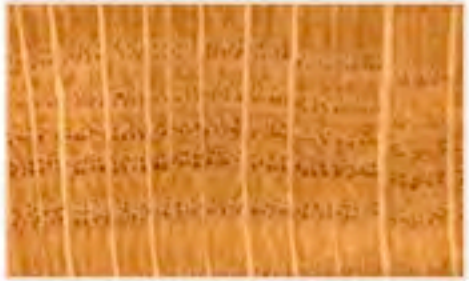
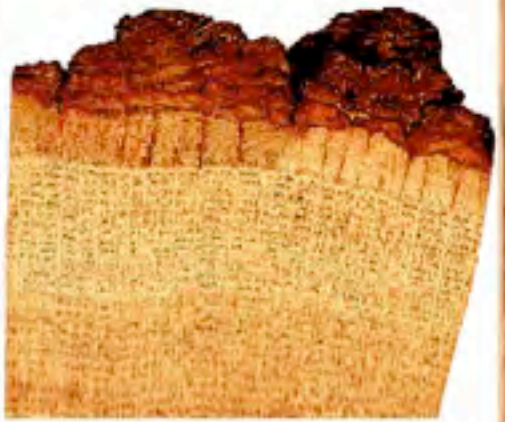
Tree Types and Names.
Basics of Wood Anatomy.





Presentation by Elisabeth Wheeler, PhD, N.C. State University

HARDWOODS:
DICOTYLEDONOUS ANGIOSPERMS

Characteristics

Flowering plants

Seeds produced in fruits

Broad leaves with netlike veins

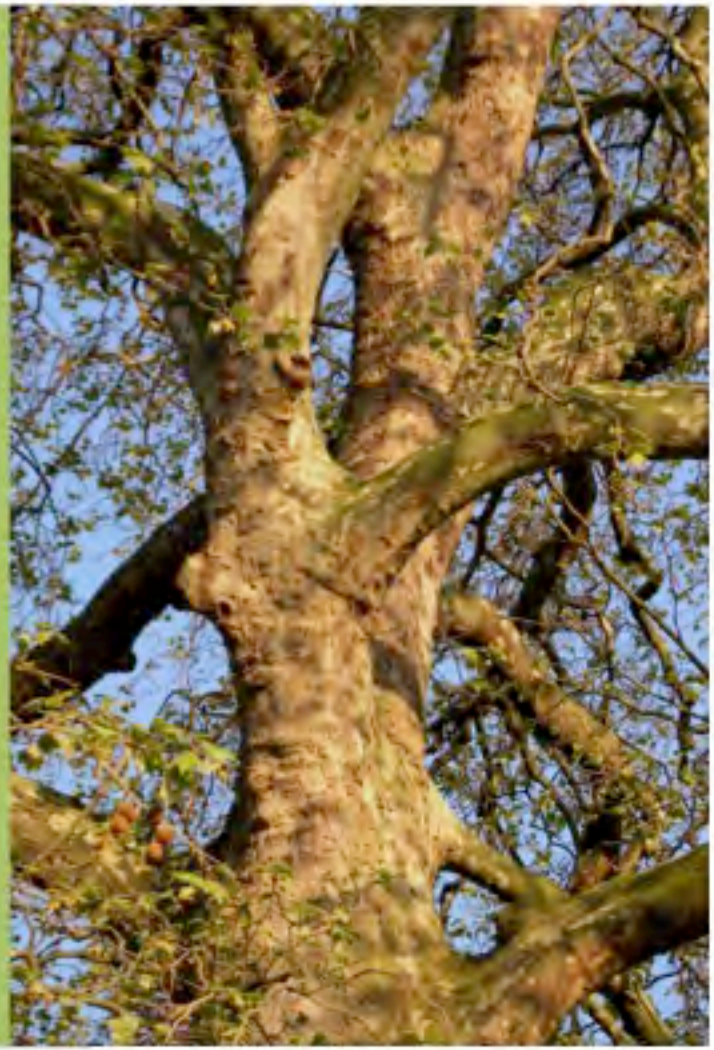
Many are deciduous (temperate)

(Oaks, Elms, Maples)

But some are evergreen

(Magnolia, Holly)

Tens of thousands of species



SOFTWOODS / CONIFERS

Characteristics

Seeds produced in cones

Needle-like leaves (usually)

Many are evergreen

- But not always
  - Bald Cypress (*Taxodium)*
  - Dawn Redwood (*Metasequoia)*

Total of ~ 400 species Worldwide

Softwoods vs. Hardwoods

- In the U.S., softwoods are on average “softer” than hardwoods
- BUT the softest wood in the world is produced by a dicot tree (native to southeast Asia). Therefore, from a botanical standpoint it’s a hardwood. This wood has a specific gravity < 0.1
- World’s heaviest wood is also produced by a dicot tree, native to South Africa (a member of the Olive family). It has a specific gravity of 1.4.




SPECIES

Botanists define species defined on external characteristics

Flowers, fruits, seeds, leaves, bark.

Not on wood anatomy.

Usually it is not possible to identify isolated pieces of wood or "fibers" to species,

- maybe to group of species, e.g. white oaks vs. red oaks,
- maybe to genus, e.g., *Liriodendron*
- maybe just to a group of genera within a family,

e.g. *Magnolia* & *Michelia* (both in Magnolia family, Magnoliaceae)

- maybe just to one family, esp. tropical hardwoods
- maybe just to few families, esp. for tropical hardwoods

Scientific Names

Species with similar characteristics are placed in the same genus,
e.g., All Oaks have acorns and are in same genus

Quercus rubra (N. Red Oak) *& Quercus falcata* (S. Red Oak)

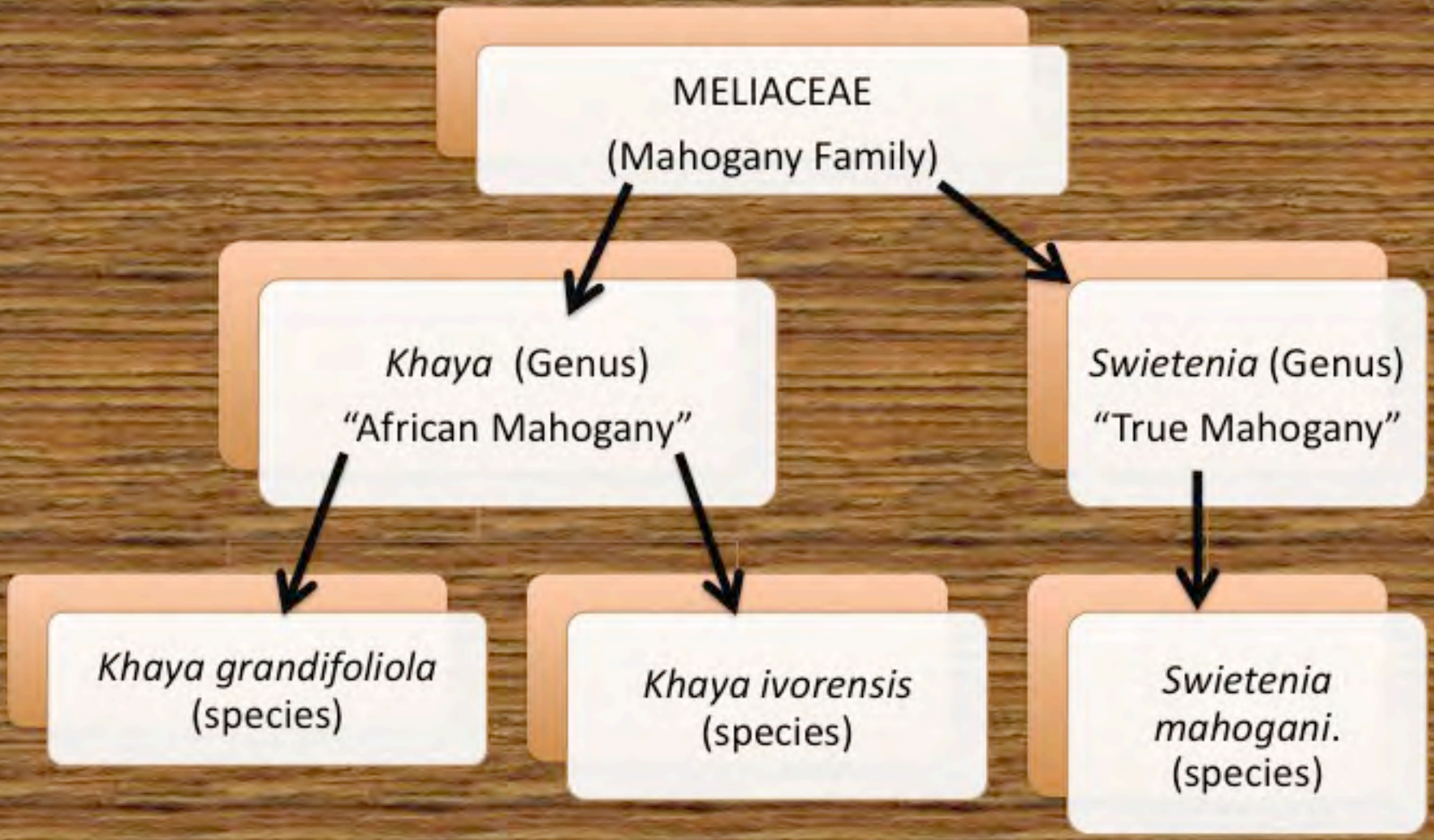
Genera with similar characteristics are placed in the same family.
for example,

