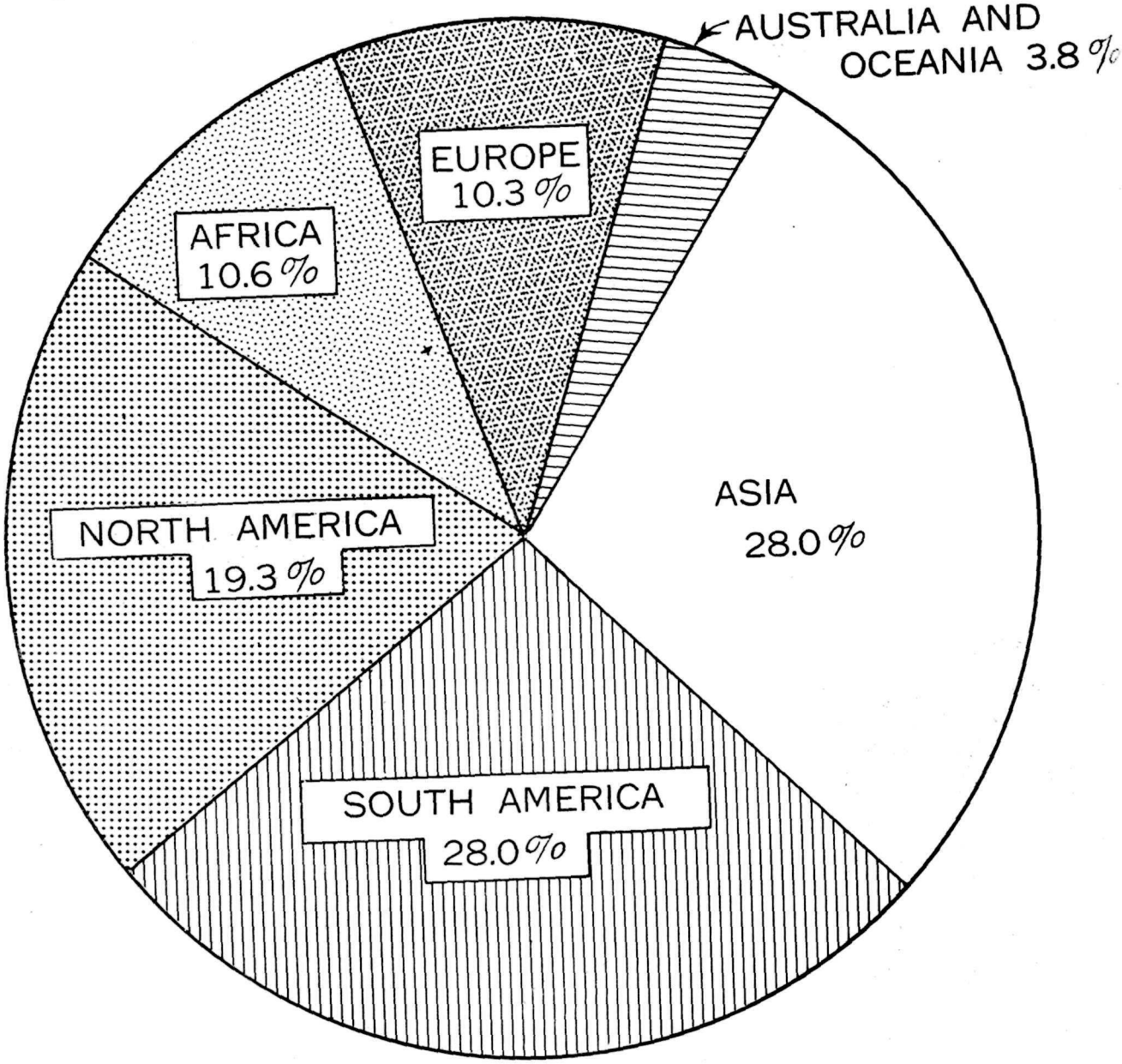
Alluvial Bottoms and Swamps:

- Red, tupelo, and swamp black gums
- Water, laurel, live, overcup, Texas, red and swamp white oaks
- Southern cypress
- Pecan, water, swamp pignut, and hammock hickories
- Beech
- River birch
- Ashes
- Red and Silver maples
- Cottonwood and willows
- Sycamore
- Southern hackberry
- Honey locust
- Holly
- Red, white and sweet bays
- Evergreen magnolia
- Pond and spruce pines
- Southern white cedar

CENTRAL HARDWOOD FOREST

Northern Portion:

- White, black, northern, red, scarlet, bur, chestnut and chinquapin oaks
- Shagbark, mockernut, pignut and bitternut hickories
- White, blue, green and red ashes
- American, rock, and slippery elms
- Red, sugar and silver maples



Forest Areas of the World by continents and percent.

Beech
Pitch, shortleaf, and Virginia pines
Yellow poplar (tulip poplar)
Sycamore
Chestnut
Black Walnut
Cottonwood
Hackberry
Black Cherry
Basswood
Ohio buckeye
Eastern red cedar

Southern Portion:

White, post, southern red, blackjack, Shumard red, chestnut, swamp chestnut and pin oaks
Red and black gums
Mockernut, pignut, southern shagbark and bigleaf shagbark hickories
Shortleaf and Virginia ("scrub") pines
White, blue, and red ashes
Yellow poplar (tulip poplar)
Black locust
Elms
Sycamore
Black Walnut
Silver and red maples
Beech
Dogwood
Persimmon
Cottonwoods and Willows
Eastern red cedar
Osage-orange

Texas Portion:

Post, southern red, and blackjack oaks
Mountain and other cedars

NORTHERN FOREST

Nothern Portion:

Red, black and white spruces
Balsam fir
White, red(Norway) jack, and pitch pines
Hemlock
Sugar and red maples
Beech
Northern red, white, black and scarlet oaks
Yellow, paper, black and gray birches
Aspen ("popple") and largetooth aspen
Basswoods
Black Cherry
American, rock, and slippery elms
White and black ashes
Shagbark and pignut hickories
Butternut
Northern white cedar
Tammarack

Southern Portion (Appalachian Region):

White, northern red, chestnut, black and scarlet oaks
Chestnut
Hemlock
White, shortleaf, pitch and Virginia ("scrub") pines
Black, yellow and river birches
Basswood
Sugar and red maples
Beech
Red spruce
Southern balsam fir
Yellow poplar (tulip poplar)
Cucumber magnolia
Black walnut and butternut
Black cherry
Pignut, mockernut and red hickories
Black locust
Black gum
Buckeye

CHAPTER II

STRUCTURE OF WOOD

Bark, Wood, and Pith:

A cross section of a tree trunk (Pg. 11) shows the following well-defined features in succession from the outside to the center: (1) Bark which may be divided into (a) the outer, corky, dead portion that varies greatly in thickness, and (b) the thin, inner, living portion; (2) wood, which in most species is clearly differentiated into sapwood and heartwood; and (3) the pith, a small spot at the center, usually darker in color. For the most practical purposes the pith is considered a part of the wood.

Between the bark and the wood is a thin layer, invisible without a microscope, called the cambium, in which all growth in thickness of bark and wood takes place. No growth in either diameter or length takes place in wood already formed; new growth is purely the addition of new layers, not the development of old ones.

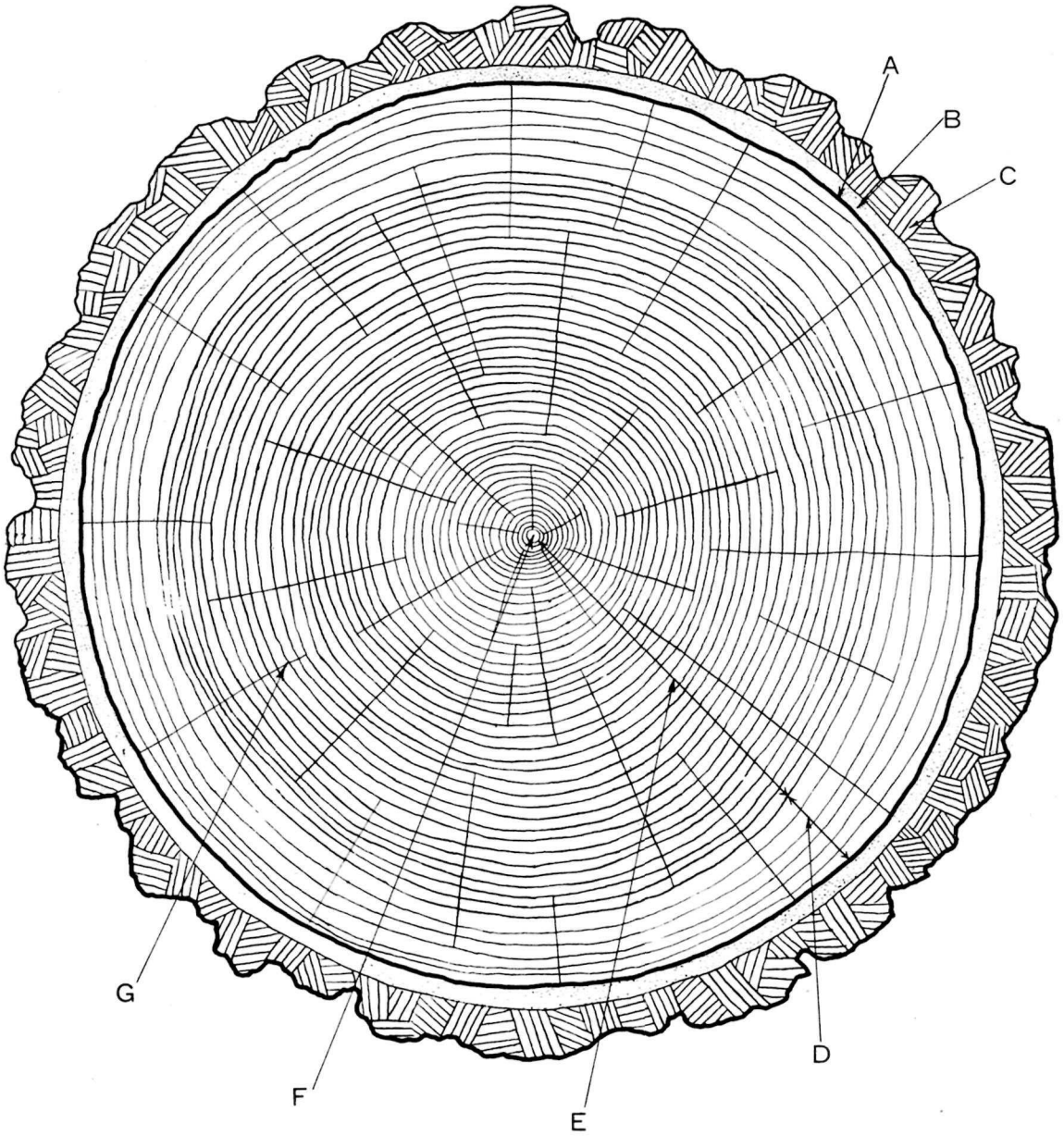
Most branches originate at the pith, and consequently their bases gradually become surrounded by the wood of the growing trunk. These enclosed portions of the branches constitute the knots. The lower branches of a forest tree die and later drop off as the tree grows in size. The dead stubs become overgrown by new wood and form loose knots. Knots vary in character even in the same tree, between trees of the same species, and between species according to growth and inherent species characteristics.

Growth Rings:

Each year, by growth in the cambium, a tree adds a layer of wood on the outside of that previously formed, thereby increasing the diameter of the trunk and pushing the bark outward. If growth is interrupted each year, by cold weather or dry seasons, the character of the cells at the end of each year's growth and the beginning of the next is sufficiently different to define sharply the annual layers or growth rings. Consequently, the age of such a tree may be determined by counting the number of annual rings at its base. In parts of the tropics, where tree growth is continuous throughout the year, no well-defined annual growth layers are formed and it is impossible, with any degree of accuracy, to tell the age of such trees.

If the growth of a tree is interrupted during the growing season, as a result of drought or defoliation by insects, two or even more differentiated rings may be formed in the same season. The inner one in such an event usually does not have a sharply defined outer boundary; it is called a false ring.

THE TREE TRUNK



A, Cambium layer (microscopic) is inside of inner bark and forms wood and bark cells. B, Inner bark is moist and soft. Carries prepared food from leaves to all growing parts of tree. C, Outer bark or corky layer is composed of dry dead tissue. Gives general protection against external injuries. D, Sapwood is the light-colored wood beneath the bark. Carries sap from roots to leaves. E, Heartwood (inactive) is formed by a gradual change in the sapwood. Gives the tree strength. F, Pitch is the soft tissue about which the first wood growth takes place in the newly formed twigs. G, Wood rays connect the various layers from pitch to bark for storage and transference of food.

Occasionally, under favorable conditions, no growth takes place in parts of a tree trunk, especially in the lower portion. In such a case, the annual growth layer is incomplete, portions being entirely missing.

Spring Wood and Summer Wood:

In many species of wood, each annual ring is divided more or less distinctly into two layers. The inner one, the spring wood, consists of cells having relatively large cavities and frequently thin walls. The outer layer, the summer wood, is composed of smaller cells. The transition from spring wood to summer wood may be either abrupt or gradual, depending on the kind of wood and the growing conditions at the time it was formed.

In most species, spring wood differs from summer wood in physical properties. It is lighter in weight, softer, and weaker; it shrinks less across and more along the grain; and it is brash in both softwoods and hardwoods.

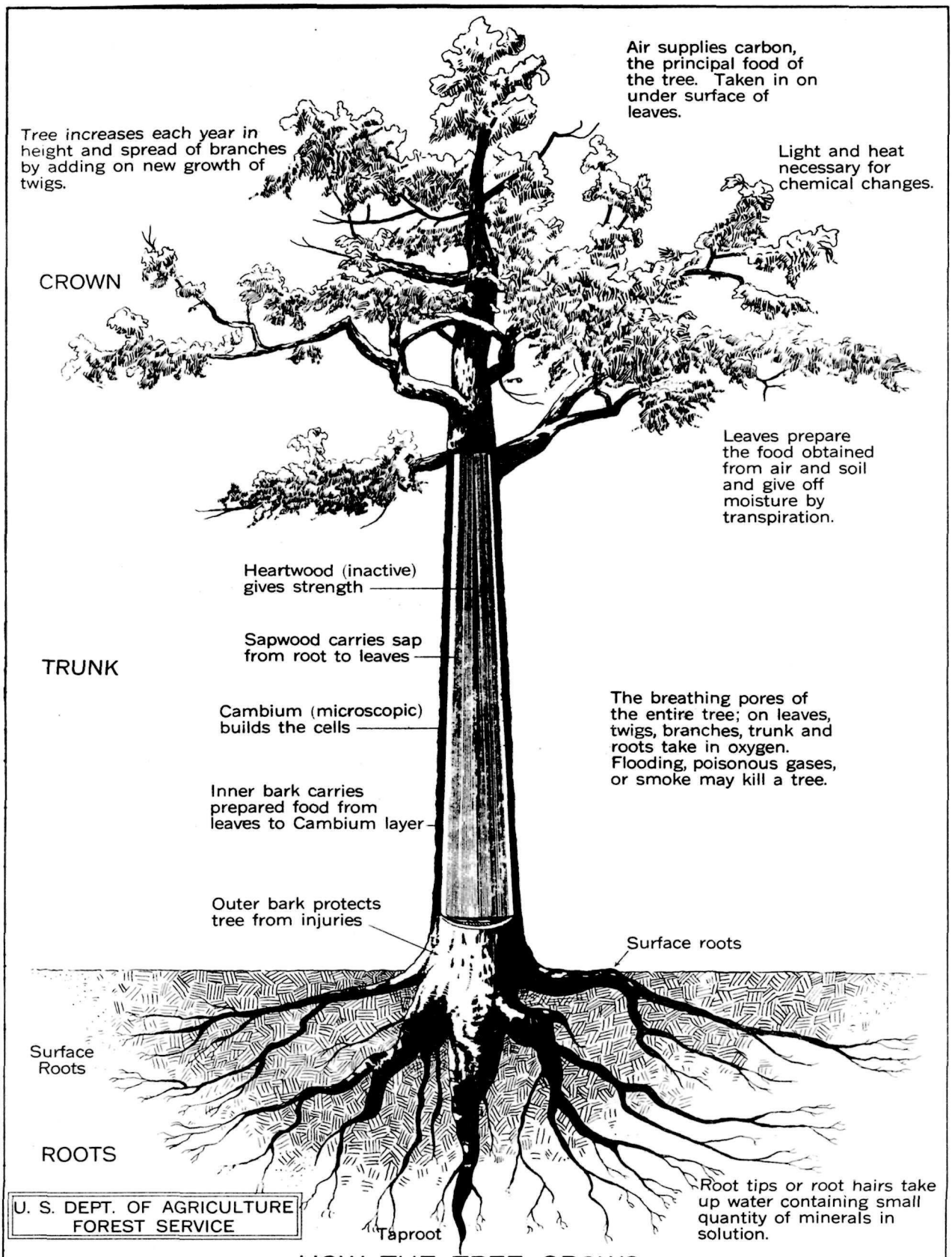
In some species of wood, such as the maples, gums, and yellow poplar, there is no appreciable difference in the structure and properties of the wood formed early and later in the season.

Sapwood and Heartwood:

The sapwood contains living cells and takes an active part in the life processes of the tree. The heartwood consists entirely of inactive tissue and serves primarily to give strength to the tree trunk. As a tree grows in diameter, the inner sapwood changes to heartwood, the change consisting principally in the living cells becoming inactive and the deposit of small amounts of additional materials, usually colored, in the cell cavities and the cell walls. In certain species, the portion of such infiltrated material that can be extracted with ordinary solvents is from 5 to 15 per cent of the dry weight of the wood, but in most species it is less. In some species, such as the ashes, hickories, and certain oaks, the pores become plugged to greater or less degree with ingrowths, known as tyloses, before the change from sapwood to heartwood takes place. Sapwood should not be considered as immature or unripe wood, but rather as mature living wood. In contrast with the physiologically inactive heartwood.

Sapwood varies greatly in width in different species of trees and even in the same species, the width within a species depending on the vigor and the age of the tree. It is rarely more than 1½ inches thick in most of the cedars, Douglas fir, the spruces, chestnut, and black walnut; but frequently is more than 3 inches thick in the maples, hickories, white ash, some of the southern yellow pines, and ponderosa pine.

Although the heartwood is usually darker in color than the sapwood, there is little or no difference between them in color in the spruces (except Sitka spruce), hemlock, the true or balsam firs, Port Oxford cedar, basswood, cottonwood, and buckeye. Such species, however, cannot be said to have no heartwood, since other differences in the



HOW THE TREE GROWS

The buds, root tips, and cambium layer are the growing parts of the tree. Water containing a a small quantity of minerals in solution is absorbed by the roots, carried up through the sapwood to the leaves and there combined with carbon from the air to make food. This food is carried by the inner bark to all growing parts of the tree, even down to the root-tips.

properties, such as durability and penetrability of liquids, of the inner and outer portions of the tree trunk usually exist.

