Introduction to Botany. Lecture 32

Alexey Shipunov

Minot State University

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Outline

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Previous final question: the answer

What is monopodial growth?

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What is monopodial growth?

- When terminal bud always makes vertical shoot

Flags with plants

Not in the coat of arms, and countries only

- Canada
- Cyprus?
- Lebanon

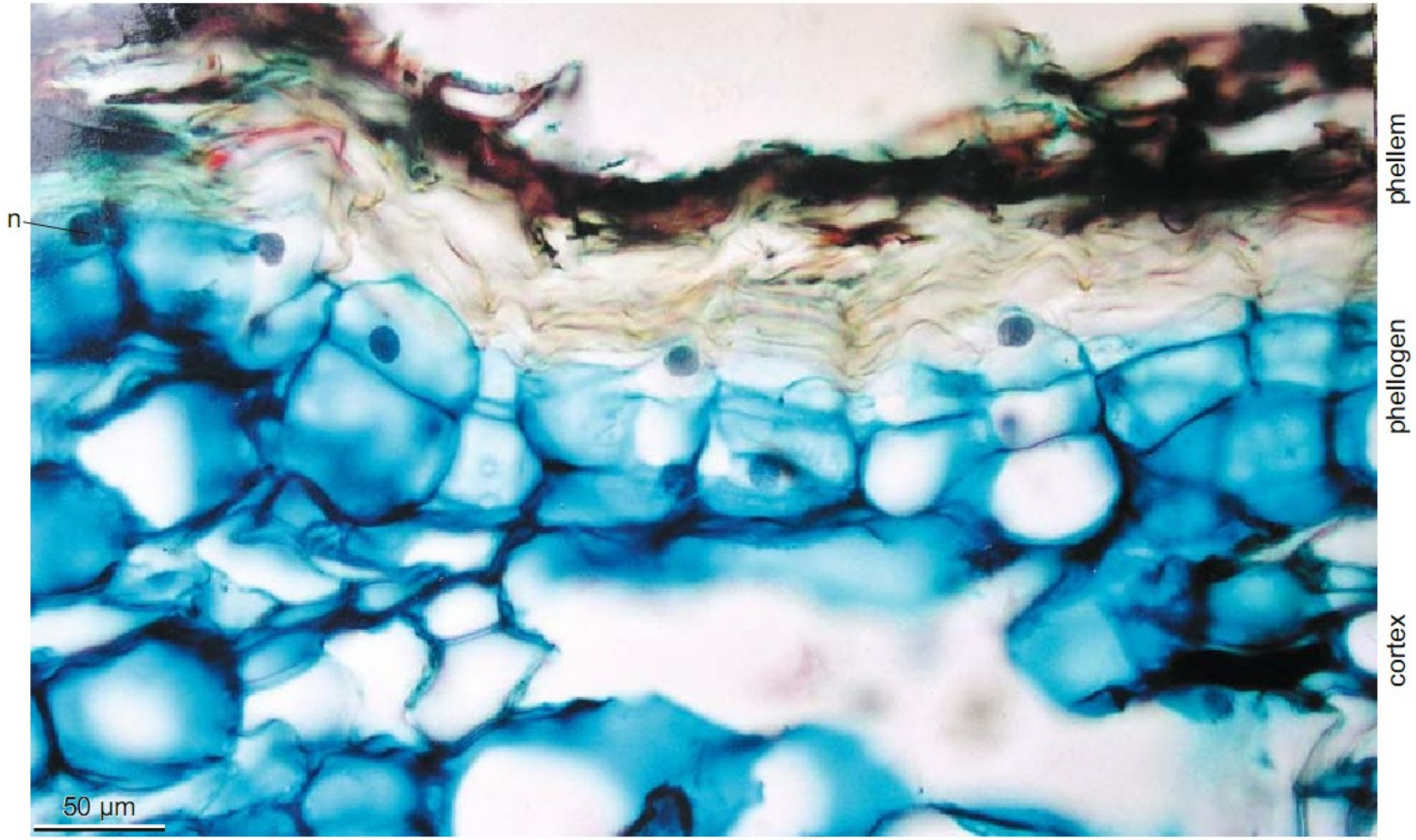
Branching, thickening and the origin of seed

Secondary stem

Periderm

- Periderm is the product of cork cambium
- 99% of periderm is a **phellem** (cork), thick outside layer
- **Phelloderm** is a tiny layer of living cells inside of cork cambium (phellogen). Phelloderm is sometimes absent.