*Castanea (*Chestnut), *Fagus (* Beech), *Quercus (*Oak)

These 3 genera belong to the Fagaceae / Beech family.

Technical information stored by species names

HIERARCHY OF NAMES. Reflects relationships



Common Name Concerns

Sometimes same common name applied to different species
Sycamore: in U.S. = *Platanus occidentalis*
in Europe = *Acer pseudoplatanus*

'Mahogany' is in the 'common name' of over 60 different species, some of which are in different plant families.

TRUE MAHOGANY *Swietenia mahogani* (family Meliaceae)
EAST INDIAN MAHOGANY *Chukrasia tabularis* (family Meliaceae)
AFRICAN MAHOGANY *Khaya* spp. (family Meliaceae)
PHILIPPINE MAHOGANY *Parashorea malaanoan* (family Dipterocarpaceae)
AUSTRALIAN SWAMP MAHOGANY *Eucalyptus robusta* (family Myrtaceae)
AMERICAN MAHOGANY *Liquidambar styraciflua* (familly Altingiaceae)
better known in the U.S. as Sweetgum or Redgum

See Common Names DB of FPL http://www2.fpl.fs.fed.us/CommNames2000.html

One species may have many common names

Especially tropical species that are widely distributed

During web search for flooring woods found this

"Description
Royal Mahogany is [a] unique wood, which we introduced into N. America for flooring use, due to its striking resemblance to genuine Honduran Mahogany and superior hardness."

What species is Royal Mahogany?

According to FPL Common Names

Royal Mahogany = *Carapa guianensis* (family Meliaceae)

Other Common Names
For This Species Include:

- Andiroba (Peru, Brazil)
- Cedro macho (Costa Rica),
- Bateo (Panama),
- Mazabalo (Colombia),
- Krapa (Surinam),
- Tangaré (Ecuador),

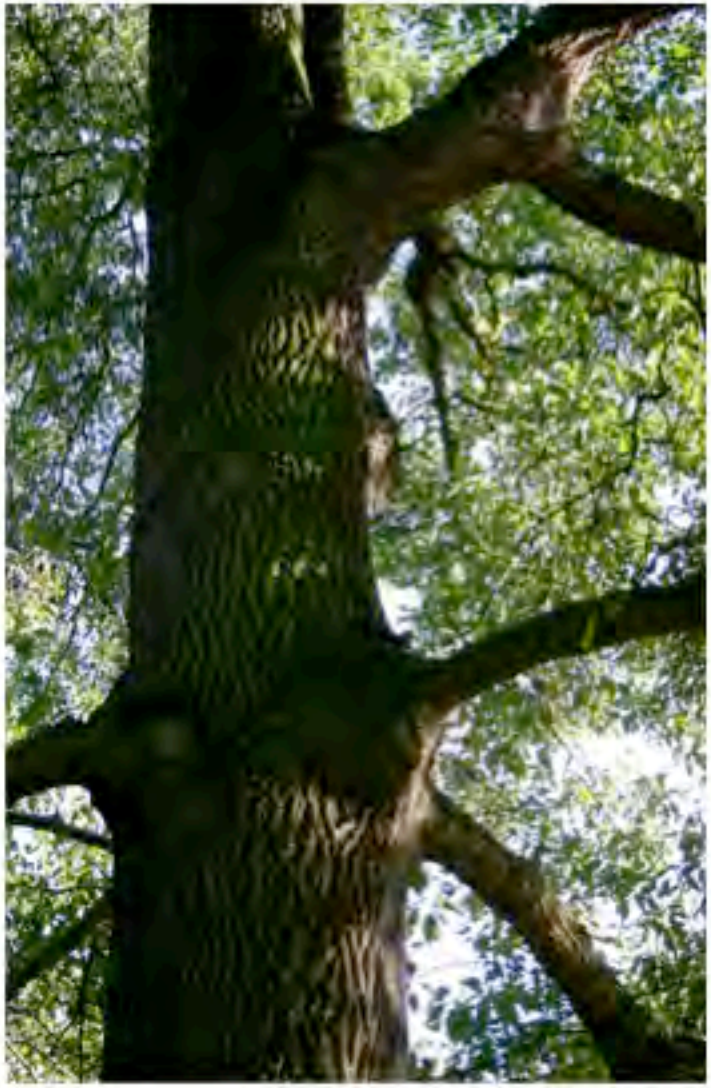
[Chudnoff 1984]

Some additional English names

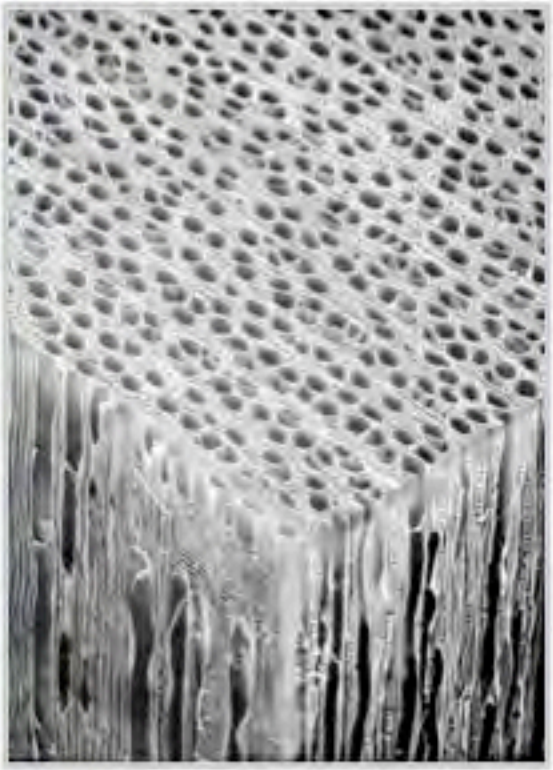
- Bastard Mahogany,
- Crabwood

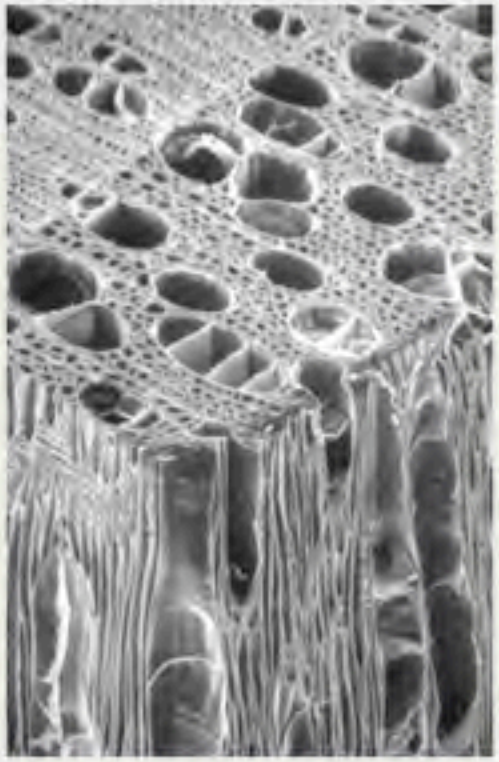
Tree of *Carapa guianensis*
From Wikipedia Commons