There is no consistent difference either in the weight when dry or in the strength of sapwood and heartwood. In some trees, the sapwood may be heavier and stronger, in others the heartwood, depending on the conditions under which the tree was growing at the time the wood was formed. Wood does not change appreciably in these properties in changing from sapwood to heartwood, except in certain species, such as redwood, western red cedar, and black locust, in which the relatively high percentage of infiltrated material in the heartwood increases the weight and certain strength properties:

Wood cells:

Wood cells are of various sizes and shapes and are more or less firmly grown together. (Brown and Panshin, Forsaith, and Jeffrey). In dry wood the cells are hollow and empty for the most part, although some contain deposits of various sorts. Most of the cells in wood are considerably elongated and pointed at the ends, and for that reason are called fibers. The length of wood fibers varies from about one-twenty-fifth inch in hardwoods to from one-eighth to one-third inch in softwoods. The strength of wood, however, does not depend on the length of the fibers, but rather on the thickness and structure of their walls.

In addition to their fibers, hardwoods have cells of relatively large diameters that comprise the pores, or vessels, through which the sap moves.

In both hardwoods and softwoods, strips of cells run at right angles to the fibers, radially in the tree, to conduct sap across the grain. These strips of cells are called rays, wood rays, and medullary rays. In some species of wood, the rays are extremely small; in others, such as sycamore and oak, they form the conspicuous flake or silver grain on quarter-sawed surfaces.

Other cells, known as wood parenchyma cells, store food; they occupy a relatively small volume in most woods. In the softwoods, there are no special vessels for conducting sap longitudinally in the tree. The wood fibers, which technically are called tracheids, serve this function.

Native species of trees are divided into two classes-hardwoods, which have broad leaves, and softwoods or conifers, which have leaves like needles or scales.

No definite degree of hardness divides the hardwoods and the softwoods. In fact, many hardwoods are actually softer than the average softwood. Softwoods are frequently called conifers, or coniferous woods, because virtually all the native species of softwoods bear cones.

Chemical Composition of Wood:

Wood is composed of about 60 per cent cellulose, 28 per cent lignin and minor quantities of other materials. Cellulose is a colorless material insoluble in ordinary solvents, such as water, alcohol, and benzine, and in dilute acids and alkalies. It forms the framework of the cell wall.

Lignin is also insoluble in most ordinary solvents, but more or less soluble in dilute alkalies. It constitutes the cementing material that binds the cells together, and is mixed with cellulose in the cell walls. By dissolving the lignin with suitable reagents, the cells may be separated, as in chemical paper-making processes.

Cellulose and lignin are responsible for many of the general properties of wood, such as its hygroscopicity, resistance to corrosion by salt water and dilute acids, and susceptibility to decay. These two major constituents are found in about the same proportions in all species, but in addition there are small quantities of other materials in wood, some of which give certain species or groups of species clearly distinctive characteristics. Color, odor, and natural resistance to decay, for example, come from materials other than cellulose or lignin (Hawley and Wise, and Schorger).

CHAPTER III

SELECTION OF LUMBER FOR FARM AND HOME BUILDING

Wise selection of lumber involves first of all singling out the determining requirements of the job. Good judgment and keen insight applied in this connection yield high returns in ultimate satisfaction. After the requirements have been determined it is relatively easy to check the properties of the different woods to see whether these requirements would be met.

One readily jumps at the conclusion that he wants a wood of high strength for the siding of his house or barn when what he really needs is good painting qualities and good weather-resisting properties and ability to stay in place rather than strength. Or, more typically, he may think at first that he wants high bending strength for the joists for his house, whereas he really wants stiffness rather than strength and needs especially to be concerned with dryness, ability to stay in place, and minimum tendency toward shrinkage.

The number of uses and the variation in service requirements that a wood must meet are so numerous that it is practically impossible to classify woods in accordance with their suitability for the various uses on strictly factual data. There is, however, available the mature judgment of technical workers who have for years been impartially studying and testing the various woods and have observed the service rendered by many woods under varying conditions of service. The opinion of such workers has been used to supplement the factual data in the preparation of the following classification of woods for principal farm and home uses. To delay classifying woods for the various uses until complete factual data are available would result in an indefinite postponement.

The species have been classed conservatively. The classification, if followed literally, therefore, will not lead the user astray with respect to the results to be obtained in service. An occasional species may be underrated for a use or the range of suitability of species may be underestimated. These imperfections resulting from limited data and the fallibility of human judgment may adversely affect the marketing of a species, but they are on the side of safety from the consumers' standpoint. In view of the need and demand for a simple, straight-forward classification of wood, especially at this time of greatly increased building activity, minor imperfections do not warrant withholding from the public the best possible advice obtainable from techanical workers in the public employ.

The classification is simple and applies to average typical conditions under which wood serves in a particular use. No attempt has been made to draw fine distinctions between woods. Neither is it to be inferred that all woods in the same class are equally suitable.

PRODUCTS OF FOREST TREES

DIRECT PRODUCTS

Fuel Wood
Christmas Trees
Acorns and Nuts
Fruit (Berries, Cherries)
Decorative Material

CONVERTED AND DERIVED PRODUCTS

Unmanufactured Products

LOGS

- Pulp Wood
- Extract Wood
- Bark
- Resins, Gums
- Sap (Maple)
- Fuel Wood
- Mine Timbers (round)
- Poles
- Piling
- Posts

Semi-Manufactured Products

- Wood Pulp
- Tannins
- Acids
- Dyes
- Oils
- Rosin, Pitch
- Charcoal
- Lumber
- Cross Ties
- Switch Timbers
- Beams
- Girders
- Billets
- Bolts
- Veneer Blocks
- Cooperage Stock
- Cants
- Flitches
- Squares

Manufactured Products

- Wood Pulp
- Cellophane
- Rayon
- Gun Cotton
- Lacquers
- Vulcanized Fiber
- Magazine Paper
- News Paper
- Book Paper
- Wrapping Paper
- Tissue Paper
- Paper Plates
- Leather (artificial)
- Wood Flour
- Lumber
- Timbers
- Rafters
- Joists
- Studding
- Flooring
- Moulding
- Paneling
- Doors
- Frames
- Lath
- Shingles
- Fixtures
- Furniture
- Barrels
- Baskets
- Boxes
- Crates
- Caskets
- Tanks
- Ladders
- Handles
- Pipes
- Pencils
- Toothpicks
- Matches
- Toys
- Spools

Many different kinds of products used in our everyday life come from Forest Trees.

SUITABILITY OF WOODS FOR VARIOUS USES

Exterior Trim (House)

Usual Requirements:

Medium decay resistance, good painting and weathering characteristics easy-working qualities, maximum freedom from warp.

Woods combining usual requirements in a high degree:

Cedars, cypress, redwood. (Adapted to blinds, rails, and balcony at porch trim, where decay hazard is high).
Northern white pine, sugar pine, western white pine, yellow poplar. (Adapted to ordinary trim where decay hazard is moderate or low.)

Woods for special architectural treatments:

Chestnut, white oak. (Used with natural finish)

Woods combining usual requirements in a good degree:

Hemlocks, ponderosa pine, spruces, white fir. (When drainage is good)
Douglas fir, western larch, southern yellow pine. (Special priming treatment advisable to improve paint-holding qualities)

Grades used:

A, B, or B and Better finish is used in the best construction. C and D finish in more economical construction, and No. 1 or No. 2 boards where appearance is not important.

Flooring (House)

Living Room and Bedroom Flooring

Usual Requirements:

High resistance to wear, attractive figure or color, minimum warp and shrinkage.

Woods combining usual requirements in a high degree:

Hard maple, red and white oak. (Most commonly used hardwoods)
Ash (white), beech, birch, walnut. (Not commonly used)
Hickory, black locust, pecan. (Not commonly available, Hard to work and nail)

Woods combining usual requirements in a good degree:

Cypress, Douglas fir, western hemlock, western larch, redwood, southern yellow pine. (Vertical grain)
Cherry, red gum, sycamore (quartered). (Not commonly available. Highly decorative and suitable where wear is light and maintenance good)

Grades used:

In beech, birch and maple flooring the grade of Firsts is ordinarily used for the better class of homes and Seconds and sometimes Thirds in low-cost jobs. In oak the grade of Clear (either plain or quartered) is used in better class work and Selects and sometimes No. 1 Common in low-cost work. Other hardwoods are ordinarily used in the same grades as oak. When softwood flooring is used (without covering) in better class homes, grade A or B and Better vertical grain is used. Grade D or C (vertical grain) is used in more economical and low-cost homes.

Kitchen Flooring (Uncovered)

Usual requirements:

Resistance to wear, fine texture, ability to withstand washing and wear without discoloring and slivering, minimum warp and shrinkage.

Woods combining usual requirements in a high degree:

Beech, birch, hard maple. (Fine textured)

Woods combining usual requirements in a good degree:

Ash, red and white oak. (Open textured)
Soft maple

Woods combining usual requirements in a fair degree:

Cypress, Douglas fir, western hemlock, western larch, redwood, southern yellow pine. (Vertical grain preferred)
Elm, hackberry, sycamore.

Grades used:

The flooring grades, Seconds in beech, birch and hard maple, and Selects in the Oaks are used in high-priced houses. In more economical construction Thirds in beech, birch, and hard maple, and No. 1 Common or No. 2 Common in the oaks are used. D (vertical grain) is the lowest grade of softwood that proves thoroughly satisfactory in high-class construction. A grade and B and Better grade (vertical grain) are used most extensively. No. 1 and No. 2 are serviceable in low-cost construction but wear unevenly around knots.

Porch Flooring

Usual requirements:

Medium to good decay resistance, medium wear resistance, non-splintering, freedom from warping.

Woods combining usual requirements in a high degree:

Cypress, Douglas fir (vertical grain), western larch, (vertical grain), southern yellow pine (vertical grain), redwood, white oak. (If full drainage is not obtainable only the heartwood of cypress, redwood and

white oak can be given a high rating).

Black locust, walnut. (Usually impractical except when cut from home-grown timber.)

Grades Used:

Grades C to A are used in the better types of homes. No. 1 and No. 2 are used in lower cost homes and are serviceable, but wear unevenly around knots, and the maintenance of paint on the knots is difficult. The superior paint-holding qualities and uniform wearing surface of vertical grain makes it preferred in all grades. Hardwoods, if used at all, should be of Select or No. 1 Common quality.

Framing (House)

Usual requirements:

High stiffness, good bending strength, good nail-holding power, hardness, freedom from pronounced warp. For this use dryness and size are more important factors than inherent properties of the different woods.

Woods combining usual requirements in a high degree:

Douglas fir, western larch, southern yellow pine. (Extensively used)
Ash, beech, birch, maple, oak. (Sometimes used but more difficult to obtain in straight pieces and harder to nail and saw than preceding group)
Cypress, redwood. (Seldom used)

Woods combining usual requirements in a good degree:

Eastern hemlock, western hemlock, eastern spruce, Sitka spruce, white fir. (Extensively used)
Northern white pine, ponderosa pine, sugar pine, western white pine. (Seldom used because of adaptability to more exacting uses. Low strength may be compensated for by the use of larger members)
Chestnut, yellow poplar. (Seldom used)

Woods combining usual requirements in a fair degree:

Elm, red gum, sycamore, tupelo. (Seldom used)

Grades used:

No. 1 Dimension is the usual softwood grade for all framing items in both high and medium-class construction. No. 2 Dimension renders satisfactory service once it is in place, but is not so straight or easily fabricated as No. 1. No. 3 Dimension is serviceable for studs and joists in the more economical and low-cost homes, especially when warped pieces and short lengths resulting from cutting out defects can be used to advantage. When hardwoods are used for framing, sound square edge is used in the better types of construction and for such items as joists, rafters, and sills. Hardwood Common Dimension is used in the more economical type of buildings and for studding in all types.

INTERIOR TRIM (House)

Interior Trim with Natural Finish

Usual requirements:

Pleasing figure, hardness, freedom from warp.

Woods combining usual requirements in a high degree:

Ash, birch, cherry, chestnut, oak, sycamore (quartered) walnut.

Woods adaptable to special selection and architectural treatment:

Pecky cypress; etched or special-grain cypress, Douglas fir, western larch, southern yellow pine; curley or bird's eye maple.
Knotty cedars, ponderosa pine, spruces, sugar pine, white pine. (Lack hardness of the preceding group)

Woods combining usual requirements in a good degree:

Cypress, Douglas fir, western hemlock, western larch, southern yellow pine, redwood beech, maple, red gum. (With conventional treatment)

Grades used:

High-class hardwood interior trim is usually of A grade. The softwood grade A or B and Better is commonly used in high-class construction. In the more economical types of construction C grade is serviceable. D grades requires special selection or some cutting to obtain clear material. Special grades of knotty pine, pecky cypress, and sound wormy oak and chestnut are available to meet special architectural requirements in some types of high-class construction.

Interior Trim with Paint Finish

Usual requirements:

Fine and uniform texture, hardness, absence of discoloring pitch, freedom from warp and shrinkage.

Woods combining usual requirements in a high degree:

Birch, cherry, walnut, yellow poplar.
Northern white pine, ponderosa pine, sugar pine, western white pine. (Where liability to marring is negligible and special priming is used.)

Woods combining usual requirements in a good degree:

Hemlock, redwood, spruce, white fir.
Basswood, beech, red gum, maple, tupelo.
Cypress, Douglas fir, western larch, southern yellow pine, ash, chestnut, oak. (Used satisfactorily where requirements for smoothness of finish are not exacting)

Grades used:

C is the lowest softwood grade commonly used for high-class paint and enamel finish. D can be used but requires some selection or cutting. No. 1 is used for ordinary or rough-paint finishes. In cheaper and more economical homes No. 2 may be used for ordinary or rough-paint finishes. Smooth-paint finishes are difficult to obtain and maintain over knots in No. 1, No. 2 and No. 3 grades. The A trim grade in the hardwoods is used for exacting requirements of high-class paint and enamel finish in high-cost homes. The standard grade of Firsts and Seconds is also used but requires some selection or cutting. No. 2 Common hardwoods are used for interior trim in the low-cost home, but in this class of home, softwoods are generally used for the interior trim that is to be painted.

Lath (House)

Usual requirements:

Low shrinkage, easy nailing, non-discoloration of plaster.

Woods combining usual requirements in a high degree:

Jack pine, lodgepole pine, northern white pine, sugar pine, ponderosa pine, western white pine, spruce, white fir, yellow poplar.

Woods combining usual requirements in a fair degree.

Cypress, Douglas fir, hemlocks, western larch, southern yellow pine, basswood.

Grades used:

Two grades of lath, No. 1 and No. 2, are available in practically all softwoods and in a number of hardwoods. In high-class and in the standard or medium types of construction No. 1 lath is usually used. No. 2 lath meets the less exacting requirements of cottages and lower-cost homes.

Roof Boards (House)

Usual requirements:

High stiffness, good nail holding, small tendency to warp, ease of working.

Woods combining usual requirements in a high degree:

Douglas fir, western larch, southern yellow pine. (Commonly used)
Cypress. (Not commonly used because of adaptability to more exacting uses.)
Ash, beech, birch, chestnut, elm, hackberry, maple, oak, tupelo. (Seldom used because not readily available and hard to work.)

Woods combining usual requirements in a good degree:

Hemlocks, ponderosa pine, spruces, white fir. (Commonly used)
Northern white pine, sugar pine, western white pine, redwood, yellow poplar. (Seldom used because of adaptability to more exacting uses.)

Grades used:

No. 2 boards are used extensively in higher type homes. In more economical construction both No. 2 and No. 3 are used. No. 3 is serviceable but not so tight as No. 2. No. 4 and No. 5 are available in some species but entail waste in cutting. When hardwoods are used No. 2 Common is adapted to the better class houses and No. 3 Common to the more economical.

SASH

Sash used in a Dry Location (Low Decay Hazard)

Usual requirements:

Moderate shrinkage, good paint qualities, freedom from warping, ease of working, screw holding power.

Woods combining usual requirements in a high degree:

Northern white pine, ponderosa pine, sugar pine, western white pine. (Principal woods used for sash)
Cypress, redwood.

Woods combining usual requirements in a good degree:

Douglas fir, western larch, southern yellow pine. (Vertical grain. Use limited by milling and finishing characteristics)

Sash used in a moist location (High Decay Hazard)

Usual Requirements:

High decay resistance. Moderate shrinkage, good paint qualities, freedom from warping, ease of working, screw-holding power.

Woods combining usual requirements in a high degree:

Northern white pine, ponderosa pine, sugar pine, western white pine. (Principal woods used for sash. Require good preservative treatment)
Cypress, cedars, redwood, chestnut. (Heartwood only or sapwood when treated)

Woods combining usual requirements in a good degree:

Douglas fir, western larch, southern yellow pine. (Heartwood only)
White oak (Harder to work and higher shrinkage than the softwoods)

Grades used:

Grades of lumber used for sash are primarily of interest to manufacturers rather than users.

SHELVING (HOUSE)

Shelving with natural or high-class paint finish

Usual requirements:

Stiffness, good finishing qualities, freedom from pitch and warp.

Woods combining usual requirements in a high degree:

Ash, birch, maple, oak, walnut. (Suitable for natural finishes used principally to match interior trim)
Cypress, redwood, yellow poplar. (Suitable for high-class paint finishes, but use limited)
Northern white pine, ponderosa pine, sugar pine, western pine. (Principal woods used for high-class paint finishes)

Woods combining usual requirements in a good degree:

Douglas fir, hemlocks, western larch, southern yellow pine, spruces, white fir, basswood, chestnut. (May be used with either natural or paint finishes)

Shelving with unfinished or plain paint coating

Usual requirements:

Stiffness, ease of working, freedom from pitch and warp

Woods combining usual requirements in a good degree:

Northern white pine, ponderosa pine, sugar pine, western white pine. (Principal woods used)
Cypress, hemlocks, redwood, spruces, white fir, basswood, chestnut, yellow poplar.
Douglas fir, western larch, southern yellow pine. (Softwoods with high stiffness)
Birch, maple, oak. (Seldom used; difficult to work)

Grades used:

The grade best adapted to use depends on the character of the shelving as well as on type of construction. C or a better grade is used for shelves that are to receive a high-class paint or enamel finish. D grade is serviceable but may entail some waste. No. 1 and No. 2 are used for shelving that is unpainted or receives only a rough-paint finish. No. 3 is serviceable, especially when cut into short lengths, but may entail some waste. When hardwoods are used for shelving in closets or storerooms No. 1 or No. 2 Common is used. Thes two grades are suitable for higher class shelving where short-length or narrow, clear cutting can be used to advantage.

SHINGLES (HOUSE)

Usual Requirements:

High decay resistance, small tendency to curl or check, freedom from splitting in nailing.

Woods combining usual requirements in a high degree:

Cedars, cypress, redwood. (Principal shingle woods; heartwood only, edge grain)

Northern white pine, ponderosa pine, sugar pine, western white pine. (Hand-made shingles or shakes from locally grown timber; require good preservative treatment)

Chestnut, white oak. (Hand-made shingles or shakes from locally grown timber; require care in nailing)

Grades used:

In western red cedar, cypress and redwood No. 1 shingles (all heart, edge-grain clear stock) should be used for the longest life and greatest ultimate economy in dwelling roofs. Other all-heart but not edge-grain grades, such as No. 2 in redwood and western red cedar and Bests in cypress are frequently used to reduce the first cost. Other grades permitting sapwood and flat grain are available and are used where low initial cost is the determining factor.