Formation of periderm zone in medlar (*Mespilus germanica*)



No phelloderm

Lenticels

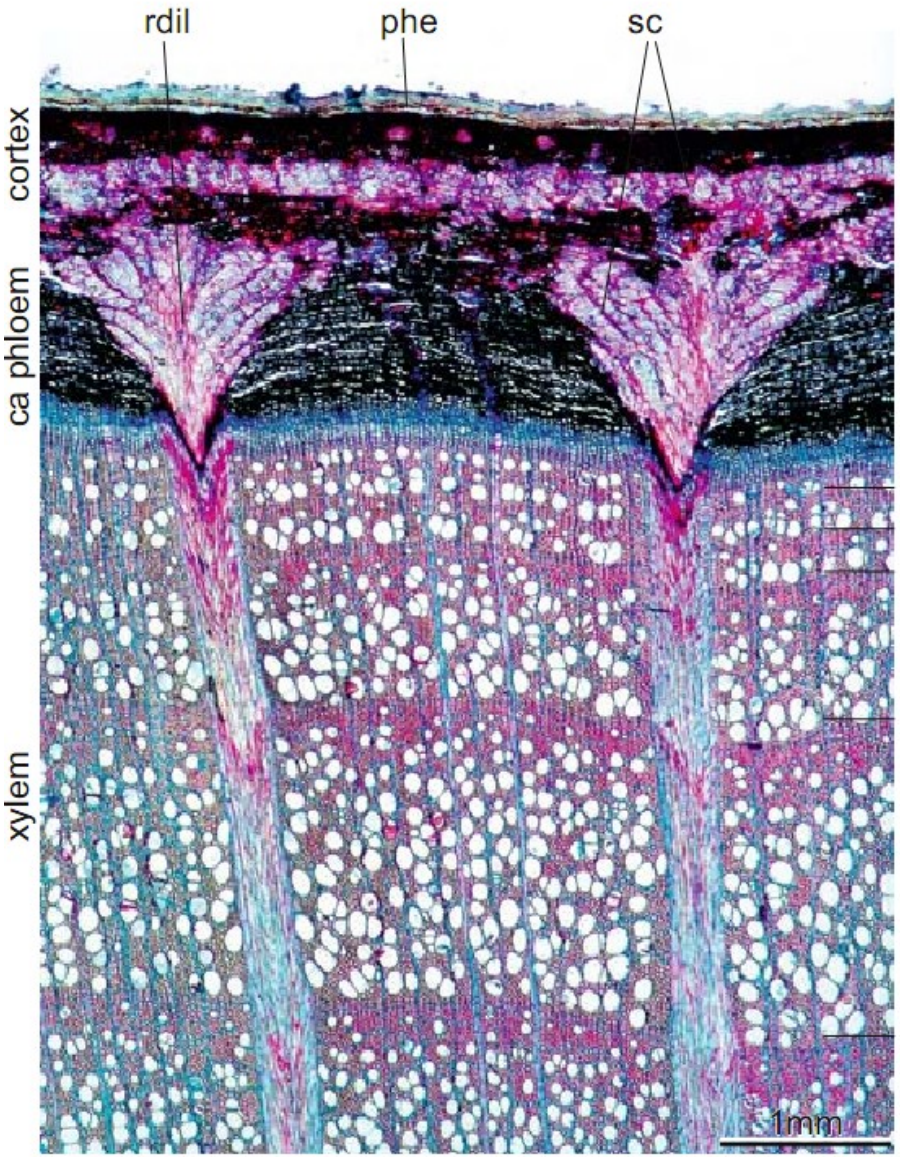
- **Lenticels** are specialized regions of periderm; they supply stem cells with oxygen
- In order to produce lenticel, some cells of cork cambium divide and grow much faster than others

Lenticel of elderberry (*Sambucus* sp.)