Basics of Wood Structure



Most of the cells in wood have a **longitudinal** orientation, "fibers", parallel to the long axis of the trees. [**Hollow** water-conducting and support cells]

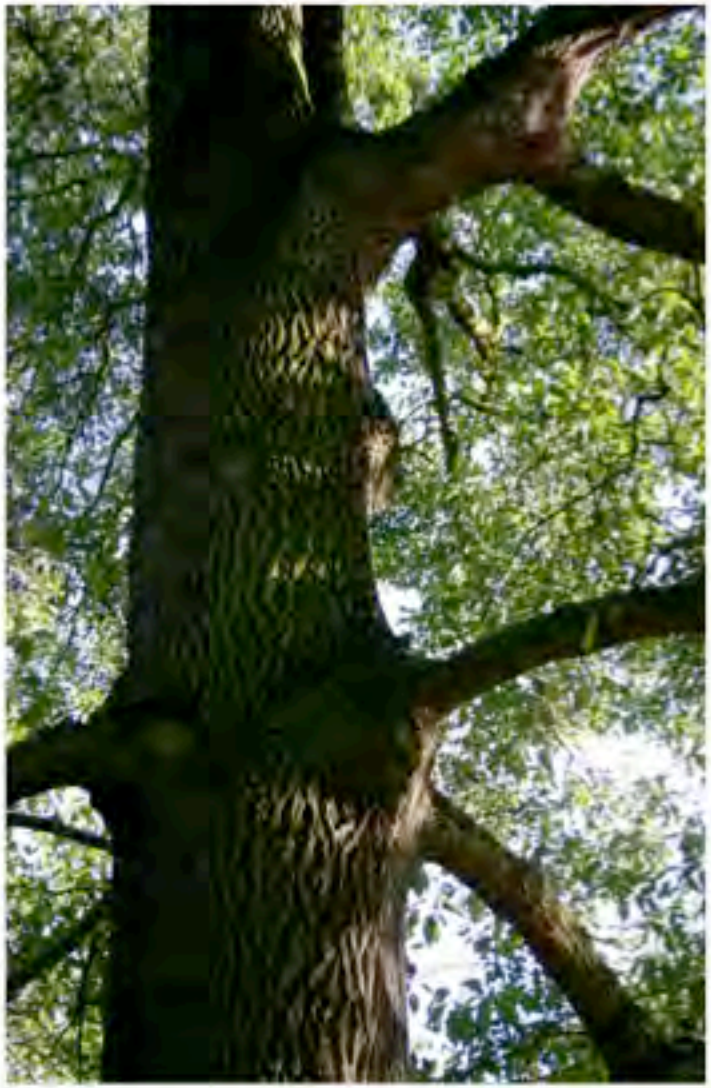




Scanning Electron Microscope Views of Woods, Photos courtesy of SUNY

Definition of Grain

- Grain = orientation of "fibers" relative to the long axis of the tree
- "Straight-grained" is considered normal, with the "fibers" oriented more or less parallel to the long axis of the tree.



SPIRAL GRAIN

Spiral grain results when the “fibers” are not parallel to long axis of tree, but in a right-handed or left handed spiral

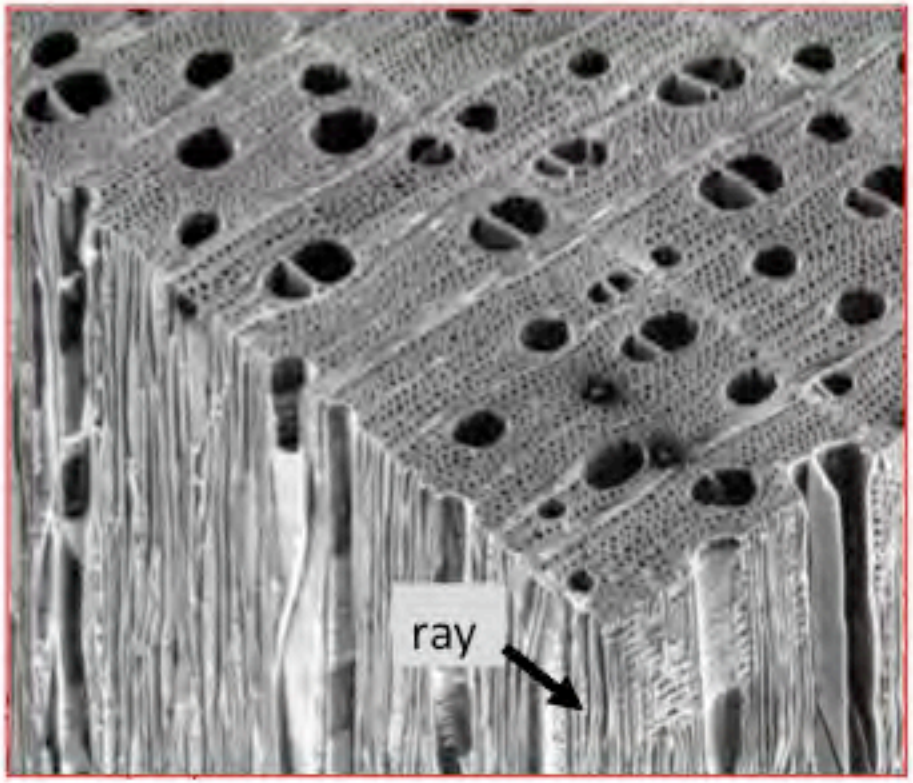
Interlocked Grain

- Interlocked grain a 'special' type of spiral grain.
- Orientation of "fibers" changes from left-handed to right-handed or left-handed to right-handed, and back and forth.
- Ribbon-stripe produced when changes in "fiber" orientation occur regularly