SIDING (HOUSE)

Usual requirements:

Good painting characteristics, easy working qualities, freedom from warp.

Woods combining usual requirements in a high degree:

Cedars, cypress, northern white pine, sugar pine, western white pine, redwood.

Woods combining usual requirements in a good degree:

Western hemlock, ponderosa pine, spruce, yellow poplar.

Woods combining usual requirements in a fair degree:

Douglas fir, western larch, southern yellow pine.

Grades used:

Redwood and cypress are available in special siding grades of Clear Heart, and western red and Port Oxford cedar in a siding grade of Clear. In other softwoods the B and Better siding is used in the highest class of construction. Siding in more economical types of construction is usually of C or D grade, but No. 1 and No. 2 are available in a number of species.

STEPPING (OUTDOOR USE)

Usual requirements:

High decay resistance, non-splintering, good bending strength and wear resistance, freedom from warping.

Woods combining usual requirements in a high degree:

Cypress, white oak (especially when quarter-sawn)
Black locust, walnut. (Usually impractical except when cut from home-grown timber)

Woods combining usual requirements in a good degree:

Douglas fir, western larch, redwood, southern yellow pine. (Vertical-grain heartwood only)

Woods combining usual requirements in a fair degree:

Cedar, Douglas fir, western larch, southern yellow pine. (Flat grain)

Grades used:

C or a higher grade of softwoods and Firsts and Seconds in hardwoods are used in high-class construction. In the less costly construction, No. 1 Common in hardwoods and as low as No. 2 grade in softwoods are used. No. 1 and No. 2 grades in softwoods are serviceable but wear unevenly around knots. Dense No. 1 southern pine is sometimes used in better type homes.

SUB-FLOORS (HOUSE)

Usual requirements:

Requirements are not exacting but high stiffness, medium skrinkage and warp, and ease of working are desired.

Woods combining usual requirements in a high degree:

Douglas fir, western larch, southern yellow pine. (Commonly used)
Cypress, redwood, ash, yellow poplar. (Seldom used because of adaptability to more exacting uses.)

Woods combining usual requirements in a good degree:

Hemlocks, ponderosa pine, spruces, white fir. (Commonly used)
Northern white pine, sugar pine, western white pine. (Seldom used because of adaptability to more exacting uses)
Beech, birch, chestnut, elm, hackberry, maple, oak, tupelo. (Seldom used. Not readily available and hard to work)

Grades used:

No. 2 boards are used extensively in higher type homes. In more economical construction both No. 2 and No. 3 are used. No. 3 is serviceable but not so tight as No. 2. No. 4 and No. 5 are available in some species but entail waste in cutting. When hardwoods are used, No. 2 Common is adapted to the better class houses and No. 3 Common to the more economical.

WALL SHEATHING (HOUSE)

Usual requirements:

Easy working, easy nailing, moderate shrinkage. All woods can be used for sheathing with satisfactory results although some woods are less time-consuming to work than others.

Woods combining usual requirements in a high degree:

Cedar, cypress, hemlocks, northern white pine, ponderosa pine, sugar pine, western white pine, redwood, spruce, white fir, basswood, chestnut, yellow poplar.

Woods combining usual requirements in a good degree:

Douglas fir, western larch, southern yellow pine, cottonwood.

Grades used:

No. 3 grade of softwoods make a serviceable sheathing when covered with good building paper. No. 1 and No. 2 make a tighter coverage but do not warrant omitting use of building paper. No. 4 and No. 5 are used in low-cost homes but are not generally available. They both entail some waste in cutting. When a hardwood is used for sheathing No. 2 Common is adapted to the better type homes, and No. 3 Common to the more economical.

JOISTS, RAFTERS, PLATES (BARN)

Usual requirements:

High-bending strength, good nail-holding power, moderate shrinkage and medium ease of working. Woods of moderate bending strength can be used with fully satisfactory results if lower strength is compensated for by the use of larger members.

Woods combining usual requirements in a high degree:

Douglas fir, western larch, southern yellow pine.
Ash, beech, birch, maple oak. (Hard to nail and work)

Woods combining usual requirements in a good degree:

Cypress, eastern hemlock, western hemlock, redwood, eastern spruce, Sitka spruce, white fir, elm red gum, hackberry, sycamore, tupelo, yellow poplar.

Woods combining usual requirements in a fair degree:

Cedar, northern white pine, ponderosa pine, sugar pine, western white pine, Engelmann spruce, basswood, chestnut, cottonwood. (Strength and stiffness equal to that of strongest species can be obtained by use of larger sizes).

Grades used:

The No. 1 Timber of Dimension grade of most softwood species is used in large barns. Added strength and nail-holding power in large, high-class barns can be obtained by the use of the select merchantable grade of Douglas fir or the Dense No. 1 grade of southern pine. The No. 2 Timber or Dimension grade of all softwood species is used in small and low-cost barns. The hardwood grades used are sound square edge for large barns and common timber for small barns.

Mangers (Barn)

Usual requirements:

Hardness, non-splintering.

Woods combining usual requirements in a high degree:

Ash, beech, birch, black locust, Osage-orange, rock elm, hickory, maple, oak, soft elm, red gum, tupelo.

Woods combining usual requirements in a fair degree:

Cypress, Douglas fir, western larch, southern yellow pine, redwood.

Grades used:

The hardwoods are used in No. 1 Common and No. 2 Common grades, the softwoods in No. 1 or No. 2. In the more economical type of work softwood grades as low as No. 4 and hardwood grades as low as No. 3 Common are sometimes used.

Roof Boards (Barn)

Usual requirements:

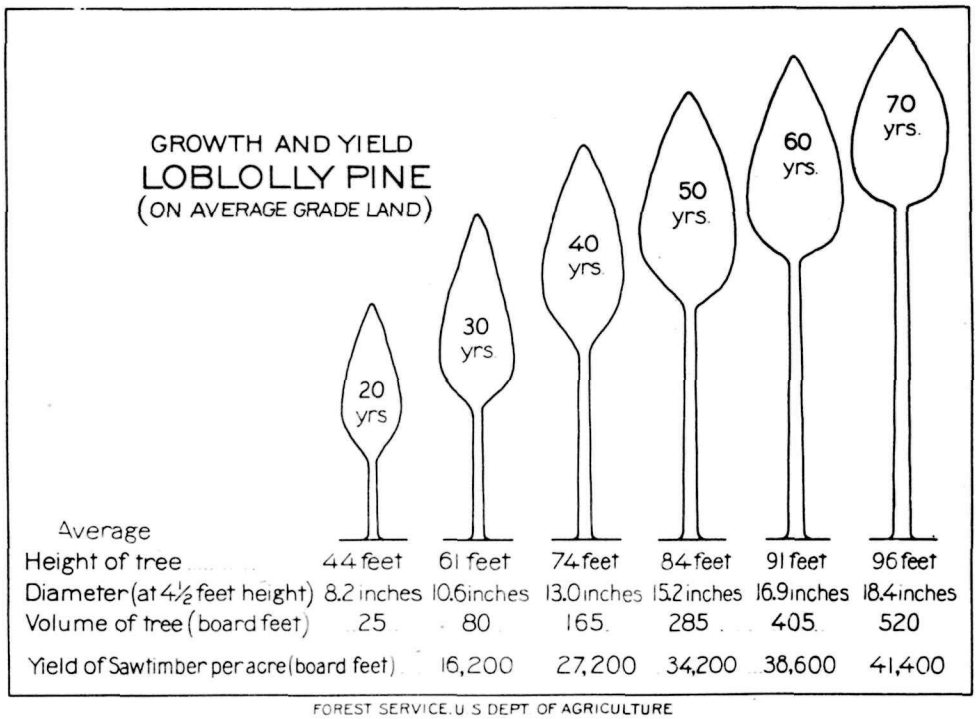
High stiffness, good nail-holding power, low shrinkage, medium decay resistance, freedom from splitting.

Woods combining usual requirements in a high degree:

Cypress, Douglas fir, western larch, southern yellow pine, redwood.

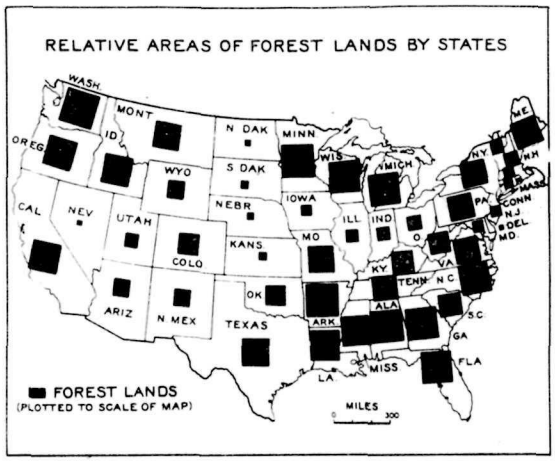
Woods combining usual requirements in a good degree:

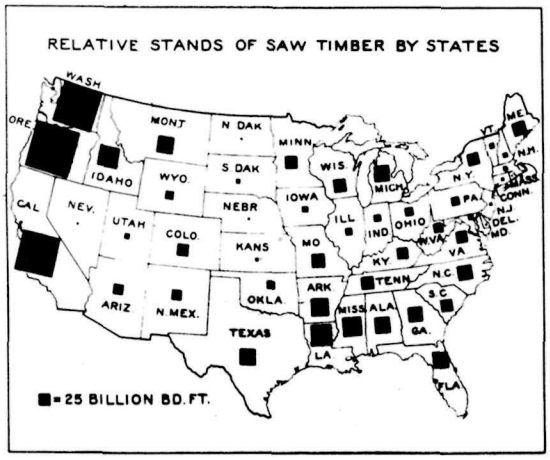
Eastern hemlock, western hemlock, northern white pine, ponderosa pine, sugar pine, eastern spruce, sitka spruce, white fir, beech, birch, maple, red oak. (Render good service in barns having low decay hazard) Chestnut, elm, red gum, white oak, yellow poplar. (Sometimes available from locally grown timber)



Average	20 yrs	30 yrs	40 yrs	50 yrs	60 yrs	70 yrs
Height of tree	44 feet	61 feet	74 feet	84 feet	91 feet	96 feet
Diameter (at 4½ feet height)	8.2 inches	10.6 inches	13.0 inches	15.2 inches	16.9 inches	18.4 inches
Volume of tree (board feet)	25	80	165	285	405	520
Yield of Sawtimber per acre (board feet)		16,200	27,200	34,200	38,600	41,400

FOREST SERVICE, U. S. DEPT. OF AGRICULTURE





Grades used:

No. 1 and No. 2 grades are used in large, high-class barns. No. 2 is serviceable. No. 2 and No. 3 is used in small and low-cost barns. No. 3 may entail some waste in cutting.

Siding and Barn Boards (Barn)

Usual Requirements:

Good painting or weathering qualities, freedom from warping or splitting, medium decay resistance. Medium bending strength in walls without foundation or interior lining.

Woods combining usual requirements in a high degree:

Cypress, redwood. (Adapted to barns without foundation walls or interior lining)

Northern white cedar, western red cedar, chestnut. (Heartwood only. Require foundation wall or interior lining)

Woods combining usual requirements in a good degree:

Northern white pine, ponderosa pine, sugar pine, western white pine, yellow poplar. (Require foundation wall or interior lining)

Douglas fir, western larch, southern yellow pine. (When given special priming coats and protected against weathering by good paint maintenance. Adapted to barns without foundation walls or interior lining)

Woods combining usual requirements in a fair degree:

Hemlocks, eastern spruce, Sitka spruce, white fir.

Grades used:

The grade of bevel siding used is generally higher than the grade used with drop siding or barn boards. When bevel siding is used, it is usually in D to A grades. When drop siding is used, it is usually in B and Better grade in the highest type barns, but No. 2 is serviceable and is used extensively in more economical types of barns. Barn boards are customarily used in lower grades than are either bevel or drop siding. No. 1 is used in the highest type barns and No. 2 in the more economical type. No. 3 and No. 4 barn boards are also used but entail some waste.

Sills and Foundation Walls (Barn)

Usual requirements:

Good nail-holding power, hardness, good decay resistance. High bending strength is important when piers or posts are used in lieu of walls.

Woods combining usual requirements in a high degree:

Cedars, cypress, chestnut, redwood, white oak.

Woods combining usual requirements in a good degree:

Douglas fir, western larch, southern yellow pine, rock elm, yellow poplar. (High in strength and nail-holding. Heartwood has medium decay resistance)

Woods combining usual requirements in a fair degree:

Eastern hemlock, western hemlock, northern white pine, ponderosa pine, sugar pine, western white pine, spruce, white fir, ash, beech, birch, soft elm, maple, red oak, sycamore. (Require good preservative treatment)

Grades used:

Softwood sills in large barns are generally of the No. 1 Timber or No. 1 Dimension grade. No. 2 Dimension is used in small and low-cost barns. Both No. 1 and No. 2 Dimension grades have a high percentage of heartwood. All-heartwood pieces should be selected for sills, especially where foundation walls are low or where condensed moisture is liable to be absorbed by the sills. Hardwood sills are usually of the sound square-edge grade in large barns and of the common-timber grade in small barns.

Stall Flooring (Barn)

Usual requirements:

High decay resistance, uniform hardness (Non-splintering)

Woods combining usual requirements in a high degree:

White oak. (Principal wood used. Adapted to use where horses are sharp-shod)

Black locust, Osage-orange. (Not usually available, adapted to use where horses are sharp-shod)

Ash, beech, birch, elms, black gum, hickory, maple, red oak, tupelo. (Require thorough preservative treatment. Adapted to use where horses are sharp-shod)

Woods combining usual requirements in a good degree:

Cypress, Douglas fir, western larch, southern yellow pine, redwood, red gum. (Heartwood only. Adapted to uses where the wear is light)

Grades used:

The No. 2 Dimension softwood grade is used in all types of construction and is serviceable. No. 3 Dimension in softwoods is sometimes used and is serviceable when sound. The hardwood grades used for stall flooring are No. 1 and No. 2 Bridge Plank.

Stanchions and Stalls (Barn)

Usual requirements:

High bending strength, medium decay resistance, hardness.

Woods combining usual requirements in a high degree:

Rock elm, black locust, white oak, Osage-orange.

Woods combining usual requirements in a good degree:

Ash, beech, birch, soft elm, red gum, hickory, maple, red oak. (Best adapted to use where mechanical wear is more important than decay hazard)

Woods combining usual requirements in a fair degree:

Cypress, Douglas fir, western larch, southern yellow pine, redwood. (Best adapted to use where mechanical wear is less important than decay hazard)

Grades used:

No. 1 or No. 2 Dimension is commonly used although grades as low as No. 4 are used. Grades lower than No. 2 may contain some decay that will require culling or cutting of some pieces. The hardwood grade, sound square edge, is commonly used in the best construction and the common hardwood lumber in more economical construction. The common hardwood lumber may require some cutting.

Studding (Barn)

Usual requirements:

Good stiffness, good nail-holding power, medium freedom from warp, moderate ease of working. In some barns, especially dairy, preservative treated or good natural decay resistance is an added requirement.

Woods combining usual requirements in a high degree:

Douglas fir, western larch, southern yellow pine.
Cypress, redwood. (Heartwood decay resistance is high)

Woods combining usual requirements in a good degree:

Hemlocks, northern white pine, ponderosa pine, western white pine, eastern spruce, Sitka spruce, white fir, chestnut, yellow poplar.

Ash, beech, birch, black locust, maple, oak. (Hard to nail and fabricate)

Elms, red gum, hackberry, sycamore. (Difficult to fabricate because or warped pieces)

No. 1 Dimension is the principal softwood grade used for studding in high-class construction. No. 2 Dimension is serviceable but is more difficult to fabricate because it contains more crooked pieces. No. 2 and No. 3 Dimensions are used in small inexpensive barns. No. 3 entails some waste in cutting. Hardwoods in common dimension are used in all types of construction.

Concrete Forms

Usual requirements:

Good stiffness, good bending strength, resistance to warping and splitting incident to installation and reuse, ease of nailing and cutting. With compensations in size of material or in frequency of bracing, almost all woods can be used in ordinary construction for concrete forms.

Woods combining usual requirements in a high degree:

Cypress, Douglas fir, western larch, southern yellow pine. (High strength and good reuse value)

Western hemlock, eastern spruce, Sitka spruce. (Easy to cut and nail. Reuse high but lack strength of preceding group of woods)

Woods combining usual requirements in a good degree:

Northern white pine, eastern hemlock, ponderosa pine, western white pine, redwood, white fir.

Woods combining usual requirements in a fair degree:

Basswood, beech, birch, cottonwood, gum, maple, oak. (Difficult to assemble or have low reuse value)

Grades used:

No. 1 and No. 2 grades of softwoods and No. 2 Common hardwoods are used in forms with minimum of bracing. Forms in which the spacing is close or the loads are small use No. 2 or No. 3 softwood grades or No. 3 Common hardwoods. No. 4 in softwoods is sometimes used for simple rough forms. The percentage of No. 4 material that can be re-used is smaller than with the better grades.

Fence Posts

Usual requirements:

High decay resistance, narrow sapwood ring, medium bending strength, high nail-holding power. Practically all species can be used if given a good preservative treatment.

Woods combining usual requirements in a high degree:

Black locust, Osage-orange. (Meet all requirements. Not readily available in all parts of the United States)

Chestnut, white oak. (Sawed or split. Heartwood only. Generally available in the eastern states, but life shorter than preceding group)

Cedars, cypress, juniper, redwood, catalpa. (Sawed or split. Heartwood only. Readily available but do not hold nails so well as preceding group)

Woods combining usual requirements in a good degree:

Douglas fir, western larch, southern yellow pine, tamarack. (Sawed or split. Heartwood only)

Woods requiring thorough preservative treatment for long service:

Beech, birch, maple, red oak, elms. (Equal the best woods when given a good preservative treatment)

Hemlocks, spruces, white fir, basswood, cottonwood, red gum, tupelo, yellow poplar.

Grades used:

Fence posts are frequently round and have no standard grades. It is not practical to limit the amount of sapwood in round posts by rules or specifications.

Gates and Fences (Exclusive of Posts)

Usual requirements:

Moderate bending strength, medium decay and weather resistance, high nail-holding power, freedom from warp.

Woods combining usual requirements in a high degree:

Cypress, Douglas fir, western larch, southern yellow pine, redwood, white oak.

Woods combining usual requirements in a good degree:

Cedar, northern white pine, ponderosa pine, sugar pine, western white pine, chestnut, yellow poplar. (Small tendency to warp, weather well but low in strength and nail-holding power)

Beech, birch, red gum, maple, red oak, tupelo. (Strong, hard, high in nail-holding power, but have greater tendency to warp and do not weather so well as preceding group.

Eastern hemlock, western hemlock, white fir, spruce. (Intermediate between preceding groups.)

Grades used:

The No. 1 and No. 2 softwood and No. 2 Common hardwood grades are used in better and more substantial gates and fences. In lighter and more economical gates and fences No. 2 or No. 3 Common hardwood are used. A softwood grade as low as No. 4 may be used but entails some waste.

Scaffolding

Usual requirements:

High bending strength, high stiffness, high nail-holding power, medium weight.

Woods combining usual requirements in a high degree:

Douglas fir, western larch, southern yellow pine, white ash.