African Mahogany With Ribbon-Stripe Pattern

In addition to the longitudinally oriented cells - RAYS

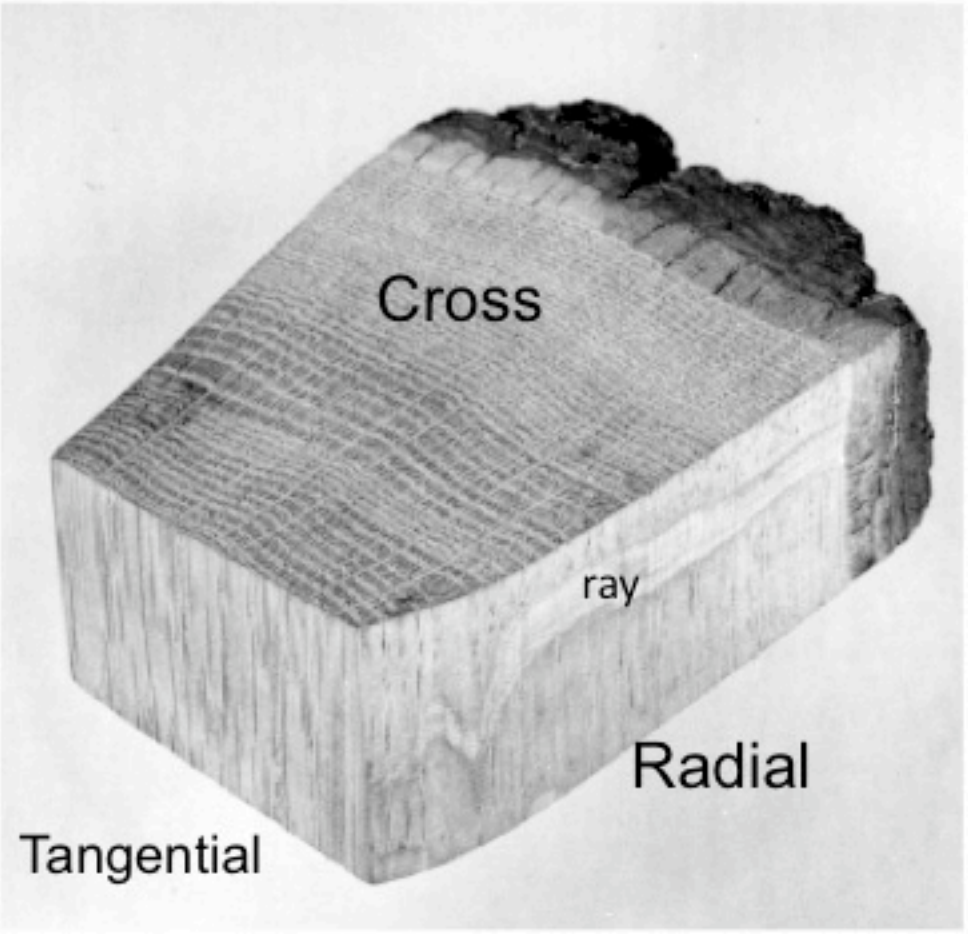
Rays are aggregations of cells with a "radial" arrangement, extend from bark towards inside of tree



Scanning Electron Microscope View of Birch
Photo courtesy of SUNY

WOOD SURFACES

- CROSS SECTION - see growth ring boundaries, and interiors of cells, end view of log.
- TANGENTIAL SECTION cut longitudinally, more or less down parallel to growth rings, at right angles to rays
- RADIAL SECTION cut longitudinally, more or less down at right angles to growth rings, and parallel to rays



Block of Southern Red Oak, *Quercus falcata*

How Wood Is Cut Affects Its Appearance And Behavior.

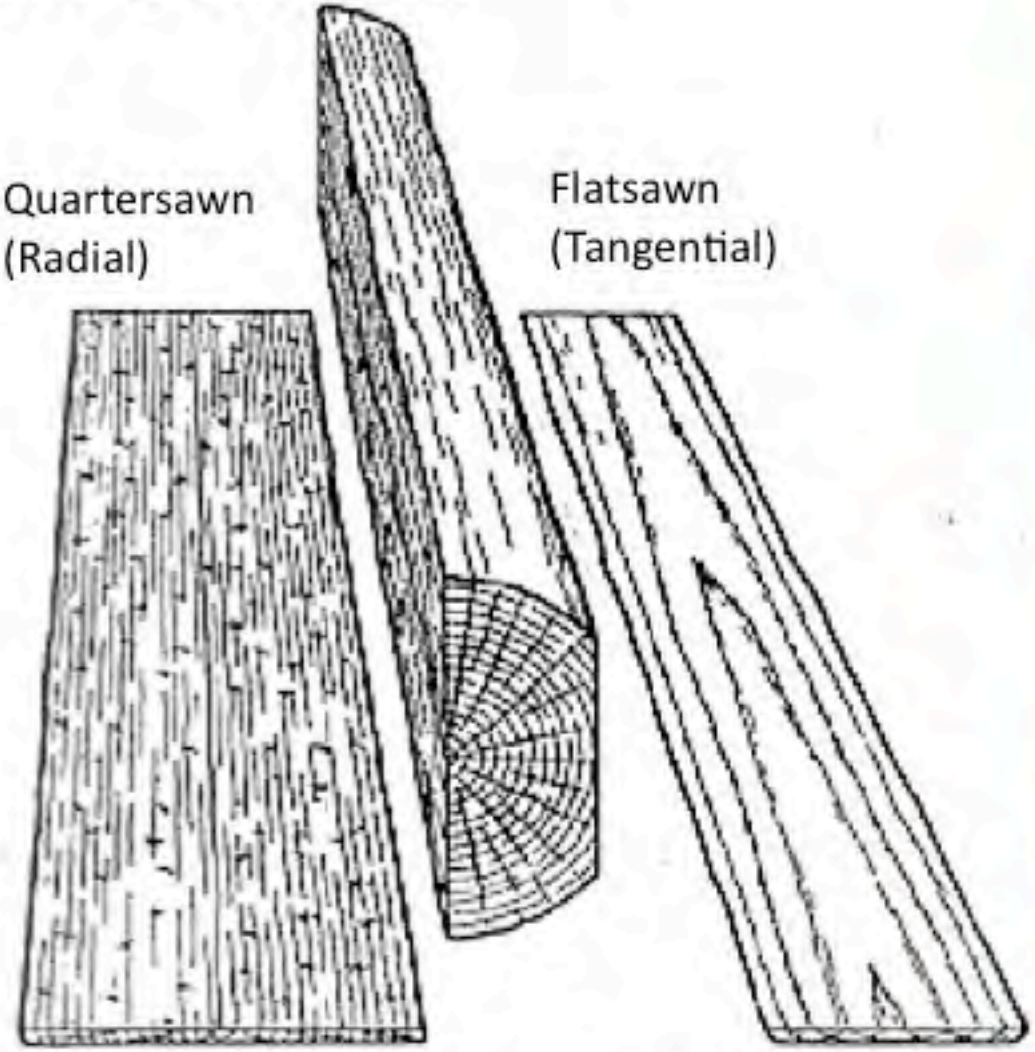
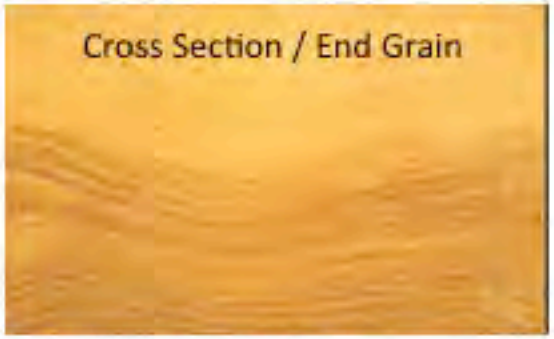
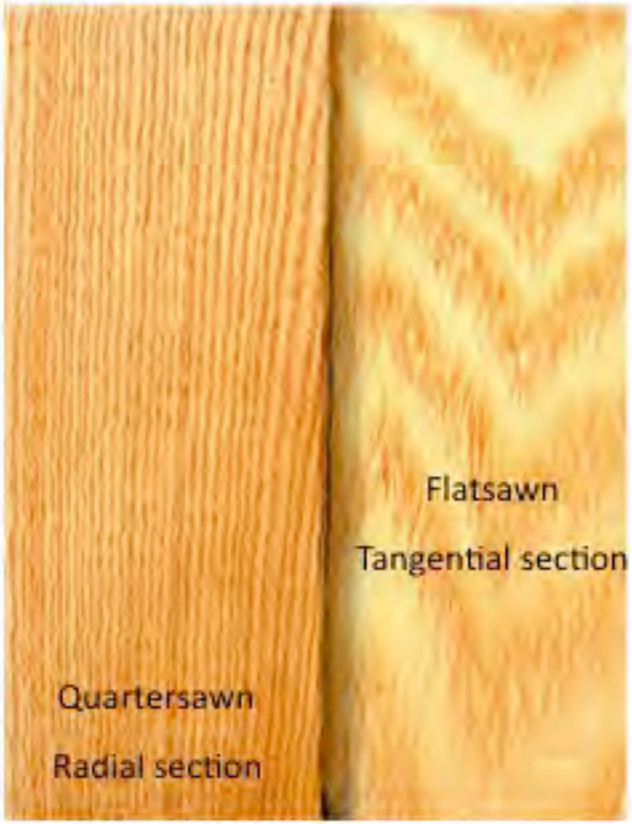