Woods combining usual requirements in a good degree:

Cypress, redwood, spruces.
Birch, elm, maple, oak. (Hard to saw and nail)

Woods combining usual requirements in a fair degree:

Sugar pine, ponderosa pine, western white pine.

Grades used:

Structural grades are usually required for scaffolding that must support loads under conditions which involve hazards to life or limb. Light scaffolding should be selected from softwood made of No. 1 Dimension or Better, and in hardwoods, uprights can be selected from Common Dimension and planking from No. 1 Bridge Plank. Selection should eliminate all pieces with large or unsound knots and crossgrain. Some State building codes designate the grades to be used for scaffolding.

Silos, Tanks, and Vats

Usual requirements:

High decay resistance, low shrinkage.

Woods combining usual requirements in a high degree:

Cedar, cypress, redwood. (Heartwood only)
Chestnut, white oak. (Quarter-sawn heartwood only)

Woods combining usual requirements in a good degree:

Douglas fir, western larch, southern yellow pine. (Heartwood only, edge grain)

Grades used:

The requirements for silos, tanks and vats are best met by grades prepared especially for those uses. Such special grades are sold as tank, tank and boat, or silo stock and are available in most of the softwoods well adapted to these uses. The clear-heart grades available in cypress and redwood are also used extensively where requirements are high. There are no special grades in hardwoods for silos, tanks, or vats. Hardwoods, when used, should be bought on special order calling for all-heart, tight stock.

Troughs (Feed) and Supports

Usual Requirements:

Medium decay resistance, medium bending strength, non-splintering, hardness.

Woods combining usual requirements in a high degree:

Cypress, redwood, chestnut, white oak. (Adaptable to use where decay hazard is high)

Douglas fir, western larch, southern yellow pine. (Adaptable to uses that are subjected to rough treatment but only moderate decay hazards)

Grades used:

No. 1 or No. 2 boards are used in the softwoods for large, long troughs. A softwood grade as low as No. 4 can sometimes be used to advantage in troughs in which the lumber is cut to short lengths. Of the hardwoods, No. 2 Common grade is the most used. The No. 3 Common hardwood grade can sometimes be used if the material is cut to short lengths.

Windmill and Well Platforms

Usual requirements:

High decay resistance, good bending strength.

Woods combining usual requirements in high degree:

Cypress, redwood, chestnut, black locust, white oak.

Woods combining usual requirements in a good degree:

Cedar, Douglas fir, western larch, southern yellow pine, rock elm. (Heartwood only)

Grades used:

No. 1 or No. 2 Dimension in softwoods and sound square in hardwoods are the grades ordinarily used.

WORKING QUALITIES OF WOOD

In selecting wood for a given purpose, the ease with which it may be worked is sometimes a factor, especially when hand tools are to be used. No test has been devised for definitely classifying woods as to workability, and the following classification is therefore based on the experience of the Forest Products Laboratory, together with the general reputation of the wood.

Table 7 - Ease of Working with Hand Tools

Easy to Work	Medium to Work	Difficult to Work
	SOFTWOODS	
Cedar, incense	Cedar, eastern red	Douglas, fir
Cedar, northern white	Cypress, southern	Larch, western
Cedar, Port Oxford	Fir, balsam	Pine, southern yellow
Cedar, southern white	Fir, white	
Cedar, western red	Hemlock, eastern	
Pine, northern white	Hemlock, western	
Pine, ponderosa	Pine, lodgepole	
Pine, sugar	Redwood	
Pine, western white	Spruce, eastern	
	Spruce, Sitka	
	HARDWOODS	
Alder, red	Birch, paper	Ash, commercial white
Basswood	Cottonwood	Beech
Buttermut	Gum, black	Birch
Chestmut	Gum, red	Cherry
Poplar, Yellow	Gum, tupelo	Elm
	Magnolia	Hackberry
	Sycamore	Hickory, true and pecan
	Walnut, black	Honeylocust
		Locust, black
		Maple
		Oak, commercial red
		Oak, commercial white

CHAPTER IV.

DEFECTS AND UNFOUNDED BELIEFS

Defects

The defects due to irregularities in the growth of the tree, which render timber unsuitable for the carpenter, are heart shake, wind-shake, star shake, and knots. Other defects, due to deterioration of the timber both before and after it has been placed in a structure, are dry and wet rot. Dry-rot is caused by a fungus growth and takes place most readily when the timber is placed in a structure so that it is alternately wet and dry. If it could be kept perfectly dry, or, on the other hand, constantly under water, it would last indefinitely. For this reason, piles should be cut off below the water level. Dry-rot takes place most rapidly when the wood is confined, such as being buried in a brick wall, so that the gases of disintegration cannot escape.

Wet rot is a form of decay which takes place in the growing tree. It is caused by the tree becoming saturated with water, and may be communicated from one piece of timber to another by contact.

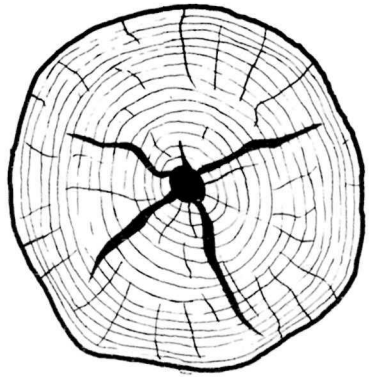
Figure 3 shows what is known as a heart-shake. It is caused by the formation through decay of a small cavity in the heart of the tree which is followed by the formation of radial cracks.

Figure 4 shows a wind-shake which is caused by the separation of the annual rings so that an annular crack is formed in the body of the tree. Such a crack may extend for a considerable distance in the direction of the length of the tree. This defect is said to be caused by the alternate expansion and contraction of the sapwood and the wrenching to which a tree is subjected during high winds.

A star shake is very much like a heart shake, except that the cracks extend across the center of the trunk but without the appearance of decay at that point.

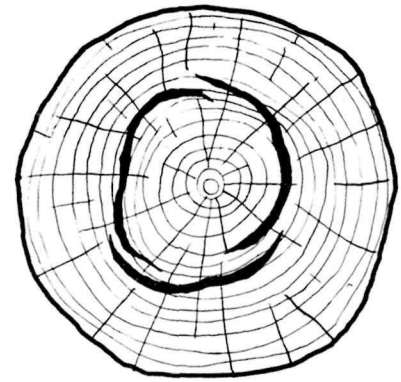
Warping of timber is the result of the evaporation of part of the water held in the cellular wall of the wood in its natural state, and the consequent shrinkage of the piece. If the timber were uniform in structure throughout, the shrinkage would be the same in all parts, and there would be no warping. As already explained, however, wood is made up of a large number of layers of different thicknesses in different parts of the log, so that one layer may shrink more than another in drying. Because of the intimate connection between these layers, one layer cannot shrink or swell without changing the form of those adjacent. The timber as a whole must, therefore, adjust itself to the new conditions, and warping results. The only way to prevent it is to permit the log to dry out or "season" before sawing. After it is once thoroughly seasoned, it will not warp unless it is allowed to absorb more moisture. Figure 5 shows cracks caused by uneven shrinkage.

LUMBER DEFECTS



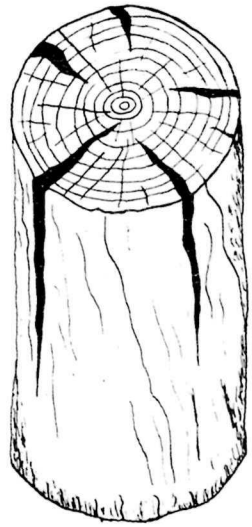
Heartshake

Fig. 3



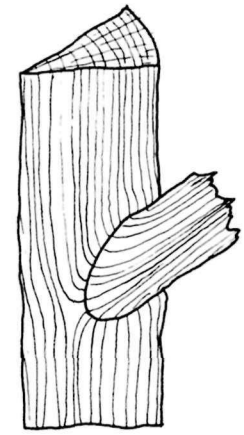
Windshake

Fig. 4



Uneven Shrinkage

Fig. 5



Knots

Fig. 6

Knots occur in all timbers. They form at the junction of the main tree trunk and branches. At such points the fibers in the main trunk are turned aside and follow the branch, as shown in Figure 6. Oftentimes a branch will break off close to the trunk, and if the tree is still growing, the end of the branch will be buried in the trunk. Meanwhile, the branch dies and a knot is formed. Since the dead wood has no connection with the live wood around it, it will work loose in time and drop out when the tree is sawed into lumber. A knot, as long as it remains in place, does not seriously impair a timber subjected to a compressive stress, but it greatly weakens a piece subjected to tension.

Some Unfounded Beliefs

Deadwood:

Because in some instances persons are prejudiced against the use of timber cut from dead trees, it is customary for individuals to specify that only timber cut from live trees will be accepted. It is true, however, that when sound trees which are dead are sawed into lumber and the weathered or charred outside is cut away, the resulting lumber cannot be distinguished from that coming from live trees, except insofar as the lumber from dead trees may be somewhat seasoned at the time it is sawed. It must be remembered that the heartwood of a living tree is fully matured and that in the sapwood only a small portion of the cells are in a living condition. As a consequence, most of the wood cut from trees is already dead even when the tree itself is considered alive.

For structural purposes, it may be said that lumber cut from fire or insect killed trees is just as good as any other lumber, unless the wood has been subject to further decay or insect attack.

Dry-rot:

Loosely used, the term "dry-rot" is applied to any type of dry, crumbly rot, and includes under these circumstances all types of brown decay in wood. The pathologist uses the term "dry-rot" in the limited sense as it applies to the work of certain decay fungi which are frequently found growing in timber where they appear to have access to no moisture. Decay fungi will not grow in perfectly dry wood, and no material decay need be expected in wood used under shelter and maintained in a normal air-dry condition. With moist wood, the fungi are able to penetrate amazingly long distances because they extend their water-supply system by means of slender, minute, porous strands. Fungi of other kinds produce a rot not unlike dry-rot, but brown or yellow in color. The wood in an advanced state is shrunken, and in some places the cracks are filled with a white soggy mass, the wood itself being brittle, friable, and easily crushed into powder.

Virgin and Second Growth:

Occasionally, an order calls for lumber of either virgin growth or second growth. The terms, however, are without significance, as an individual cannot tell one type from the other when they are delivered.

The virgin growth, which is also called old growth or first growth, refers to timber which grows in the forest along with many other trees, and therefore has suffered the consequence of the fight for sunlight and moisture.

The second growth is considered as that timber which grows up with less of the competition for sunlight and moisture which characterized first-growth timber.

Because of environment, the virgin growth is usually thought of as wood of slow-growing type, whereas the second growth is considered as of relatively rapid growth, evidenced by wider annual rings. In such hardwoods as ash, hickory, elm, and oak, these wider annual rings are supposed to indicate stronger and tougher wood, whereas in the conifers, such as pine and fir, this condition is supposed to result in a weaker and brashier wood. For this reason, where strength and toughness are desired, the second growth is preferred among hardwoods, and virgin growth is desired in conifers. Because of the variety of conditions under which both virgin and second growth timbers grow, because virgin growth may have the characteristics of second growth, and because second growth may have the characteristics of virgin timber, it is advisable in judging the strength of wood to rely upon its density and rate of growth, rather than upon its being virgin growth or second growth.

Time of Cutting Timber:

The time when timber is cut has very little to do with its durability or other desirable properties, if, after it is cut, it is cared for properly. Timber cut in the late spring, however, or early summer is more likely to be attacked by insects and fungi. In addition, seasoning will proceed much more rapidly during the summer months; and, therefore, will result in checking, unless the timber is shaded from the intense sunlight. It is stated that there is practically no difference in the moisture content in green lumber, either during the summer or winter.

Air-Dried and Kiln-Dried Wood:

There is a prevailing misapprehension that air-dried lumber is strong or better than kiln-dried lumber. Exhaustive tests have conclusively shown that good kiln-drying and good air-drying have exactly the same results upon the strength of wood. Wood increases in strength with the elimination of moisture content. This has little significance, because in use wood will come to practically the same moisture content whether it has been kiln-dried or air-dried.

The same kiln-drying process cannot be applied to all species of wood. Consequently, it must be remembered that lack of certain strength properties in wood may be due to improper kiln-drying. Similar damage may also result from air seasoning under unsuitable conditions.

Sapwood versus Heartwood:

The belief is common that in some species the heartwood is stronger than the sapwood, and that the reverse is the case in such species as

hickory and ash. Tests have shown conclusively that neither is the case, and that sapwood is not necessarily stronger than heartwood or heartwood stronger than sapwood, but that density rather than other factors makes the difference in strength. In trees that are mature, the sapwood is frequently weaker, whereas in young trees the sapwood may be stronger. Density, proportion of spring and summer wood, then must be the basis of consideration of strength rather than whether the wood be sapwood or heartwood.

Under unfavorable conditions, the sapwood of most species is more subject to decay than the heartwood.

Blue Stain:

In the sapwood of many species of both softwoods and hardwoods, there often develops a bluish-black discoloration known as blue stain. It does not indicate an early stage of decay, nor does it have any practicable effect on the strength of the wood.

Blue stain is caused by a fungus growth in unseasoned lumber. Although objectionable where appearance is of importance, as in unpainted sash or trim, blue stain need cause no concern for framing lumber. Precaution should be taken, however, to make sure that no decay fungus in present with the blue stain.

CHAPTER V

MILL WORK

Sawing Logs into Lumber

The process of "breaking down" a log into lumber consists of sawing into "cants", edging, and trimming.

Some large mills cut slabs and a few boards off the outside, thereby squaring up the log. The squared timber called a "cant", is then cut into smaller cants, which are passed to other machines for cutting into boards and planks.

Edging is the cutting of boards and planks lengthwise so as to square the edges and make the boards of even width, sometimes ripping the lumber to select out the higher grade stock.

Trimming is cross-cutting the stock into standard lengths with square ends. Sometimes defects and poor stock are trimmed out in this process.

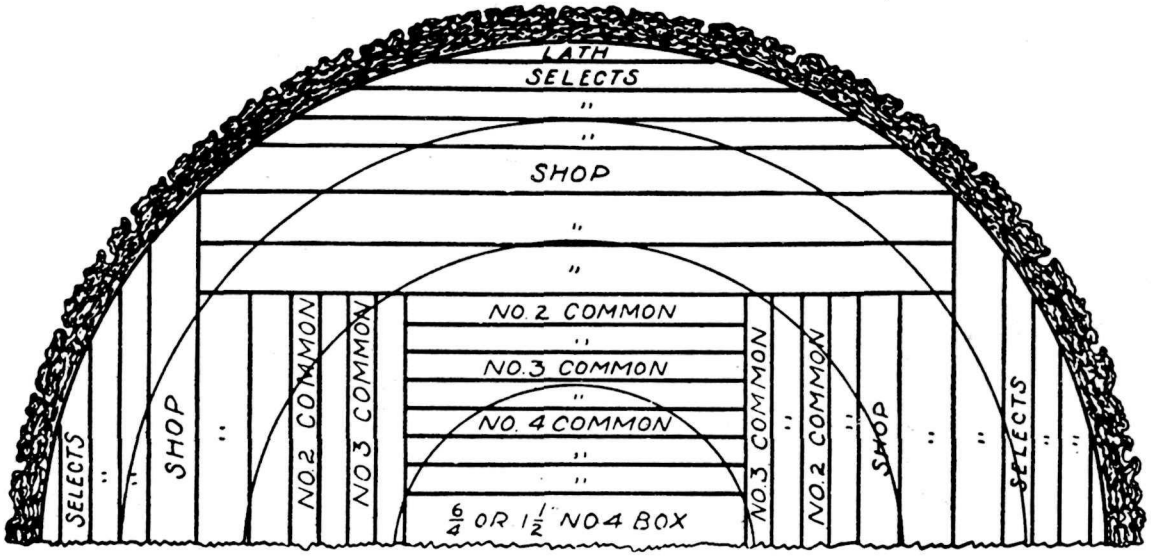
Every effort is made to secure the greatest amount of high-grade lumber from a log, because the best grades bring much higher prices. Knowledge of the values of the various grades of lumber is vitally important to the man in charge of sawing, for the profit in a mill may easily depend upon the judgment employed in "breaking down."

The best part of the log, producing the high-grade lumber, is near the bark, while the center produces the lowest grades. Even sapwood is considered better lumber for many purposes then heartwood, because the latter may have many defects. Northern hardwoods are especially susceptable to defective hearts. A typical Western white-pine log may have No. 4 Common near its center, surrounded by No. 3 Common, then No. 2 Common, with the selects near the bark and reached by taking off only a thin slab.

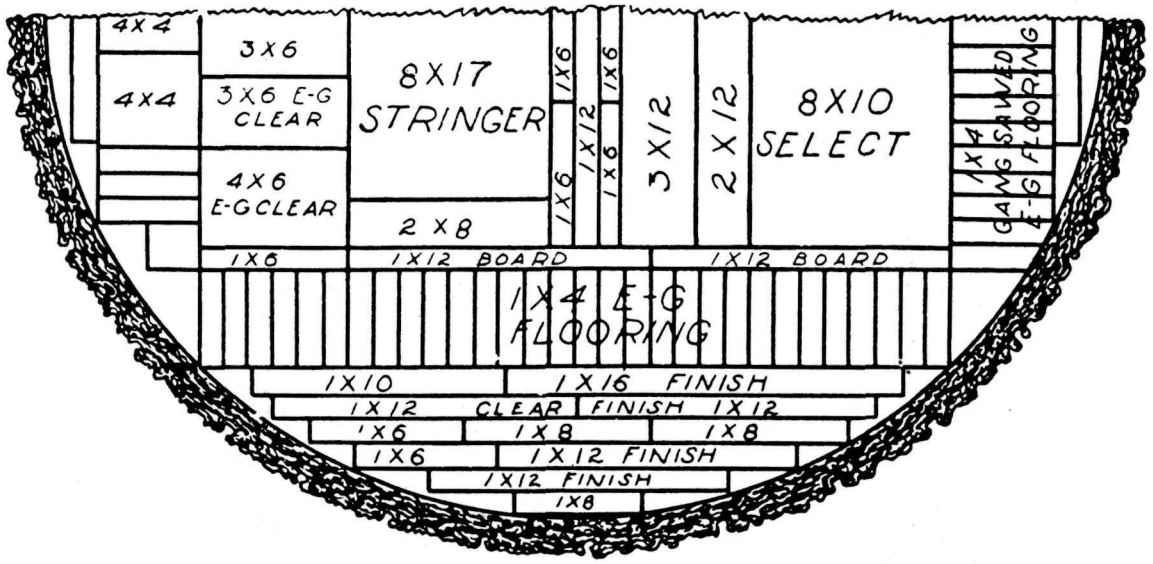
The various kinds of lumber which might be obtained from one log are shown on page 44. It is evident that there must be an established order or method of "breaking down" into lumber, if it is to be done so precisely. Actually, there are two methods.

Sawing "alive" or "through and through" is one method, shown on page 46. It is easier and requires less time, as the log is turned less, remaining in one position practically throughout the operation. But there is more waste, since a board can only be as wide as the small end of the cant.

The other method is sawing "around", always used for large logs. It is shown in the four steps on page 46.



Sawing-Around Method for Western White Pine



Quarter-sawing, shown on page 48, has come into vogue because it exposes the flakes or spots of irregular shape made by the medullary rays of the wood. The flakes exposed in true radially-cut lumber of such woods as oak and sycamore are especially beautiful, and consequently these woods, quarter-sawed, are in great demand for furniture and fine trim.

Standard Patterns

Typical Patterns of Lumber, as shown on Page 50

With softwood flooring, "standard match" means that the upper lip of the groove is thicker than the lower. The thickness of the lower lip is the same for all standard thicknesses of flooring, and hence the difference between upper and lower lips become more pronounced in the heavier thicknesses. Ceiling, which is thinner than 1 inch, is usually machined with a bead and a V. Partition usually has the bead and V also, but on both sides, and it is thicker than ceiling. Drop siding is usually made from 1-inch lumber and probably is made in more patterns than any other product except molding. Some of these patterns are shiplapped, while others are tongued and grooved. Bevel siding is made by resawing 4/4-inch or 5/4-inch lumber on an angle. Square edge lumber in either boards, timbers, or dimensions, of course, forms only rectangles of different dimensions. Boards are frequently dressed and matched (D&M) in which event the tongue and groove are in the center, making the pieces center-matched. For some uses it is considered preferable to shiplap boards.

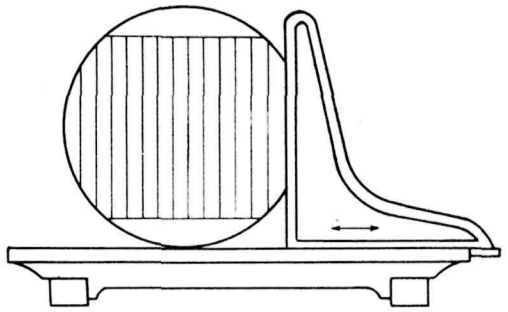
Finish or Select Lumber, Lumber Grades

Select grades provide for good appearance and finishing qualities. Grades A and B are suitable for natural, and grades C and D for paint finishes. In a few species where there is a pronounced difference in color between heartwood and sapwood, and where high natural resistance to decay is required, a grade of clear heart is available.

Grade A is practically clear wood. It is manufactured for such items as finish, flooring, ceiling, partition and siding. A large number of manufacturers do not segregate the grade even in these items, and some of the lumber associations do not recognize the quality as a separate grade. When the grade is not segregated, it is combined with B grade and sold as B and Better. Grade A lumber is used almost entirely for interior and exterior trim and for flooring. The demand is small and confined largely to high-class construction, such as office buildings and the higher-cost residences.

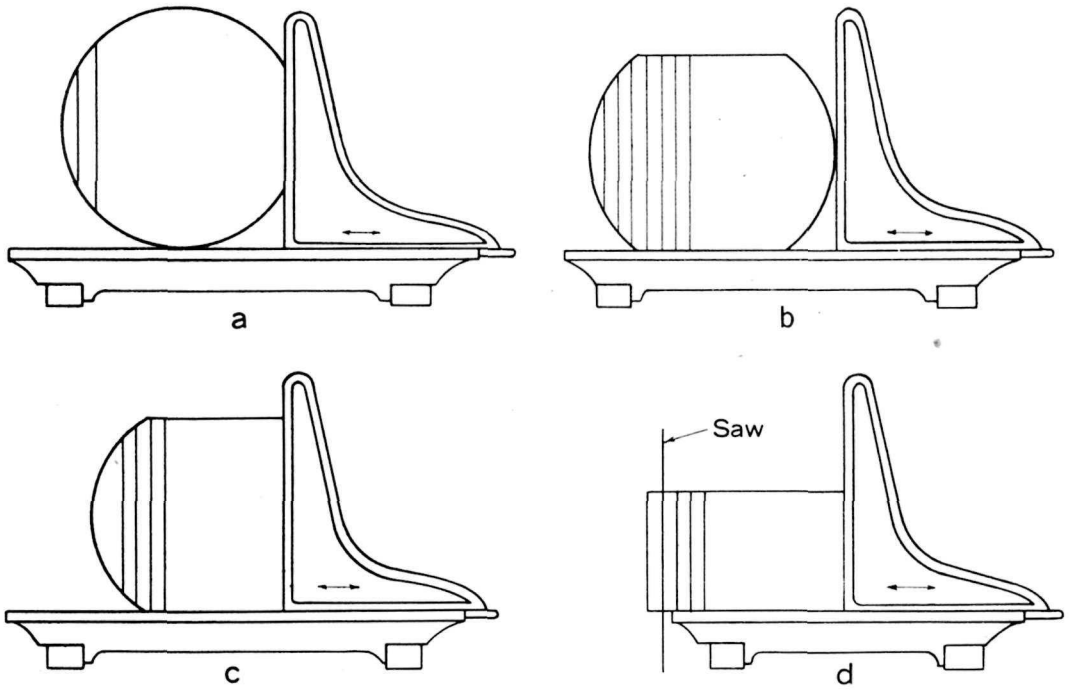
Grade B allows a few small imperfections. In practice, these small imperfections mainly take the form of minor skips in manufacture and small checks or stain due to seasoning, and, depending on the species, small pitch areas, pin knots, or the like. Grade A pieces in the mixed grade are practically clear, but the average board contains 1 to 2 small imperfections. Grade B and Better is the highest quality segregated in a number of woods. In construction, it is the grade most commonly used

HOW A LOG IS SAWED, OR "BROKEN DOWN" INTO LUMBER



Sawing Alive or Through and Through

Fig. 8



Sawing Around

Fig. 9

for high-class interior and exterior trim, especially where these are to receive a natural finish. It is the principal grade used for flooring in homes, office, and public buildings. In industrial uses, it meets the special requirements for large sized practically clear stock.

Grade C is classified as allowing a limited number of small imperfections that can be easily covered with paint. Specifically, the number of these per board average about twice that of B and Better, and the proportion of them in grade C that are small knots is greater than in B and Better. Grade C lumber is especially adapted to use where a high-class paint finish is desired. It is, therefore, popular for cornice, and other exteriors of dwellings, porch flooring, porch columns, trim for bedrooms and kitchens, built-in kitchen fixtures, and siding for the better class of structures. It is used to some extent for natural finishes in medium and low-priced dwellings and offices.

Grade D is classified as allowing any number of surface imperfections that do not detract from the appearance of the finished when painted. In practice the number of such surface features per board averages 3 to 5 times as many as in B and Better. Certain manufacturing and natural imperfections are not much more numerous in grade D than in grade C, but the number and size of the knots in grade D are considerably greater than in grade C, and usually the back is of somewhat lower quality. Commercial grading permits an occasional course knot or hole in grade D that may be cut out with restrictions as to waste. Grade D is in reality a one-face grade--that is, only one face shows in actual use. Grade D is used in construction for the same uses as grade C. It goes into moderate or low-priced houses, furnishing a medium-priced lumber for casing, cornice work, shelving, and built-in fixtures that are to be painted. It is also used extensively for millwork and molding, and is adaptable to industrial uses requiring short-length clear lumber.

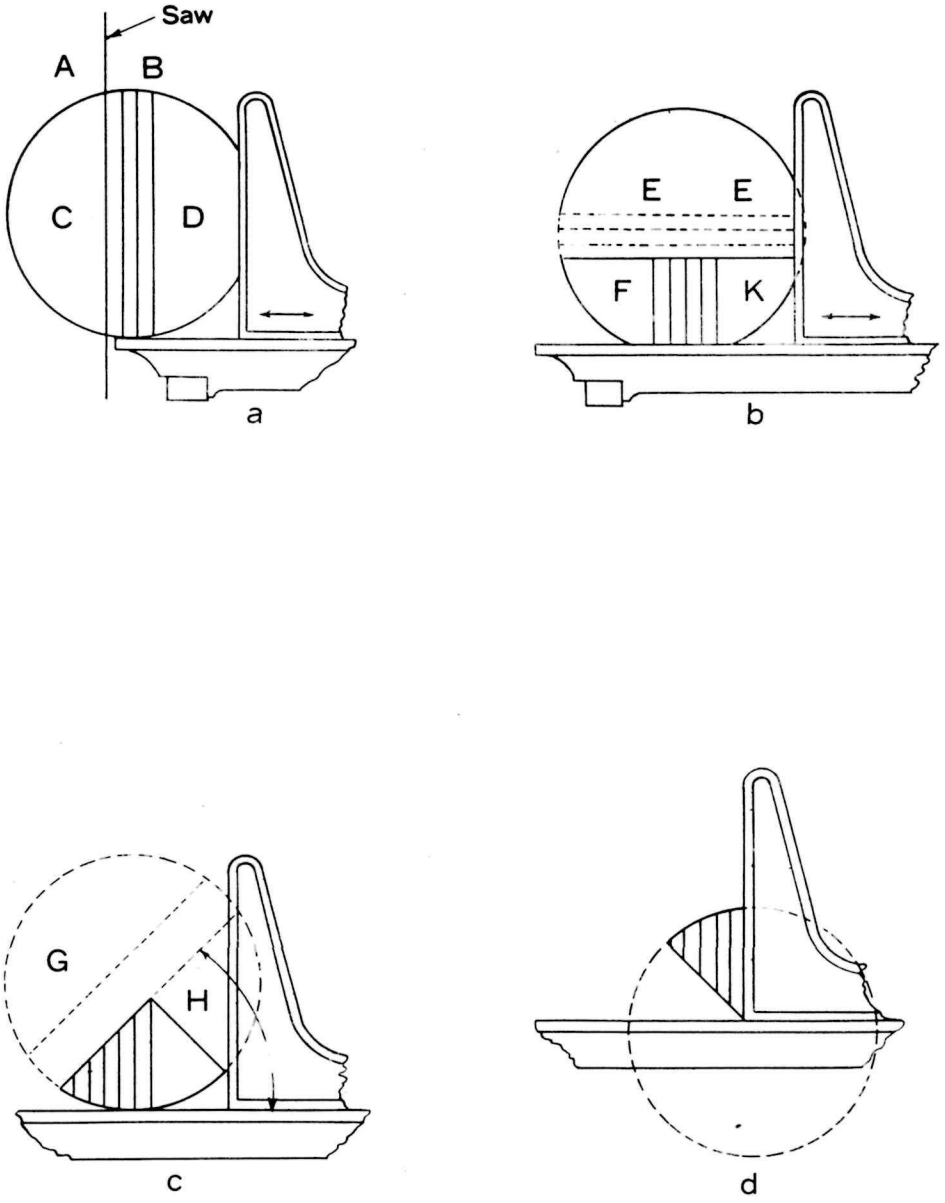
The knots occurring in grade B and Better are predominantly under one-half inch in diameter, and have smooth, hard surfaces. A small proportion of the knots in grade C are as large as 1 inch in diameter, and a few are not of the best quality. A few knots in grade D lumber are more than 1 inch in diameter and in quality are slightly soft, rough, or loose.

Depending on the species, the highest commercially recognized grade may be C and Better, or D and Better, but no such combination of grades, except B and Better, is recognized in American lumber standards unless the actual proportions in the mixed grade are specified in the invoice.

Seasoning faults, such as check, either in flat surfaces or at the ends of boards, are among the more frequent imperfections in the select grades. Imperfect seasoning often causes a lowering of grade, but the number of such occurrences is considerably reduced at plants of careful manufacturers.

Pitch pocket is a relatively common feature in the select grades of several species but occurs less frequently than knots in all the important species except one. The variation among grades in the number and

HOW A LOG IS SAWED, OR "BROKEN DOWN" INTO LUMBER



Quarter Sawing

Fig. 10

size of pitch pockets is not so marked as in the case of knots. The frequency of pitch pockets as compared with other forms of pitch, varies considerably among the species.

Among the other features that are factors in the select grades, are stain and chipped and torn grain.

Boards - Grade Qualities

Grades of boards contain features that detract from the appearance of the finish, but are suitable for general utility and construction purposes. The differences between the various board grades are due to the character more than to the number of such features as knots, pitch, and the like. The number of knots and the like in a board averages in different species about 5 to 20 per 8 board-feet, regardless of grade. No. 1 and No. 2 boards are for use without waste. No. 3, No. 4 and No. 5 boards permit a limited amount of waste.

No. 1 boards are described in the basic classification as sound and tight-knotted stock in which the size of the knot is limited. The provisions further state that it may be considered watertight lumber. In most species practically all boards in the grade contain knots, although in some species pitch is the predominant characteristic of the grade. The size of the knots varies with the species. From one-half to three-fourths of the knots are usually intergrown; the remaining knots are incased, a small proportion of which are unsound, broken, or checked.

No. 1 boards are used in construction, both for finish and covering. As a finishing lumber this grade is used for siding, cornices, and other exterior trim in medium and low-priced homes, and for sheathing and roof boards in the more expensive type of buildings. It is well adapted to coverage for farm buildings, especially where a weathertight structure is required. Its use for interior trim is confined to cheaper construction and where high-class paint finishes are not required. In this grade it is difficult to conceal entirely the knots with paint. The No. 1 board is a general utility item in industrial use. It is used extensively for door and window frames and for backing and concealing parts of furniture and fixtures.

No. 2 boards are classified as allowing large and coarse features, such as knots, that may be considered grain-tight. In practice, a small amount of through-shake, through-pitch pockets, and decay is permitted in the grade. The proportion of large knots is greater than in No. 1, and whereas 33 to 75 per cent of the knots are intergrown, 10 per cent or more are usually unsound, loose, or otherwise partially open. Some commercial grading rules allow knot holes in the grade, provided they are strictly limited as to size and number. No. 2 boards are used primarily as coverage where the wood is not painted or otherwise finished. Subfloors, sheathing and concrete forms are typical uses for the grade. Dressed and matched, it is used for rough flooring in inexpensive farm and factory buildings, garages, warehouses, and the cheaper types of cottages. It is extensively used for barn boards laid up vertically and for the form of drop siding for barns, garages, and warehouses. The popular type of knotty finish is largely selected from this grade. Industrially, No. 2 boards go into the same uses as No. 1 boards, but are

STANDARD PATTERNS

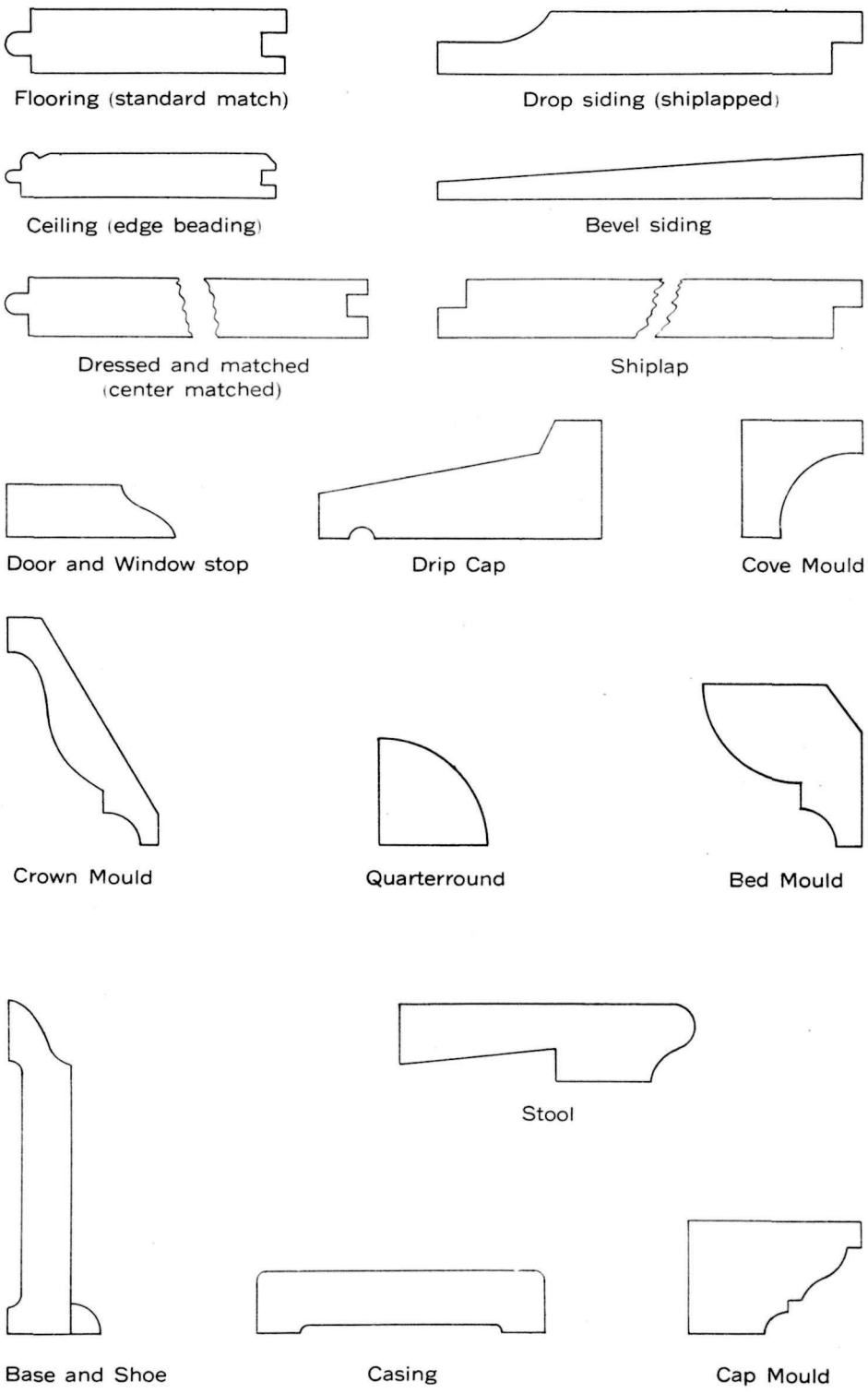


Fig. 11

better adapted to uses requiring short length or small pieces than to uses requiring the board as a whole.

No. 3 boards are classified as allowing larger and coarser knots than No. 2 boards, and also occasional knot holes. A larger portion of large knots and increased amounts of shake, decay, and holes distinguish No. 3 boards from No. 2 boards. No. 3 boards are used in construction for concrete forms, sheathing, sub-floors, roof boards, barn boards, and temporary construction. They fill a demand from builders of less exacting type of buildings for a cheaper material than No. 2. Industrially, it is extensively used for boxes and crates, and in some species for foundry flasks.

Grades No. 4 and No. 5 boards are provided for in American lumber standards but are not produced in some species. No. 4 is described in the basic-grade classification as a low-quality lumber admitting of the coarsest features, such as decay and holes. The only requirement as to the quality of No. 5 lumber is that it holds together under ordinary handling.

No. 4 boards are not graded for use as a whole. They are used for sheathing, sub-floors, and roof boards in the cheaper types of construction. The use of the grade for these purposes involves some additional labor and a small amount of waste in cutting out defective material. Boxes and crates are the most important industrial outlet for the grade.