Diagram from the Wood Handbook





Ash Surfaces

SWEETGUM. *Liquidambar styraciflua.*

The American Woods

Exhibited by actual specimens
with copious notes
By Romeyn B. Hough

http://www.lib.ncsu.edu/specialcollections/forestry/hough/index.html

NCSU LIBRARIES

GROWTH RINGS

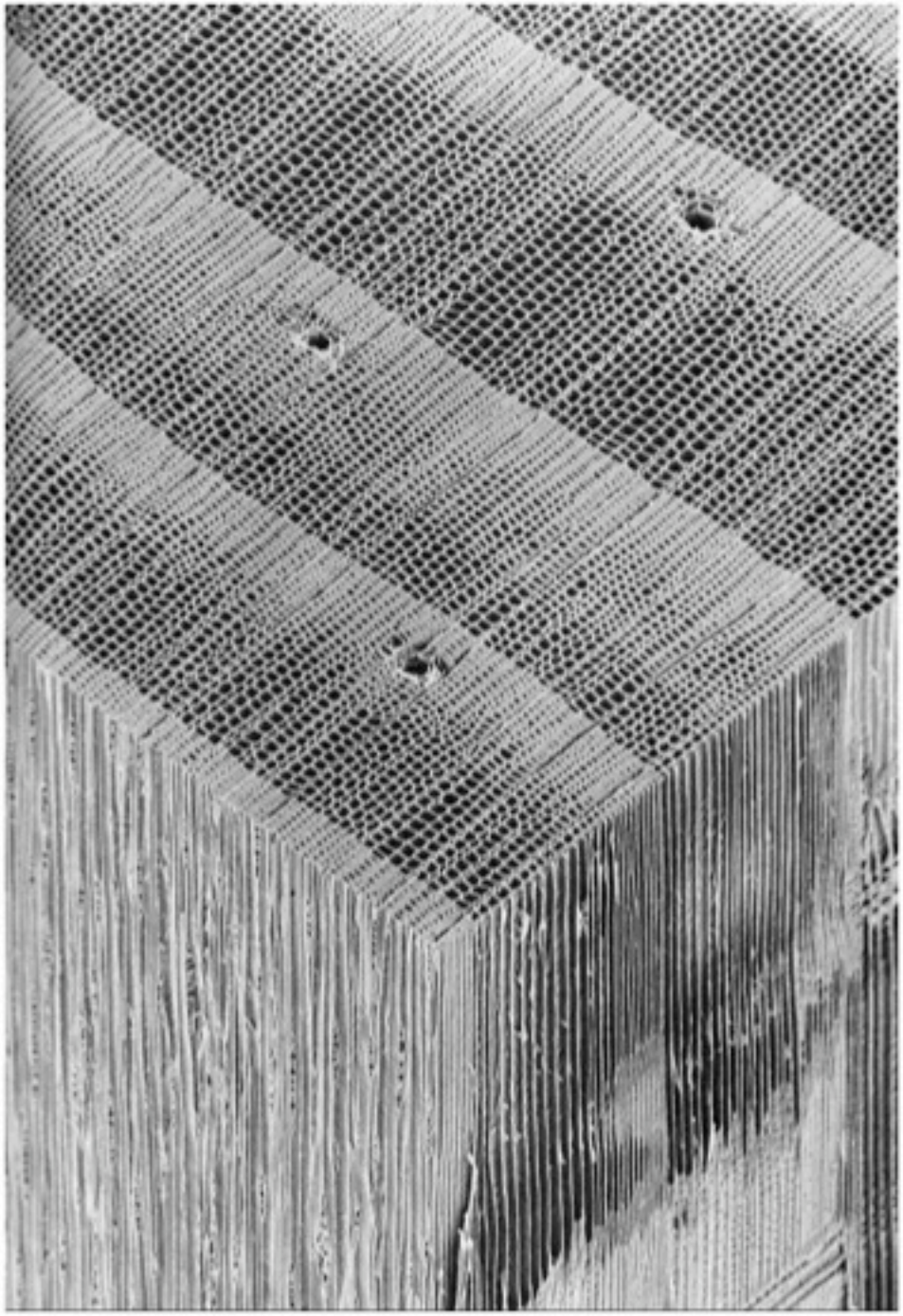
Wood accumulated during one growing season

In our climate usually the growth rings are annual and distinct

earlywood = wood formed first in the growing season (springwood)

latewood = wood formed later in the growing season (summerwood)

In tropics: growth rings may or may not be annual and may or may not be distinct.



SOFTWOODS

Homogeneous axial system with tracheids for support and conduction

Narrow rays

Slide from P. Baas, NHN,
SEM FFPRI, Japan

HARDWOODS

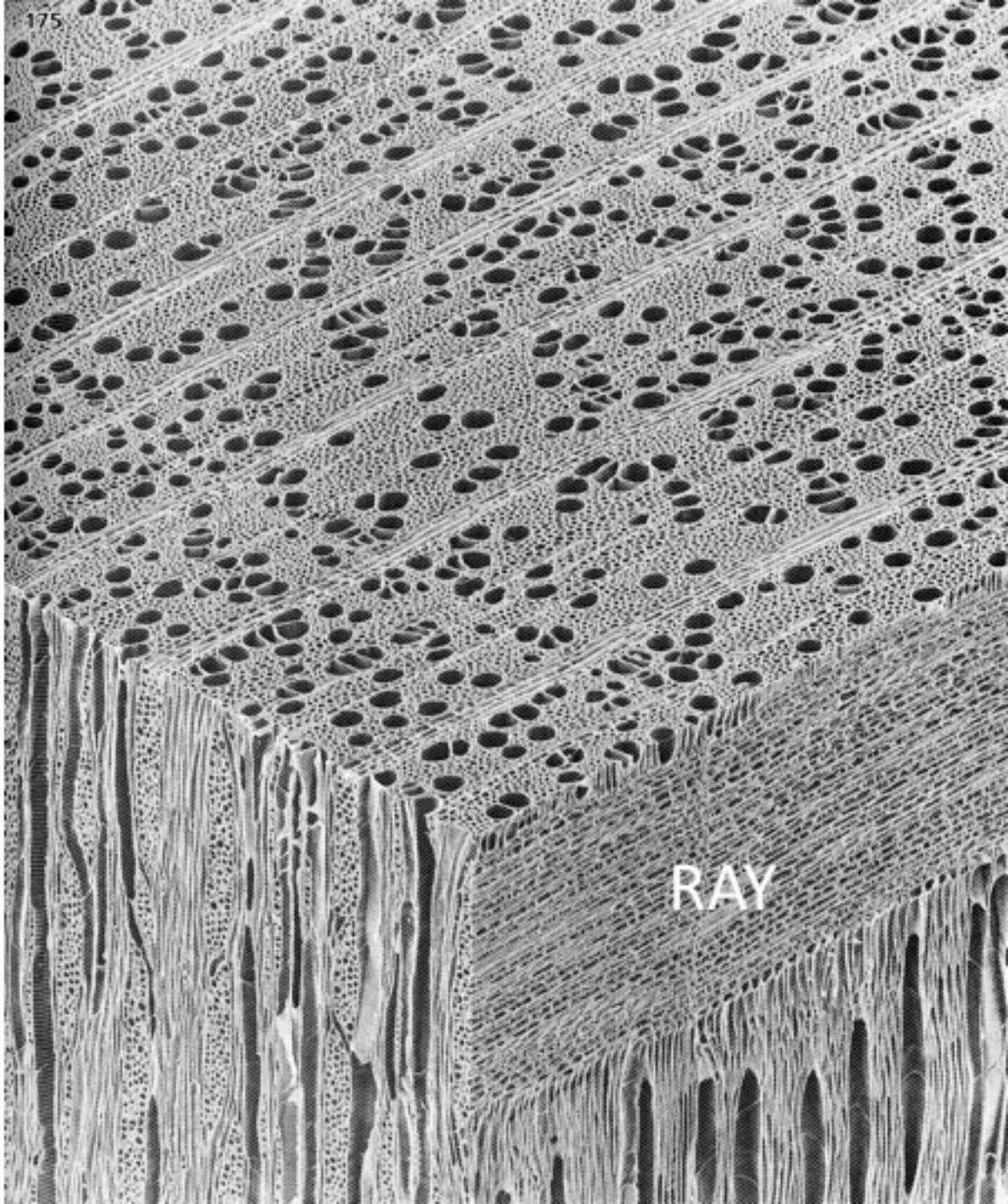
Vessels for conduction

Fibers for support

Rays vary in size

+ Axial parenchyma

Prunus (Cherry)



Slide from P. Baas, NHN, SEM FFPRI, Japan

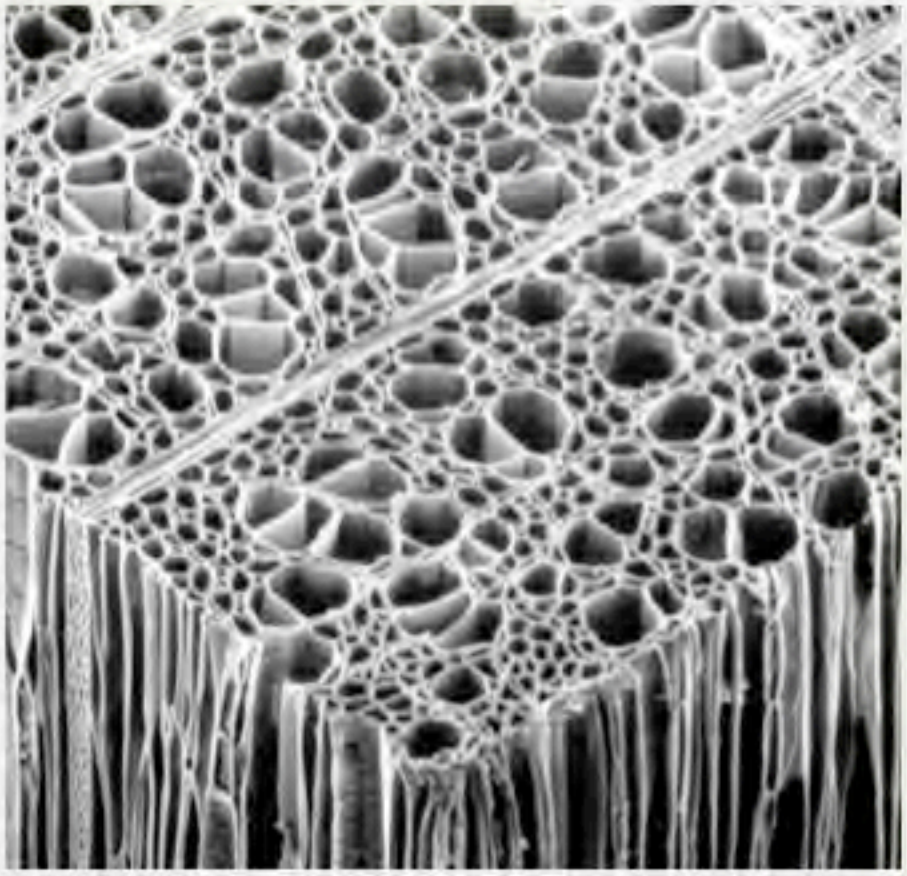
Hardwoods: Low & High SG

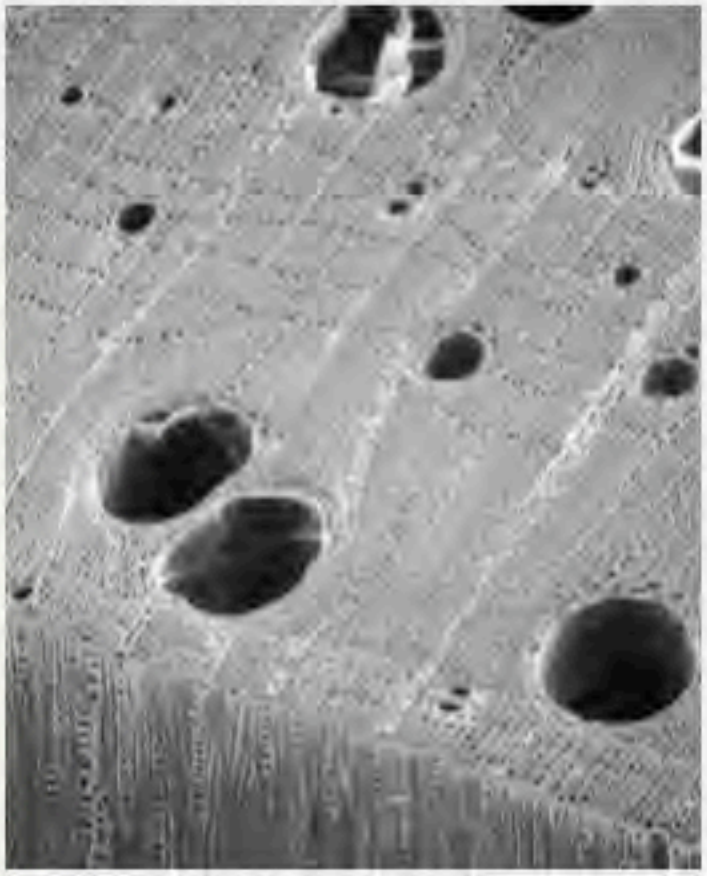
Which one is Hickory?

Hickory has a low proportion of vessels, high proportion of fibers

Which one is Basswood?

Basswood has a high proportion of vessels, & thin-walled fibers.





Scanning electron micrographs courtesy SUNY

POROSITY

PORE = Opening of vessel as seen in Cross Section
Aka End Grain

If pores of near even size and distribution, then wood is **DIFFUSE POROUS**

Beilschmiedia tawa
L.Y.T. Westra (Lauraceae)

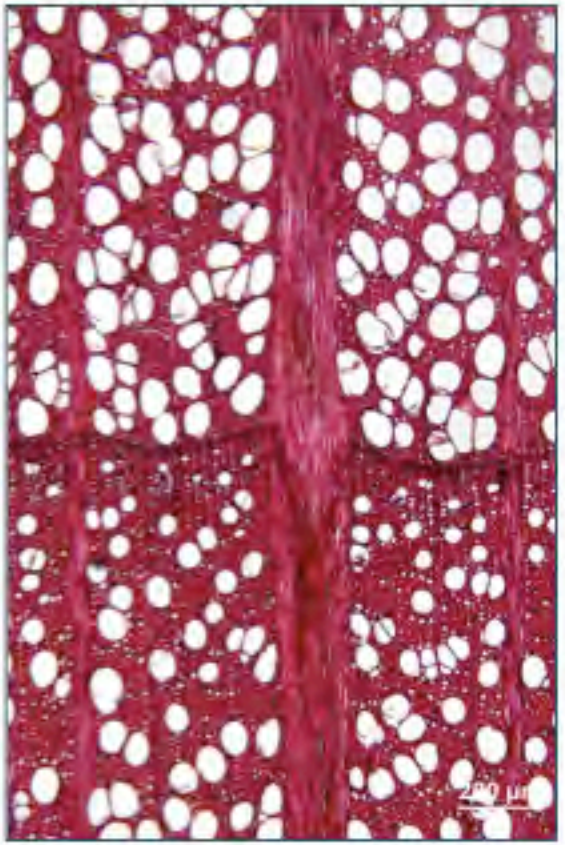
Acer pseudoplatanus: L.Y.T. Westra (Sapindaceae)