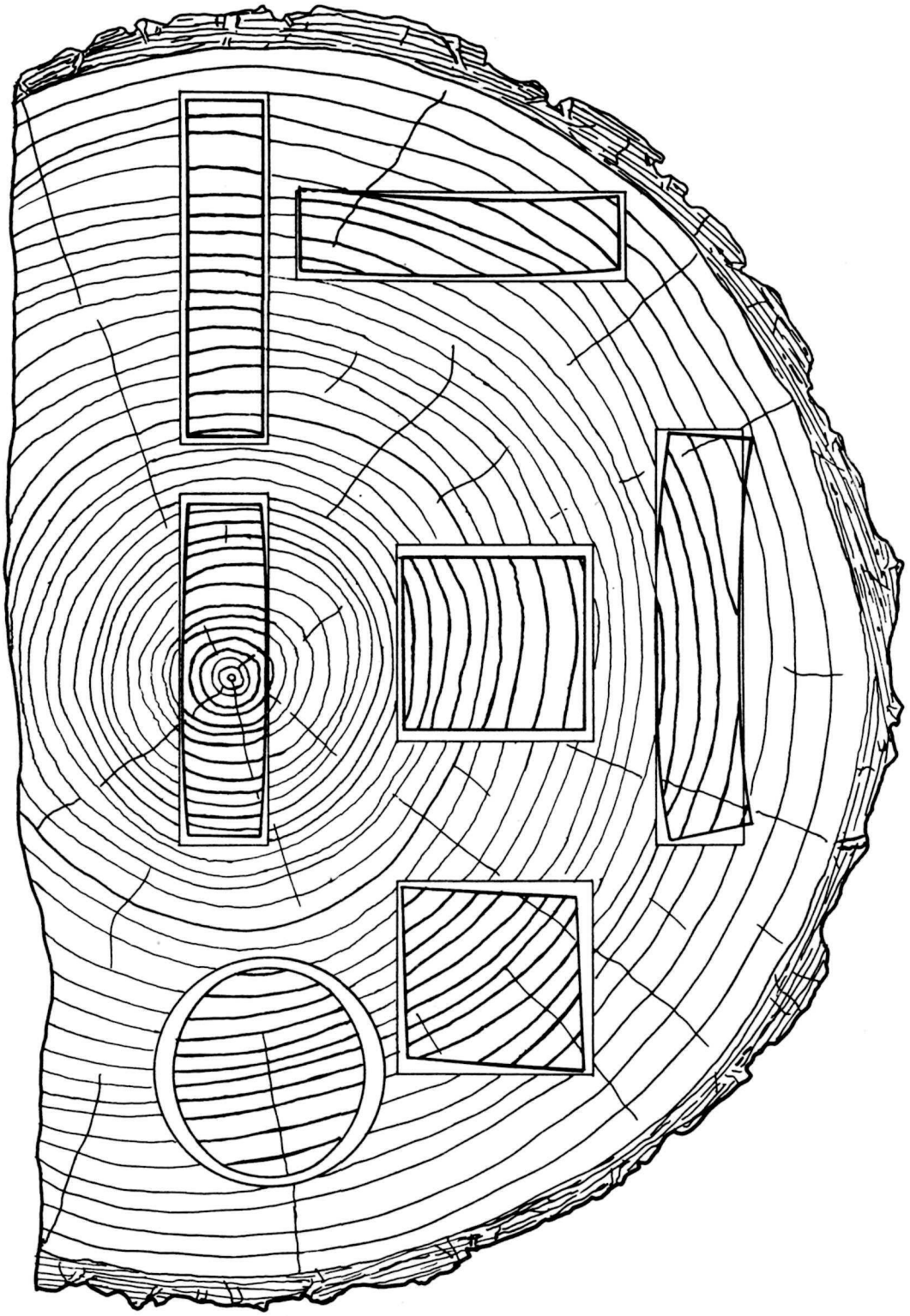
No. 5 boards are seldom shipped far from the mill and are, therefore, not commonly available at retail yards in non-forested regions. They are used for rough and temporary coverage of buildings and for boxes and crates.

In cases where commercial grading rules divide the entire range of boards into 3 grades instead of 5 grades, as in American lumber standards, the first or highest grade of the 3-grade division will normally contain material with a wider range in quality than the first grade of the 5-grade division, and the third or lowest grade of the 3-grade division will contain lower-quality material than the third grade of the 5-grade division. This fact and the differences in inherent properties of different species make it impossible to consider the common grades of corresponding name for the different woods as interchangeable in use.

In most species, one-third to two-thirds of the knots in the grades of boards are intergrown, whereas in the select grades of finish, intergrown knots comprise only a small proportion of the total. Intergrown knots may check if large, but they do not loosen or drop out, as they are integral parts of the wood.

In some species a large number of the incased knots remain tight, but in other species many of them loosen. The loosening becomes more pronounced in large knots and as the lumber becomes drier. As a rule, incased knots comprise a larger percentage of the total number of knots in the small-knotted select grades than they do in the larger-knotted grades of boards.

HOW BOARDS WARP



Spike knots are formed by cutting a branch lengthwise rather than crosswise, as is the case with round knots. Spike knots occur infrequently in grades better than No. 2 boards.

Wood that contains small areas of clearly evident decay is not permitted in grades better than No. 2 boards.

Dimension lumber is from 2 to 5 inches in thickness and of any width. It is manufactured only in Nos. 1, 2 and 3 dimension grades.

Dimension lumber is graded primarily on its strength, stiffness and straightness. Grading is based principally on the requirements of framing for buildings. The dimension grades are best adapted to use where stiffness is the controlling factor, as in joists and studs, or where the size of the member is determined by common building practice rather than specially designed to carry definite live and dead loads. * Rafters of dwelling houses are good examples of members whose size is generally determined by common practice rather than by special design.

No. 1 dimension is a sound grade allowing knots limited in size, depending on the size of the piece. Features, such as pitch, torn grain, checks, and stain, that do not materially affect the strength of the piece, are not limited. Wane is limited to provide good nailing on one side and two edges.

This grade is for joists, rafters, scaffolding, in light framing and for less exacting items in heavier framing. Likewise, it is used for planking for warehouses, platforms, and other heavy-duty flooring, where the wearing surface rather than load-carrying capacity is the important factor. The structural grades of joists and plank should be used in preference to dimension grades for flooring designed to carry heavy loads.

No. 2 dimension admits large, coarse, unsound knots, warped pieces, certain types of decay, has fair nailing edges, and other features that will not weaken the piece to an extent that will render it unfit for use as a whole.

It is used in construction for joists and rafters in medium-priced light-frame construction and for plates, sills, studding, and other vertical load-bearing members in high-priced light construction. It is used as flooring to provide wearing surface where the load is not carried by the wood floor. Industrially, it is used for crating and other uses where short lengths are required.

* Where members are designed to carry heavy loads, and where strength rather than stiffness is the controlling factor, as in heavy construction, the structural grades of joists and plank should be used in preference to the dimension grades, as the structural grades are more scientifically graded and definite working stresses can be assigned to them.

No. 3 dimension is described generally as including all pieces falling below the grade of No. 2 that are suitable for use in cheap building. It admits all features of No. 2 without limitations on size or number, providing they do not seriously affect the utility of the piece or involve waste of more than 25 per cent in one-third of the pieces. It is used for studding in low-priced and temporary light-frame construction. In small buildings, where the members are short, No. 3 dimension may be cut and used with considerable economy.

Structural Material - Size Standards

Structural material is divided into three classes --- joist and plank, beams and stringers, and posts and timbers. Standard lengths in all three classes are in multiples of 2 feet.

The thicknesses and widths adopted as standard for each of the three classes of structural material are given in the following table:

American standard thicknesses and widths for structural material. (The thicknesses apply to all widths, and the widths to all thicknesses)

Structural Item	Thicknesses			Widths		
	Nominal Thickness	Permissible minimum rough thickness	Dressed thickness (S1S or S2S)	Nominal width	Permissible minimum rough width	Dressed width (S1E or S2E)
	Inches	Inches	Inches	Inches	Inches	Inches
Joist and plank	(2	1/8 off	3/8 off	4 to 7	3/16 off	3/8 off
	(3 and 4	3/16 off		8 & wider	1/4 off	1/2 off
Beams & Stringers	(5 and 6	do	1/2 off	do	do	do
	(7 & thicker . .	1/4 off				
Posts & Timbers	(5 x 5.6 x 6 . .	3/16 off	do	5 x 5.6 x 6	3/16 off	do
	(8 x 8 and (larger	1/4 off		8x8 & larger	1/4 off	

COMMON BOARDS

Product	Rough Green or nominal sizes (board measure)		Minimum rough-dry dimensions			Dressed Dimensions		
	Thickness	Width	Thickness		Width	Thicknesses		Width (face when worked)
			Standard yard	Standard Industrial		Standard yard	Standard Industrial	
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Finish	(----------	3	------	------	2-3/4	5/16	------	2-5/8
	(----------	4	------	------	3-5/8	7/16	------	5-1/2
	(----------	5	------	------	4-5/8	9/16	------	4-1/2
	(----------	6	------	------	5-5/8	11/16	------	5-1/2
	(1	7	29/32	39/32	6-5/8	25/32	26/32	6-1/2
	(1-1/4	8	1-3/16	------	7-3/8	1-1/16	------	7-1/4
	(1-1/2	9	1-7/16	------	8-3/8	1-5/16	------	8-1/4
	(1-3/4	10	1-9/16	------	9-3/8	1-7/16	------	9-1/4
	(2	11	1-6/8	1-7/8	10-3/8	1-5/8	1- 6/8	10-1/4
	(2-1/2	12	2-1/4	------	11-3/8	2-1/8	------	11-1/4
	(3	------	2-6/8	------	------	2-5/8	------	------
Common Boards and strips	(1	3	29/32	30/32	2-3/4	25/32	25/32	2-5/8
	(1-1/4	4	1-3/16	------	3-3/4	1-1/16	------	3-5/8
	(1-1/2	5	1-7/16	------	4-3/4	1-5/16	------	4-5/8
	(----------	6	------	------	5-3/4	------	------	5-5/8
	(----------	7	------	------	6-3/4	------	------	6-5/8
	(----------	8	------	------	7-5/8	------	------	7-1/2
	(----------	9	------	------	8-5/8	------	------	8-1/2
	(----------	10	------	------	9-5/8	------	------	9-1/2
	(----------	11	------	------	10-5/8	------	------	10-1/2
	(----------	12	------	------	11-5/8	------	------	11-1/2

Product	Rough Green or nominal sizes (board measure)		Minimum rough-dry dimensions			Dressed Dimensions		
	Thickness	Width	Thickness		Width	Thickness		Width (face when worked)
			Standard yard	Standard Industrial		Standard yard	Standard Industrial	
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Bevel Siding	(------	4	------	------	------	7/16 x 3/16	------	3-1/2
	(------	5	------	------	------	10/16 x 3/16	------	4-1/2
	(------	6	------	------	------	------	------	5-1/2
Wide bevel siding	(------	8	------	------	------	7/16 x 3/16	------	7-1/4
	(------	10	------	------	------	9/16 x 3/16	------	9-1/4
	(------	12	------	------	------	11/16 x 3/16	------	11-1/4
Rustic & Drop siding (shiplapped)	(------	4	------	------	------	9/16	------	3-1/8
	(------	5	------	------	------	3/4	------	4-1/8
	(------	6	------	------	------	------	------	5-1/16
	(------	8	------	------	------	------	------	6-7/8
Rustic & Drop siding (D. & M.)	(------	4	------	------	------	9/16	------	3-1/4
	(------	5	------	------	------	3/4	------	4-1/4
	(------	6	------	------	------	------	------	5-3/16
	(------	8	------	------	------	------	------	7

Product	Rough green or nominal sizes (board measure)		Minimum rough-dry dimensions			Dressed Dimensions		
	Thickness	Width	Thickness		Width	Thickness		Width (face when worked)
			Standard yard	Standard Industrial		Standard yard	Standard Industrial	
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Flooring ----------	(------	2	------	------	------	5/16	------	1-1/2
	(------	3	------	------	------	7/16	------	2-3/8
	(------	4	------	------	------	9/16	------	3-1/4
	(1	5	------	------	------	25/32	------	4-1/4
	(1-1/4	6	------	------	------	1-1/16	------	5-3/16
	(1-1/2	------	------	------	------	1-5/16	------	------
Ceiling ----------	(------	3	------	------	------	5/16	------	2-3/8
	(------	4	------	------	------	7/16	------	3-1/4
	(------	5	------	------	------	9/16	------	4-1/4
	(------	6	------	------	------	1-1/16	------	5-3/16
Partition ----------	(------	3	------	------	------	3/4	-----	2-3/8
	(------	4	------	------	------	------	------	3-1/4
	(------	5	------	------	------	------	------	4-1/4
	(------	6	------	------	------	------	------	5-3/16
Shiplap ----------	(1	4	------	------	------	25/32	------	3-1/8
	(------	6	------	------	------	------	------	5-1/8
	(------	8	------	------	------	------	------	7-1/8
	(------	10	------	------	------	------	------	9-1/8
	(------	12	------	------	------	------	------	11-1/8

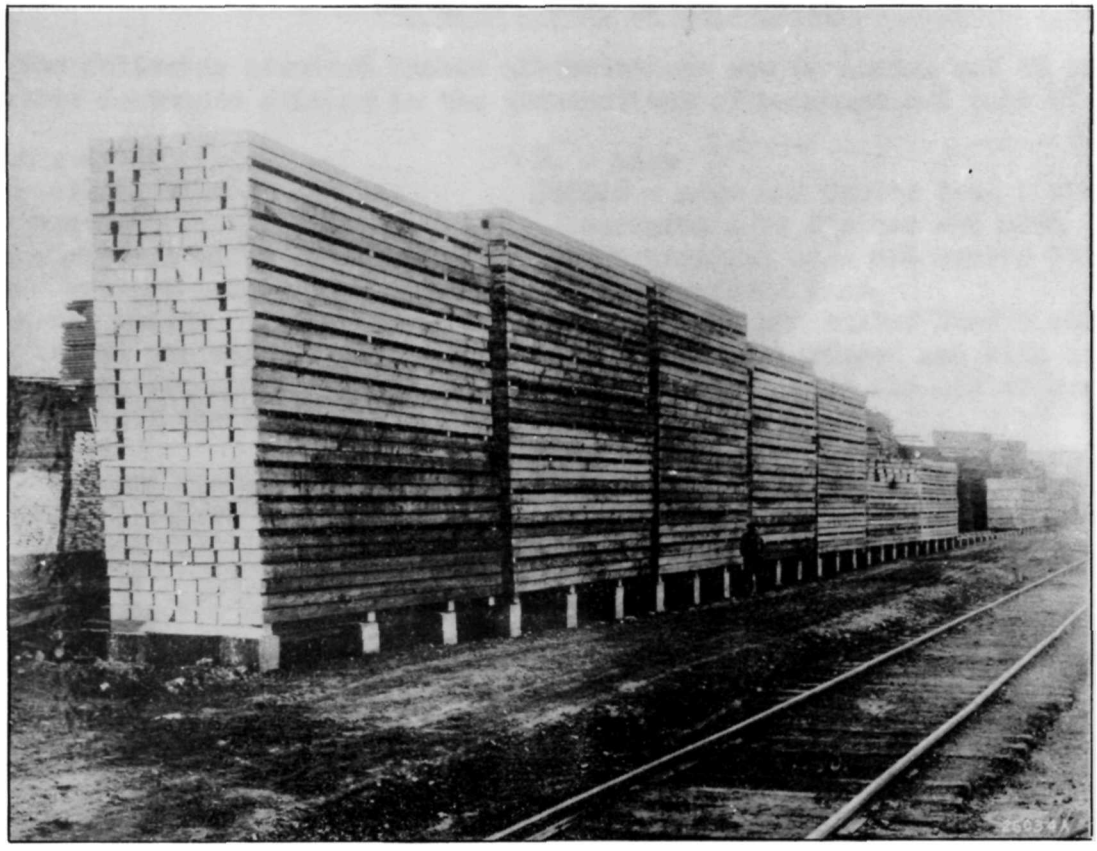
	Rough green or nominal sizes (board measure)		Minimum rough-dry dimensions			Dressed Dimensions		
	Thickness	Width	Thickness: Standard yard	Thickness: Standard Industrial	Width	Thickness: Standard yard	Thickness: Standard Industrial	Width (face when worked)
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Dressed and Matched ---	(1	4	------	------	------	25/32	------	3-1/4
	(1-1/4	6	------	------	------	1-1/16	------	5-1/4
	(1-1/2	8	------	------	------	1-5/16	------	7-1/4
	(------	10	------	------	------	-----	------	9-1/4
	(------	12	------	------	------	-----	------	11-1/4
Dimension and heavy joist	(2	2	1-3/4	1-7/8	1-3/4	1-5/8	1-3/4	1-5/8
	(2-1/2	4	2-1/4	------	3-3/4	2-1/8	------	3-5/8
	(3	6	2-3/4	------	5-3/4	2-5/8	------	5-5/8
	(4	8	3-3/4	------	7-5/8	3-5/8	------	7-1/2
	(------	10	------	------	9-5/8	-----	------	9-1/2
	(------	12	------	------	11-5/8	-----	------	11-1/2
Factory flooring, heavy roofing, heavy decking, and sheet piling ------	(2	4	1-3/4	------	------	1-5/8	------	3
	(2-1/2	6	2-1/4	------	------	2-1/8	------	5
	(3	8	2-3/4	------	------	2-5/8	------	7
	(4	10	3-3/4	------	------	3-5/8	------	9
	(------	12	------	------	------	-----	------	11

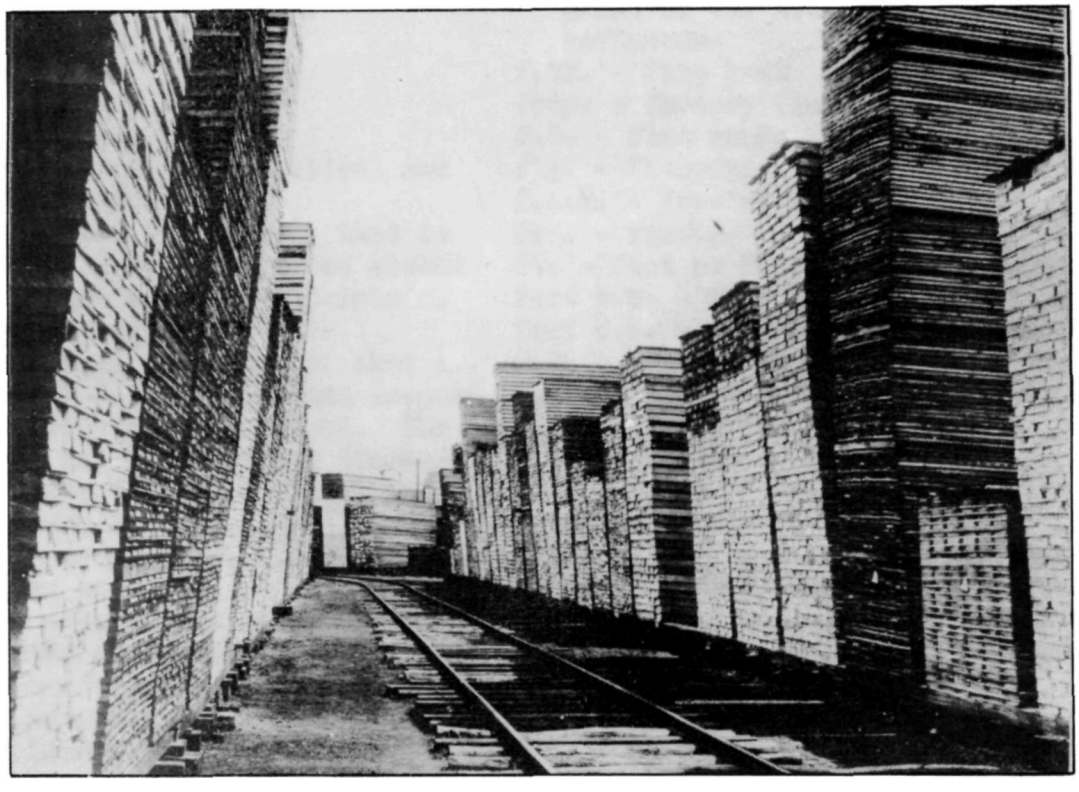
CHAPTER VI

STANDARD LUMBER ABBREVIATIONS

The following standard lumber abbreviations are in common use in contracts and other documents arising in the transactions of purchase and sale of lumber:

AD - air dried
a.l. - all lengths
av. - average
av.w. - average width
av.l. - average length
a.w. - all widths
B1S - beaded one side
B2S - beaded two sides
BBS - box bark strips
bd. - board
bd.ft. - board foot; that is, an area of 1 square foot by 1 inch thick
bdl. - bundle
bdl.bk.s. - bundle bark strips
bev. - beveled
b.m. - board (foot) measure
Btr. - better
Clg. - ceiling
Clr. - clear
CM. - center matched; that is, tongue-and-groove joints are worked along the center of the edge of the piece.
Com. - common
Csg. - casing
Ctg. - crating
cu.ft. - cubic foot
D&CM - dressed (1 or 2 sides) and center matched
D&H - dressed and headed; that is dressed 1 or 2 sides and worked to tongue-and-groove joints on both the edge and ends.
D&M - dressed and matched; that is, dressed 1 or 2 sides and tongued and grooved on the edges. The match may be center or standard.
D&SM- dressed (1 or 2 sides) and standard matched.
D2S&CM - dressed two sides and center matched.
D2S&M - dressed two sides and (center or standard) matched.
D2S&SM - dressed 2 sides and standard matched.
Dim. - Dimension
D.S. - drop siding
E. - edge
E&CB1S - edge and center bead 1 side; surfaced 1 or 2 sides and with longitudinal edge and center bead on a surfaced face.
E&CB2S - edge and center bead 2 sides; all 4 sides surfaced and with a longitudinal edge and center bead on the 2 faces.
ECM - ends center matched
E&CV1S - edge and center V 1 side; surface 1 or 2 sides and with a longitudinal edge and center V-shaped groove on a surfaced face.
E&CV2S - edge and center V 2 sides; all 4 sides surfaced and with a longitudinal edge and center V-shaped groove on each of the 2 faces.
E.G. - edge grain
EM - end matched - either center or standard.
ESM - ends standard matched
FAS - Firsts and seconds - a combined grade of the two upper grades of hardwoods.
f.bk. - flat back
fcty. - factory (lumber)
F.G. - flat grain
flg. - flooring
f.o.k. - free of knots
Frm. - framing
ft. - foot or feet. Also one accent (')
feet b.m. - feet board measure
feet s.m. - feet surface measure
G.R. - grooved roofing
H.bk. - hollow back
Hdl. - handle (stock)
Hdwd. - hardwood
Hrt. - heart
Hrtwd. - Heartwood
1s&2s. - ones and twos - a combined grade of the hardwood grades of firsts and second.
in. - inch or inches. Also two accent marks ('')
KD. - kiln-dried
k.d. - knocked down
lbr. - lumber





Good Examples for Stacking Lumber

lgth. - length
lgr. - longer
lin.ft. - lineal foot; that is, 12 inches
Lng.- lining
LR. - log run
Lr.MCO. - log run, mill culls out.
Lth. - lath
M. - thousand
M.b.m. - thousand (feet) board measure
MCO. - mill culls out
Merch. - merchantable
m.l. mixed lengths
Mldg. - moulding
MR. - mill run
M.s.m. - thousand (feet) surface measure
m.w. - mixed widths
No. - number
Ord. - order
P. - planed
Pat. - pattern
Pky. - pecky
Pln. - plain, as in plain sawed
Pn. - partition
Qtd. - quartered - when referring to hardwoods
rdm. - randon
res. - resawed
rfg. - roofing
Rfrs. - roofers
rip. - ripped
r.l. - random lengths
rd. - round
R.Sdg. - rustic siding
r.w. - random widths
S&E - surfaced 1 side and 1 edge
S1E - surfaced one edge
S2E - surfaced two edges
S1S - surfaced one side
S2S - surfaced two sides
S1S1E - surfaced 1 side and 1 edge
S2S1E - surfaced 2 sides and 1 edge
S1S2E - surfaced 1 side and 2 edges
S4S - surfaced four sides
S4SCS - surfaced 4 sides with a calking seam on each edge
S&CM - surfaced 1 or 2 sides and center matched
S&M - surfaced and matched; that is, surfaced 1 or 2 sides and tongued and grooved on the edges. The match may be center or standard.
S&SM - surfaced 1 or 2 sides and standard matched.
S2S&CM - surfaced 2 sides and center matched.
S2S&M - surfaced 2 sides and center or standard matched
S2S&SM - surfaced 2 sides and standard matched
Sap. - sapwood
SB - standard bead
Sd. - seasoned
Sdg.-siding
Sel. - select
S.E.Sgd. - square-edge siding
s.f. - surface foot; that is, an area of 1 square foot.
Sftwd. - softwood
Sh.D. - shipping dry
Ship. - shiplap
s.m. - surface measure
SM. - standard matched
smkd. - smoked (dried)
Smk.stnd.- smoke stained
s.n.d. - sap no defect
snd. - sound
sq. - square
Sq. E.&S. - square edge and sound
sqrs. - squares
Std. - standard
stnd. - stained
stk. - stock
S.W. - sound wormy
T&G - tongued and grooved
TB&S - top, bottom and sides
Tbrs. - timbers
Thickness - 4/4, 5/4, 6/4, 8/4, etc. 1 inch, 1¼ inches, 1½ inches, 2 inches, etc.
V1S - V 1 side; that is, a longitudinal V-shaped groove on 1 face of a piece of lumber.
V2S - V 2 sides; that is, a longitudinal V-shaped groove on 2 faces of a piece of lumber
V.G. - vertical grain
w.a.l. - wider, all lengths
Wth. - width
Wdr. - wider
Wt. - weight

CHAPTER VII

GLOSSARY

Air-Dried: Air-dry condition is the normal condition, with respect to moisture, of wood exposed to the air, although this condition may have been obtained by artificial means. The term "air-dried" means dried by exposure to air, while "kiln dried" indicates artificial drying.

Air-dry is a very general term and may mean any degree of dryness from about 6 per cent moisture, as in furniture stock, to over 30 per cent moisture, as in timber dried to reduce its shipping weight. The degree of dryness in timber depends upon species, size, and the conditions under which the material is dried, especially such as humidity, method of piling, shelter, time of drying, etc. For instance, the wood of the conifers dries much more rapidly, on the average, than that of the hardwoods. Douglas fir bridge timbers will fall to about 30 per cent moisture in 2 years. Inch lumber of the same species, under the same conditions will dry to 15 per cent moisture in considerably less time, and small-sized timber dried in a heated room will in some cases reach 6 per cent moisture. The same species, in the same sizes, piled in the same manner under shelter out of doors, will scarcely ever fall below 12 per cent moisture.

American Lumber Standards: American lumber standards embody provisions for softwood lumber dealing with recognized classifications, nomenclature, basic grades, seasoning standards, sizes, uniform workings, description, measurement, tally, shipping provisions, grade marking, tally cards, and inspection of lumber. The primary purpose of these standards is to serve as a guide or basic example in the preparation or revision of the grading rules of the various lumber manufacturers' associations; their use as a framework for such rules will eliminate differences often existing. A purchaser in order to buy in conformity with American lumber standards must make use of association rules that are in conformity with them, as the basic standards are not in themselves commercial rules.

Annual Growth Ring: (See Ring, Annual Growth)

Bastard Sawn: Hardwood lumber in which the annual rings make angles of 30° to 60° with the surface of the piece.

Beams and Stringers: Large pieces (nominal dimensions, 5 x 8 inches and up) of rectangular cross section graded with respect to their strength in bending when loaded on the narrow face.

Birdseye: A small central spot with the wood fibers arranged around it in the form of an ellipse, so as to give the appearance of an eye.

Blemish: Anything not necessarily a defect; marring the appearance of wood.

Blue stain: (See Stain, blue)

Boards: (See lumber)

Bow: That distortion of a board in which the face is convex or concave longitudinally.

Boxed Heart: The term used when the pith falls entirely within the four faces anywhere in the length of a piece.

Brashness: A condition of wood characterized by low resistance to shock and by an abrupt failure across the grain without splintering.

Broad-leaved Tree: (See Hardwoods)

Brown Stains: (See Stain, Brown)

Burl: A large wartlike excrescence on a tree trunk. It contains the dark piths of a large number of buds which rarely develop. The formation of a burl apparently results from an injury to the tree.

Cambium: The layer of tissue just beneath the bark from which the new wood and bark cells of each year's growth develop.

Cell: A general term for the minute units of wood structure. It includes fibers, vessel segments, and other elements of diverse structure and function.

Cellulose: The carbohydrate that is the principal constituent of wood and forms the framework of the cells.

Check: A lengthwise separation of the wood, the greater part of which occurs across the rings of annual growth.

Chemical Brown Stain: (See Stain, Chemical Brown)

Close-Grained Wood: (See Grain)

Coarse-Grained Wood: (See Grain)

Collapse: The flattening of single cells or rows of cells in heartwood during the drying or pressure treatment of wood, characterized externally by a caved-in or corrugated appearance.

Compartment Kiln: (See Kiln)

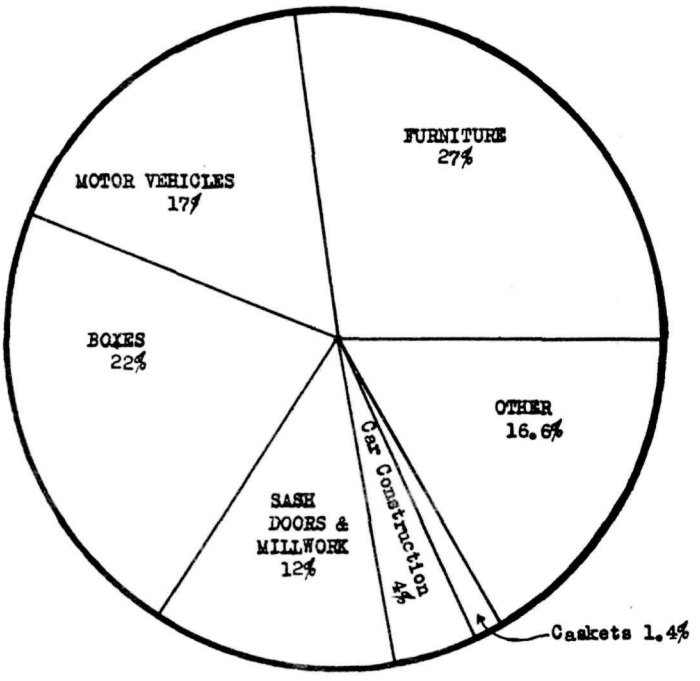
Compression Wood: Abnormal wood that often forms on the lower side of branches and of leaning trunks of softwood trees. Compression wood is identified by its relatively wide annual rings, usually eccentric, and its relatively large amount of summer wood, usually more than 50 per cent of the width of the annual rings in which it occurs. Compression wood shrinks excessively lengthwise as compared with normal wood.

Conifer: (See softwoods)

Crook: That distortion of a board in which the edge is convex or concave longitudinally.

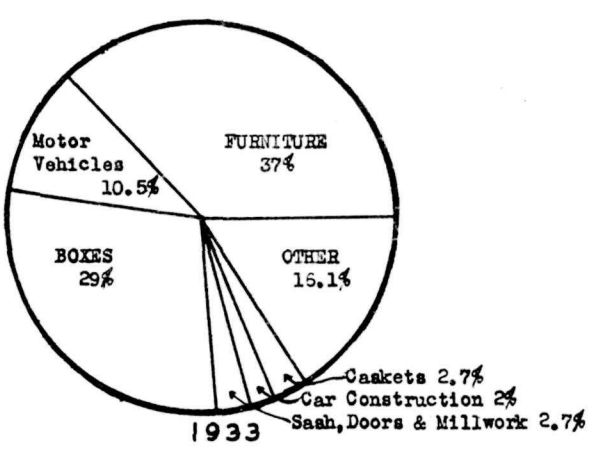
Crossband: To place the grain of layers of wood at right angles in order to minimize shrinking and swelling and consequent warping; also the layer of veneer at right angles to the face piles.

INDUSTRIAL CONSUMPTION OF HARDWOOD LUMBER

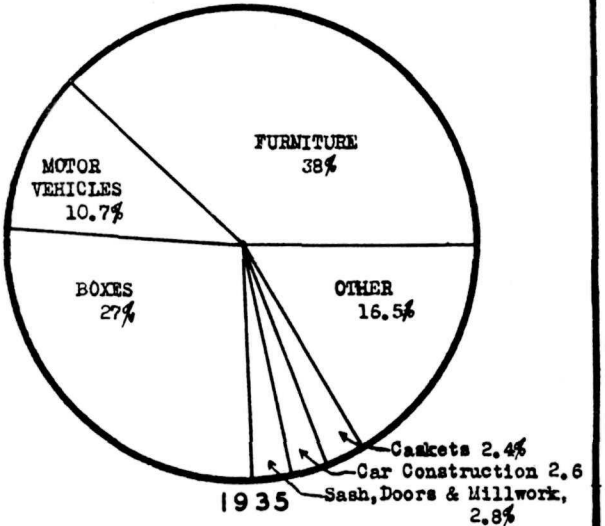


1928

1928 Industrial Consumption - 4,231,443,000 feet of hardwoods



1933



1935

1933 Industrial Consumption - 1,706,323,000 feet of hardwoods
1935 Industrial Consumption - 2,050,000,000 feet of hardwoods

Flooring and other planing mill products are not included in above.

Source: 1928 and 1933: U.S.Forest Service
1935 Lumber Survey Committee Estimates

Prepared by National Lumber Manufacturers Association

Cross Break: A separation of the wood cells across the grain. Such breaks may be due to internal strains resulting from unequal longitudinal shrinkage or to external forces.

Cross Grain: (See Grain)

Cup: The distortion of a board in which the face is convex or concave transversely.

Decay: Disintegration of wood substance through the action of wood-destroying fungi.

Incipient Decay: The early stage of decay in which the disintegration has not proceeded far enough to soften or otherwise impair the hardness of the wood perceptibly.

Typical or advanced decay: The stage of decay in which the disintegration is readily recognized because the wood has become punky, soft and spongy, stringy, pitted or crumbly.

Defect: Any irregularity occurring in or on wood that may lower its strength.

Density: Dense, as applied to wood, means compact, heavy (when dry), containing much wood substance in small space. For example - hickory is a very dense wood.

The oven-dry specific gravity is a measure of the density of wood. This figure is based on the wieght, exclusive of moisture, but including rosin and other substances not volatile at 100° C.

Density Rule: Rules for estimating the density of wood based on percentage of summer wood and range of growth. The rules at present apply only to southern yellow pine and Douglas fir and differ slightly.

Diagonal Grain: (See Grain)

Diamond: A distortion in drying that causes a piece of wood originally rectangular in cross section to become diamond-shaped.

Diffuse-porous woods: Hardwoods in which the pores are practically uniform in size throughout each annual ring, or decrease slightly toward the outer border of the ring.

Dimension: (See Lumber)

Dimension Stock: Squares of flat stock usually in pieces under the minimum sizes admitted in standard lumber grades, rough or dressed, green or dry, cut to the approximate dimensions required for the various products of wood-working factories.

Dote: "Dote", "doze," and "rot" are synonymous with "decay", and are any form of decay which may be evident as either a discoloration or a softening of the wood.

Dry Rot: A term loosely applied to many types of decay but especially to that which, when in an advanced stage, permits the wood to be easily crushed to a dry powder. The term is actually a misnomer for any decay, since all fungi require considerable moisture for growth.

Durability: A general term for permanence or lastingness. Frequently used to refer to the degree of resistance of a species or of an individual piece of wood to attack by wood-destroying fungi under conditions that favor such attack. In this connection the term "resistance to decay" is more specific.

Edge Grain: (See Grain)

Elastic Limit: The elastic limit (sometimes called proportional limit) is that point where the distortion ceases to be in proportion to the load. For example, if a beam deflects one-sixteenth of an inch with a 50-pound load, it will deflect one-eighth of an inch with 100 pounds, and so on, each additional load of 50 pounds causing an additional deflection of one-sixteenth of an inch until the "elastic limit" is reached, after which the deflections increase more rapidly than the increase in load.

A timber stressed beyond the elastic limit will not resume its original form immediately upon the removal of the load.

Elasticity: Elasticity is the property (possessed by most materials) of changing form with the application of force and recovering at once upon release from the force.

In any elastic material the amount of compression or deformation is proportional to the force applied.

Air and other gases under compression are elastic. The most commonly recognized elastic material is rubber. Timber is elastic within comparatively narrow limits.

The term "very elastic" as applied to wood is indefinite, because it may mean that the force required to produce a given deformation is great and the recovery sudden, as in an ivory ball (see "Modulus of elasticity"); or that the amount of distortion to the elastic limit is great, as in a rubber ball, or that the wood possesses high elastic resilience, a combination of the two properties.

Empty-cell Process: Any process for impregnating wood with preservatives or chemicals in which air is imprisoned in the wood under the pressure of the entering preservative and then expands, when the pressure is released, to drive out part of the injected preservative.

Encased Knot: (See Knot)

Extractives: Substances in wood, not an integral part of the cellular structure, that can be dissolved out with hot or cold water, ether, benzene, or other relatively inert solvents.

Equilibrium Moisture Content: The moisture content at which wood neither gains nor loses moisture when surrounded by air at a given relative humidity and temperature.

Factory and Shop Lumber: (See lumber)

Fiber: A wood fiber is a comparatively long (one twenty-fifth or less to one-third inch) narrow, tapering cell closed at both ends.

Fiber-Saturation Point: Green wood usually contains water within the cell walls and "free" water in the pores. In drying, the water in the pore is the first to be evaporated. The fiber saturation point is that point at which no water exists in the pores of the timber but at which the cell walls are still saturated with moisture. The fiber saturation point varies with the species. The ordinary proportion of moisture -- based on the dry weight of the wood -- at the fiber saturation point is from 20 to 30 per cent.

Fiber Stress at Elastic Limit: Fiber stress at elastic limit is the stress obtained in a timber by loading it to its elastic limit. It is the greatest stress the timber will take under a given loading and immediately return to its former position.

Figure: The pattern produced in a wood surface by irregular coloration and by annual growth rings, rays, knots, and such deviations from regular grain as interlocked and wavy grain.

Flakes: (See Rays, wood)

Flat Grain: (See Grain)

Flexibility: Flexibility is that quality which renders a material capable of being bent without breaking. Thus, green timber is more flexible than dry.