Diffuse-Porous Wood

"In some temperate diffuse-porous woods, e.g., *Fagus* spp (Beech), *Platanus* spp (Sycamore, Plane Tree) the latest formed vessels in the latewood may be considerably smaller than those of the earlywood of the next ring, but vessel diameter is more or less uniform throughout most of the growth ring . . . "

Fagus sylvatica
L.Y.T Westra

Fagus japonica
FFPRI, Tsukuba, Japan



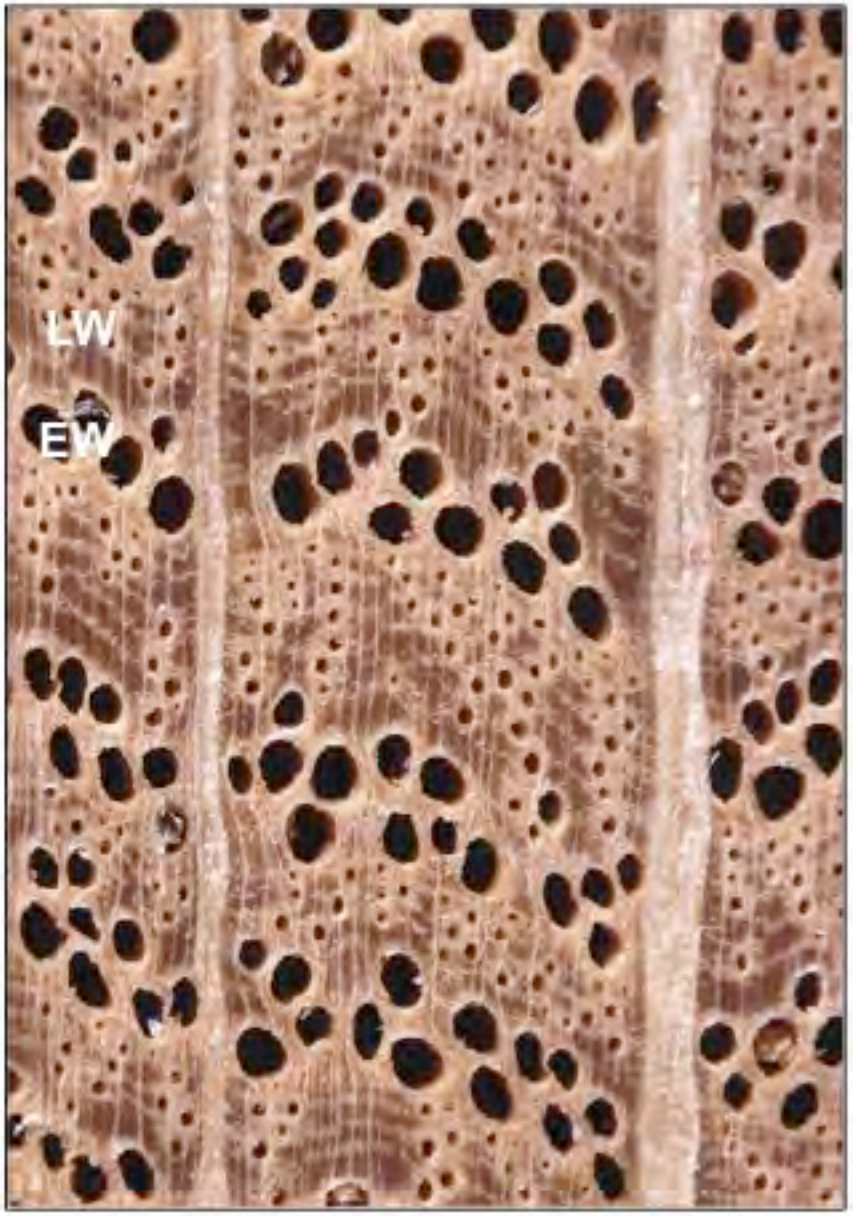
Fagus grandifolia
E.A. Wheeler

Ring-Porous Woods

Have a distinct earlywood (ew) zone, with wide pores, and an abrupt transition to a latewood (lw) zone with narrow pores.

Growth rings are distinct

Usually earlywood zone about the same size each year, size of latewood zone varies.



Quercus rubra
L.Y.T Westra

RING POROUS WOODS

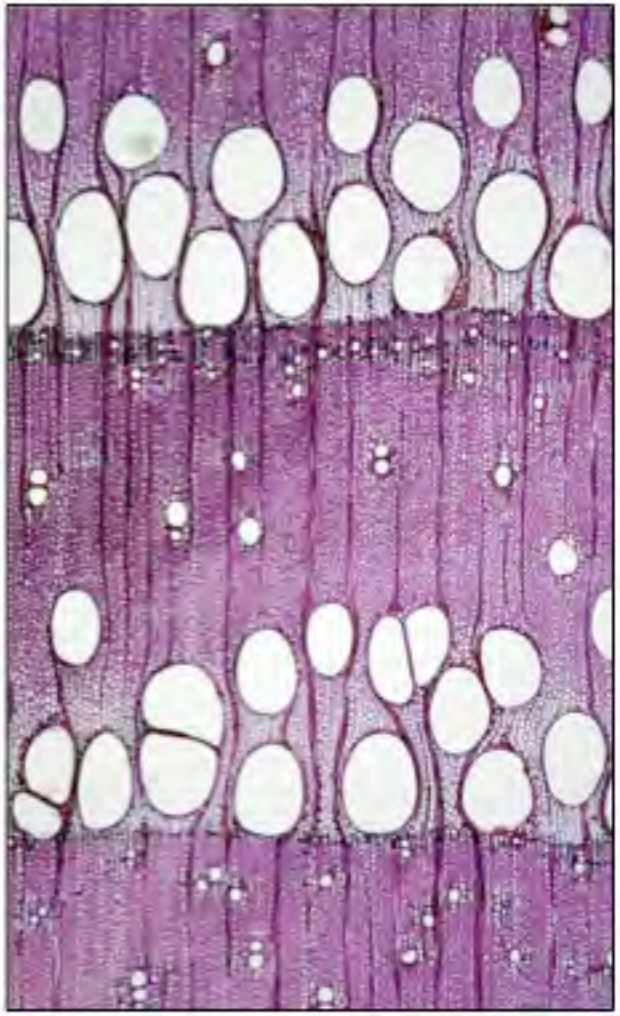
Wider rings have a higher % latewood

Fraxinus mandshurica (Oleaceae)
(MANCHURIAN ASH)

Wood ring-porous.

Appearance is affected by variation in growth ring width.