Flitch: A thick piece of lumber with wane (bark) on one or more edges.

Full-cell Process: Any process for impregnating wood with preservatives or chemicals in which a vacuum is drawn to remove air from the wood before admitting the preservative.

Grade: The designation of the quality of a manufactured piece of wood.

Grain: The direction, size, arrangement, appearance, or quality of the fibers in wood.

Close-grained Wood: Wood with narrow and inconspicuous annual rings. The term is sometimes used to designate wood having small and closely spaced pores, but in this sense the term "fine textured" is more often used.

Coarse-grained Wood: Wood with wide and conspicuous annual rings; that is, rings in which there is considerable difference between spring wood and summer wood. The term is sometimes used to designate wood with large pores, such as oak, ash, chestnut, and walnut, but in this sense the term "coarse-textured" is more often used.

Cross Grain: Grain not parallel with the axis of a piece. It may be either diagonal or spiral grain or a combination of the two.

Diagonal Grain: Annual rings at an angle with the axis of a piece as a result of sawing at an angle with the bark of the tree.

Edge Grain: Edge-grain lumber has been sawed parallel with the pith of the log and approximately at right angles to the growth rings; that is, the rings form an angle of 45° or more with the surface of the piece.

Flat Grain: Flat-grain lumber has been sawed parallel with the pith of the log and approximately tangent to the growth rings; that is, the rings form an angle of less than 45° with the surface of the piece.

Interlocked-Grained Wood: Wood in which the fibers are inclined in one direction in a number of rings of annual growth, then gradually reverse and are inclined in an opposite direction in succeeding growth rings, then reverse again.

Open-Grained wood: Common classification of painters for woods with large pores, such as oak, ash, chestnut and walnut. Also known as "coarse textured."

Plain-sawed: Another term for flat grain.

Quarter-sawed: Another term for edge grain.

Spiral Grain: A type of growth in which the fibers take a spiral course about the bole of a tree instead of the normal vertical course. The spiral may extend right-handed or left-handed around the tree trunk.

Vertical Grain: Another term for edge grain.

Wavy-grained Wood: Wood in which the fibers collectively take the form of waves or undulations.

Green: Green is the condition of timber as taken from the living tree.

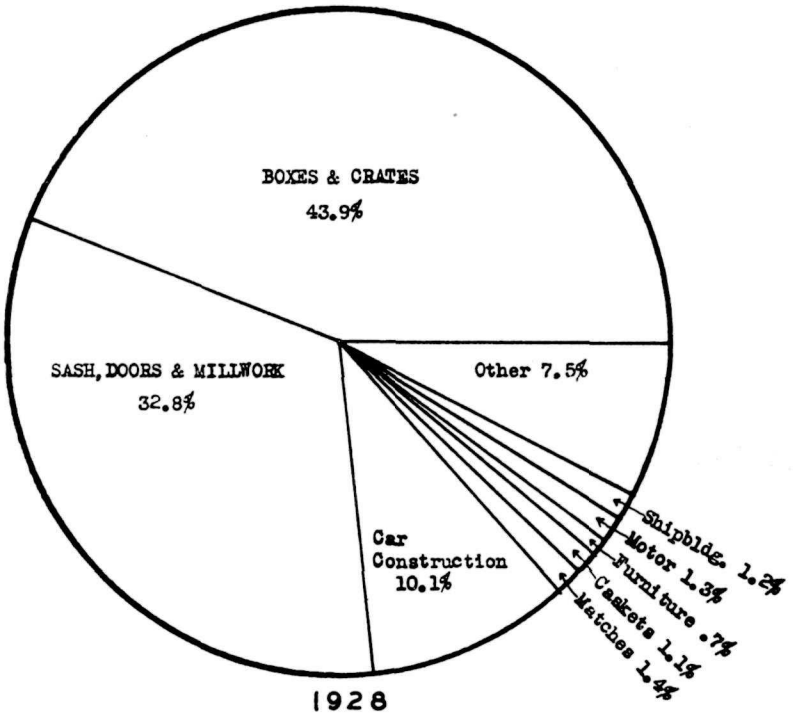
Immediately upon being sawed from the tree, lumber begins to lose moisture and otherwise change its condition. The rapidity of these changes is determined by the species, humidity, and circulation of air, heat, etc.

Growth Rings: (See Ring, Annual Growth)

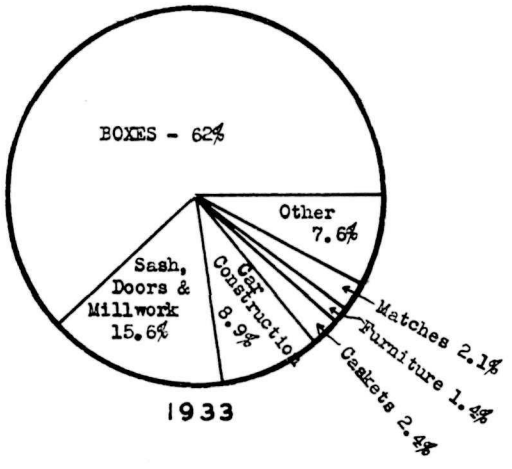
Hardwoods: The botanical group of trees that are broadleaved. The term has no reference to the actual hardness of the wood. Angiosperms is the botanical name for hardwoods.

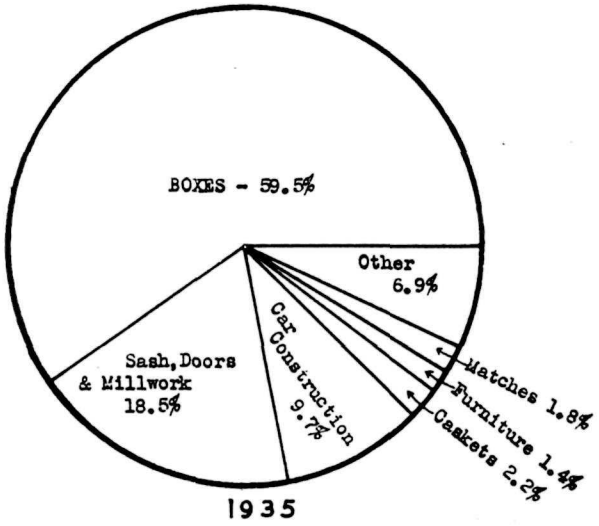
Heart, Heartwood: The wood, extending from the pith to the sapwood, the cells of which no longer participate in the life processes of the tree. Heartwood may be infiltrated with gums, resins, and other materials which usually make it darker and more decay-resistant than sapwood.

INDUSTRIAL CONSUMPTION OF SOFTWOOD LUMBER



1928 Industrial Consumption - 8,341,549,000 feet of Softwoods





1933 Industrial Consumption - 3,311,784,000 feet of Softwoods
1935 Industrial Consumption - 4,010,000,000 feet of Softwoods

Flooring and other planing mill products not included in above.

Source: 1928 and 1933: U.S. Forest Service.
1935 Lumber Survey Committee Estimates

Prepared by National Lumber Manufacturers Association.

Honeycomb: Checks, often not visible at the surface, that occur in the interior of a piece, usually along the wood rays.

Imperfect Manufacture: Includes all defects or blemishes which are produced in manufacturing, such as chipped grain, loosened grain, raised grain, torn grain, skips in dressing, hit and miss, variation in sawing, miscut lumber, machine burn, machine gouge, mismatching, and insufficient tongue or groove.

Interlocked Grained Wood: (See Grain)

Joist and Plank: Pieces (nominal dimensions 2 to 4 inches in thickness by 4 inches and wider) of rectangular cross section graded with respect to their strength in bending when loaded either on the narrow face as joist or on the wide face as plank.

Kiln: A heated chamber for drying lumber.

Compartment Kiln: A dry kiln designed to keep the same temperature and relative humidity throughout at any given time. In it the entire charge of lumber is dried as a unit, under drying conditions that increase in severity during the operation.

Progressive Kiln: A dry kiln designed to provide drying conditions that increase in severity from entrance to exit. In it the entire charge is only a part of the total charge of lumber; a unit of perhaps four truck loads is moved through the kiln in a chain of several units, from day to day, with a single unit leaving and another entering at a time.

Kiln Brown Stain: (See Stain, Chemical Brown)

Kiln Dried: (See Seasoning)

Knot: That portion of a branch or limb that has become incorporated in the body of a tree.

Decayed Knot: A knot which, due to advanced decay, is not so hard as the surrounding wood.

Encased Knot: A knot whose rings of annual growth are not intergrown with those of the surrounding wood.

Intergrown Knot: A knot whose rings of annual growth are completely intergrown with those of the surrounding wood.

Round Knot: A knot whose sawn section is oval or circular.

Sound Knot: A knot which is solid across its face and which is as hard as the surrounding wood.

Spike Knot: A knot sawn in a lengthwise direction.

Laminated Wood: A piece of wood built up of piles or laminations that have been joined either with glue or with mechanical fastenings. The term is most frequently applied where the piles are too thick to be classified as veneer and when the grain of all piles is parallel.

Lignin: A principal constituent of wood, second in quality to cellulose.

It incrusts the cell walls and cements the cells together.

Lumber: The product of the saw and planing mill not further manufactured than by sawing, resawing, and passing lengthwise through a standard planing machine, crosscut to length and matched.

Factory and Shop Lumber: Lumber intended to be cut up for use in further manufacture. It is graded on the basis of the percentage of the area which will produce a limited number of cuttings of a specified or a given minimum, size and quality.

Yard Lumber: Lumber that is less than 5 inches in thickness and is intended for general building purposes.

Boards: Yard lumber less than 2 inches thick, 8 inches or more in width.

Dimension: All yard lumber except boards, strips, and timbers; that is, yard lumber 2 inches and less than 5 inches thick, and of any width.

Strips: Yard lumber less than 2 inches thick and less than 8 inches wide.

Mechanical Properties: Mechanical properties are the properties of wood which enable it to resist deformations, loads, shocks, or forces. Thus the ability to resist shearing forces is a mechanical property of timber. (See "Strength")

Millwork: Generally all building materials made of finished wood and manufactured in millwork plants and planing mills are included under the term "millwork." It includes such items as inside and outside doors; window and door frames, blinds, porch work, mantels, panel work, stairways, moldings, and interior trim. It does not include flooring, ceiling, or siding.

Modulus of Elasticity: Modulus of elasticity is the ratio of stress per unit area to corresponding strain per unit length, the distortion or strain being within the elastic limit.

Numerically, the modulus of elasticity of a material is the force in pounds required to stretch a sample of that material with a cross-sectional area of 1 square inch to double its length, on the assumption that the fibers would not be stressed beyond their elastic limit. India rubber has a very low modulus of elasticity, while that of steel is very high. It is, then, the measure of the stiffness or rigidity of a substance.

Moisture Content of Wood: Weight of the water contained in the wood usually expressed in percentage of the weight of the oven-dry wood.

Moisture Gradient: A condition of graduated moisture content between the successive layers of a material, such as wood, due to the losing or absorbing of moisture. During seasoning the gradations are between the moisture content of the relatively dry surface layers and the wet layers at the center of the piece.

Open Grained Wood: (See Grain)

Peck: Pockets or areas of disintegrated wood caused by advanced stages of localized decay in the living tree. It is usually associated with cypress and incense cedar. There is no further development of peck once the lumber is seasoned.

Physical Properties: Physical properties, as the term is used in this bulletin, are those properties of wood which have to do with its structure, such as density, cell arrangements, fiber length, etc. In its broad sense the term physical properties include all those properties listed as mechanical properties, as well as those pertaining to its structure.

Pitch Pocket: An opening extending parallel to the annual rings of growth usually containing, or which has contained pitch, either solid or liquid.

Pith: The small soft core occurring in the structural center of a log.

Plywood: A piece of wood made of three or more layers of veneer joined with glue and usually laid with the grain of adjoining plies at right angles. Almost always an odd number of piles are used to secure balanced construction.

Plain-Sawed: (See Grain)

Planing Mill Products: Products worked to pattern, such as flooring, ceiling, and siding.

Pocket Rot: Advanced decay which appears in the form of a hole, pocket or area of soft rot usually surrounded by apparently sound wood.

Pore: (See Vessel)

Posts and Timbers: Pieces of square or approximately square cross section, 4 by 4 inches or larger in nominal dimensions graded primarily for use as posts or columns but adapted to miscellaneous uses in which strength in bending is not especially important.

Preservative: Any substance that, for a reasonable length of time, will prevent the action of wood-destroying fungi, borers of various kinds, and similar destructive life when the wood has been properly coated or impregnated with it.

Progressive Kiln: (See Kiln)

Quarter-sawed: (See Grain)

Radial: Radial means extending outward from a center or an exis. Thus a radial surface in a tree is one extending from the pith of the tree outward, such as the wide faces of a quarter-sawed board.

Rate of Growth: The rate at which a tree has laid on wood, measured radially in the trunk or in lumber cut from the trunk. The unit of measure in use is the number of annual growth rings per inch.

Rays, Wood: Strips of cells extending radially within a tree and varying in height from a few cells in some species to 4 inches or more in oak. The rays serve primarily to store food and transport it horizontally in the tree.

Rings: Rings are those circular markings around the center of a tree section which are produced by the contrast in density, hardness, color, etc., between springwood and summerwood. One ring, known as an annual ring, consists of a layer of springwood and a layer of summerwood.

Ring, Annual Growth: The growth layer put on in a single growth year.

Ring-porous Woods: A group of hardwoods in which the pores are conparatively large at the beginning of each annual ring and decrease in size more or less abruptly toward the outer portion of the ring, thus forming a distinct inner zone of pores known as the springwood and the outer zone with smaller pores known as the summerwood.

Rot: (See Decay)

Rotary-cut Veneer: (See Veneer)

Sap: All the fluids in a tree, special secretions and excretions, such as gum, excepted.

Sapwood: The layers of wood next to the bark, usually lighter in color than the heartwood, one-half inch to 3 or more inches wide that are actively involved in the life processes of the tree. Under most conditions sapwood is more susceptible to decay than heartwood; as a rule, it is more permeable to liquids than heartwood. Sapwood is not essentially weaker or stronger than heartwood of the same species.

Sawed Veneer: (See Veneer)

Seasoning: Removing moisture from green wood in order to improve its serviceability.

Air-dried or Air Seasoned: Dried by exposure to the air, usually in a yard, without artificial heat.

Kiln Dried: Dried in a kiln with the use of artificial heat.

Second Growth: Timber that has grown after the removal by any means of all or a large portion of the previous stand.

Shake: A separation along the grain, the greater part of which occurs between the rings of annual growth.

Shear: Shear is the name of the stress which tends to keep two adjoining planes or surfaces of a body from sliding, one on the other, under the influence of two equal and parallel forces acting in opposite directions. A force which produces shear (or shearing stress) in a material is called a shearing force.

Shop lumber: (See Lumber)

Side Cut: The term used when the pith is not present in a piece.

Sliced Veneer: (See Veneer)

Softwoods: The botanical group of trees that have needle or scalelike leaves and are evergreen for the most part, cypress, larch and tamarack being exceptions. The term has no reference to the actual hardness of the wood. Softwoods are often referred to as conifers, and botanically they are called gymnosperms.

Specific Gravity: The ratio of the weight of a body to the weight of an equal volume of water at some standard temperature.

Spiral Grain: (See Grain)

Split: A lengthwise separation of the wood, due to the tearing apart of the wood cells.

Spring Wood: The portion of the annual growth ring that is formed during the early part of the season's growth. It is usually less dense and weaker mechanically than summer wood.

Stain, Blue: A bluish or grayish discoloration of the sapwood caused by the growth of a certain moldlike fungi on the surface and in the interior of the piece; made possible by the same conditions that favor the growth of other fungi.

Stain, Brown: A rich brown to deep chocolate-brown discoloration of the sapwood of some pines caused by a fungus that acts similarly to the blue-stain fungus.

Stain, Chemical Brown: A chemical discoloration of wood, which sometimes occurs during the air-drying or kiln-drying of several species, apparently caused by the oxidation of extractives.

Stain, Sap: (See Stain, Blue)

Strain: The deformation or distortion produced by a stress or force is known as strain.

Strength: The term in its broader sense embraces collectively all the properties of wood which enable it to resist different forces or loads. In its more restricted sense, strength may apply to any one of the mechanical properties, in which event the name of the property under consideration should be stated, thus strength is compression parallel to grain, strength in bending, hardness, etc.

Stress: Stress is distributed force.

Fiber Stress is the distributed force tending to compress, tear apart, or change the relative position of the wood fibers.

Stress is measured by the force per unit area. Thus a short column 2 inches square (4 square inches) and supporting a load of 2,000 pounds will be under a stress or fiber stress of 500 pounds per square inch.

Strips: (See Lumber)

Structural Timber: Pieces of wood of relatively large size in which strength is the controlling element in their selection and use. Trestle timbers (stringers, caps, posts, sills, bracing, bridge ties, guard rails); car timbers (car framing, including upper framing, car sills); framing for buildings (posts, sills, girders, framing joists); ship timbers (ship timbers, ship decking); and cross arms for poles are examples of structural timbers.

Summer Wood: The portion of the annual growth ring that is formed during the latter part of the yearly growth period. It is usually more dense and stronger mechanically than spring wood.

Tangential: Strictly, coincident with a tangent at the circumference of a tree or log, or parallel to such a tangent. In practice, however, it often means roughly coincident with a growth ring.

Texture: A term often used interchangeably with grain. In this handbook it refers to the finer structure of the wood (see Grain) rather than the annual rings.

Timber, Standing: Timber still on the stump.

Timbers: Lumber 5 inches or larger in least dimension.

Timbers, Round: Timbers used in the original round form, such as poles, piling, and mine timbers.

Tracheid: The elongated cells that constitute the greater part of the structure of the softwoods (frequently referred to as fibers). Also a portion of some hardwoods.

Twist: A distortion caused by the turning or winding of the edges of a board so that the four corners of any face are no longer in the same plane.

Veneer: Thin sheets of wood.

Rotary-cut Veneer: Veneer cut in a continuous strip by rotating a log against the edge of a knife in a lathe.

Sawed Veneer: Veneer produced by sawing.

Sliced Veneer: Veneer that is sliced off by moving a log, bolt or flitch against a large knife.

Vertical Grain: (See Grain)

Vessels: Wood cells of comparatively large diameter which have open ends and are set one above the other forming continuous tubes. The openings of the vessels on the surface of a piece of wood are usually referred to as pores.

Virgin Growth: The original growth of mature trees.

Wane: Bark, or lack of wood or bark from any cause, on edge or corner of a piece.

Warp: Any variation from a true or plane surface. Warp includes bow, crook, cup, and twist, or any combination thereof.

Wavy-grained wood: (See Grain)

Weathering: The mechanical or chemical disintegration and discoloration of the surface of wood that is caused by exposure to light, the action of dust and sand carried by the winds, and the alternate shrinking and swelling of the surface fibers that come with the continued variation in moisture content brought by changes in weather.

Weathering does not include decay.

Wood Preservative: (See Preservative)

Workability: The degree of ease and smoothness of cut obtainable with hand or machine tools.

Working of Wood: Change in the dimensions of a piece of wood with change in moisture content.

Yard Brown Stain: (See Stain, Chemical Brown)

Yard Lumber: (See Lumber)