FFPRI, Tsukuba, Japan

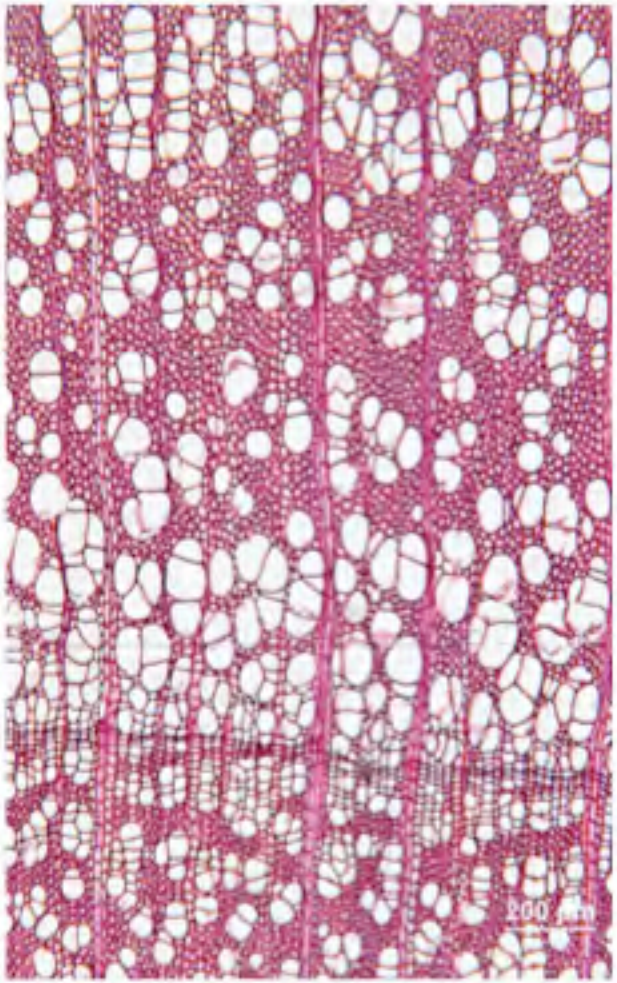


Semi-ring-porous Woods

- Vessels in the earlywood are distinctly larger than those in the latewood of the previous growth ring, but in which there is a gradual change to narrower vessels in the intermediate and latewood of the same growth ring or
- Earlywood with distinct ring of vessels not markedly larger than latewood vessels

English Walnut. *Juglans regia:* (Juglandaceae) L.Y.T. Westra

Persimmon. *Diospyros virginiana* (Ebenaceae) Bill Bryan



Blue Elderberry E.A. Wheeler

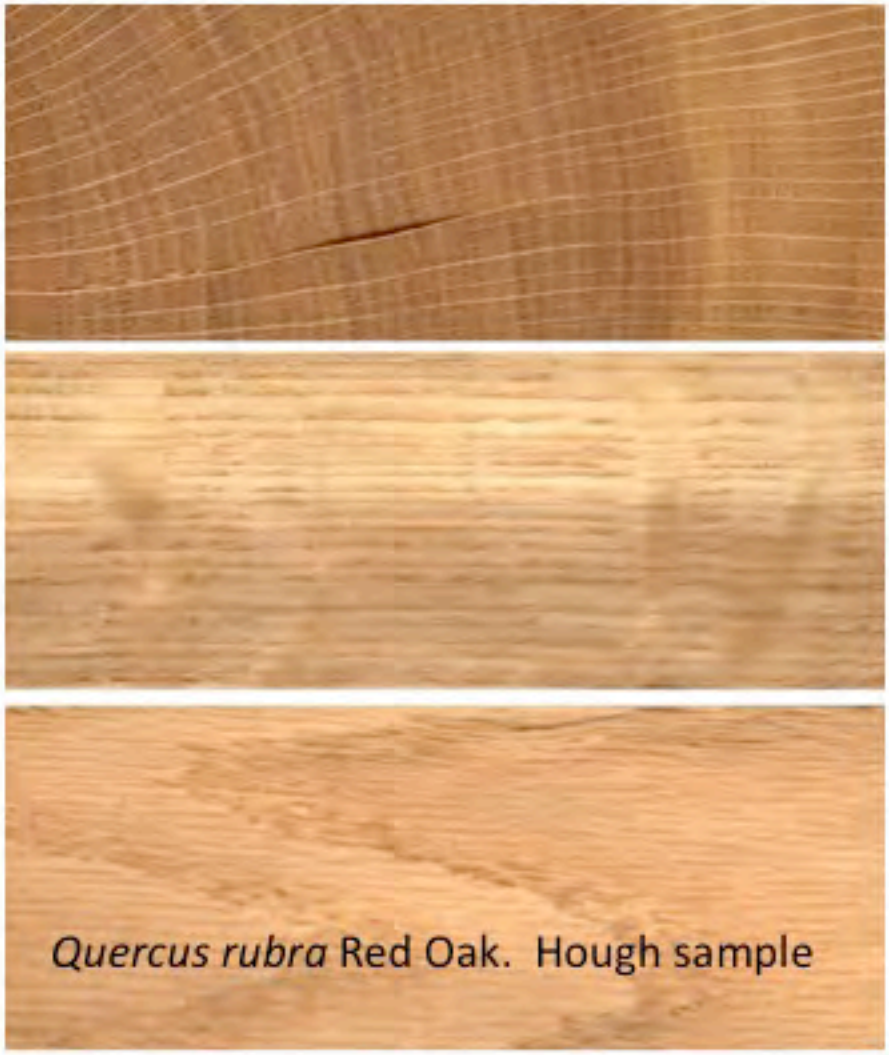
TEXTURE:

Degree of difference between earlywood & latewood affects texture

Diffuse porous (with narrow vessels) expect even texture

Acer rubrum Red Maple. Hough sample

Ring porous expect uneven texture



Quercus rubra Red Oak. Hough sample

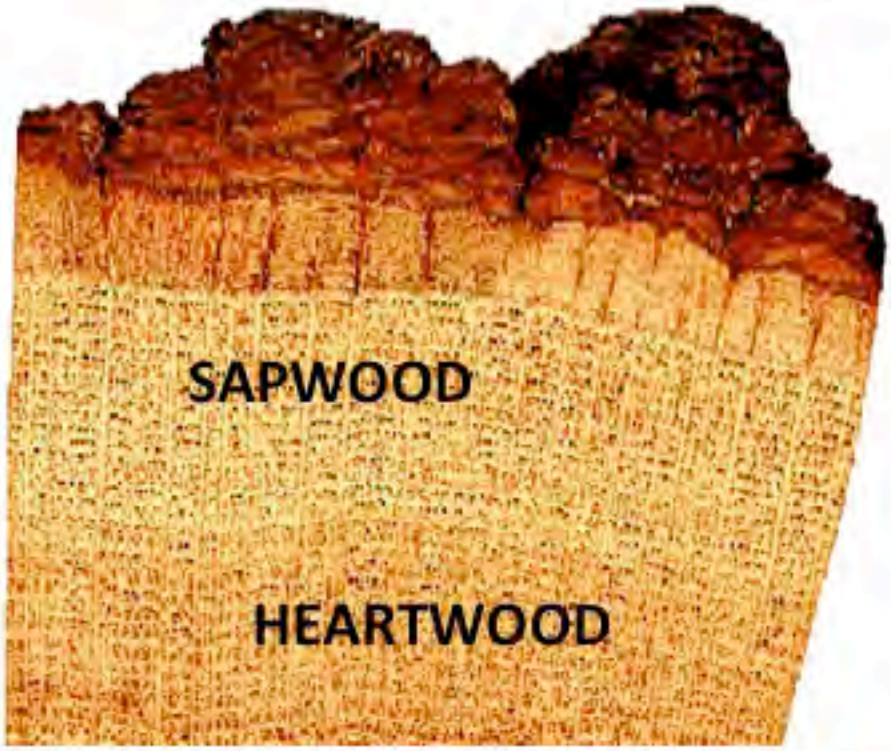
HEARTWOOD

Wood with no living cells.

Hoadley: “The central core of wood in mature stems that was at one time sapwood but no longer conducts sap or has living cells.

In most species, infiltration of extractives imparts a perceptibly darker color to this wood.”

HEARTWOOD



Southern Red Oak
Quercus falcata

Same cell types and cell proportions in sapwood and heartwood.

Because of extractives, heartwood **may**

- have different color than sapwood,
- be less permeable,
- be more resistant to decay,
- be more dimensionally stable

HEARTWOOD

NOT ALL HEARTWOOD HAS A DARKER COLOR THAN THE SAPWOOD

Some species have light-colored heartwood

- Spruce (*Picea)*
- Aspen (*Populus)*

Photo: Hardwood veneers in Costa Rica, photo by Mark Ambrose