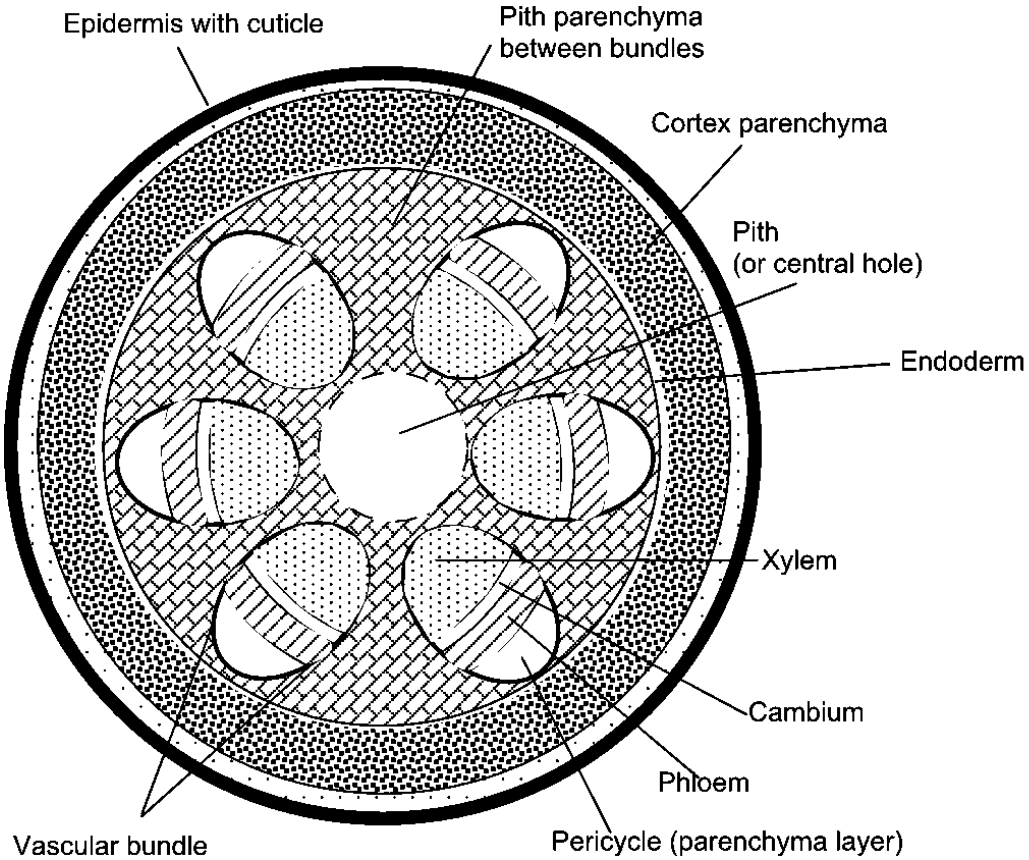
Secondary phloem (bast)

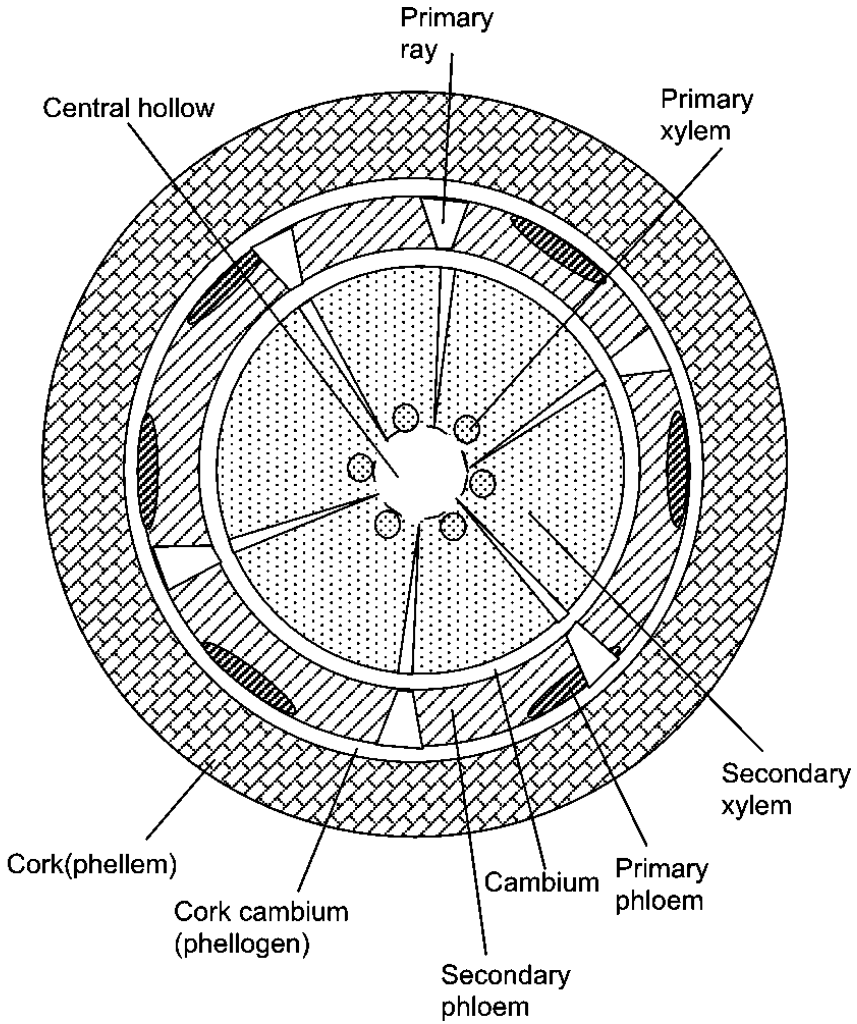
- Forms outside vascular cambium
- Rich of fibers
- Does not form annual rings
- Has rays of parenchyma cells, sometimes wedge-shaped (**dilated**)

Dilated rays in beech (*Fagus* sp.) stem

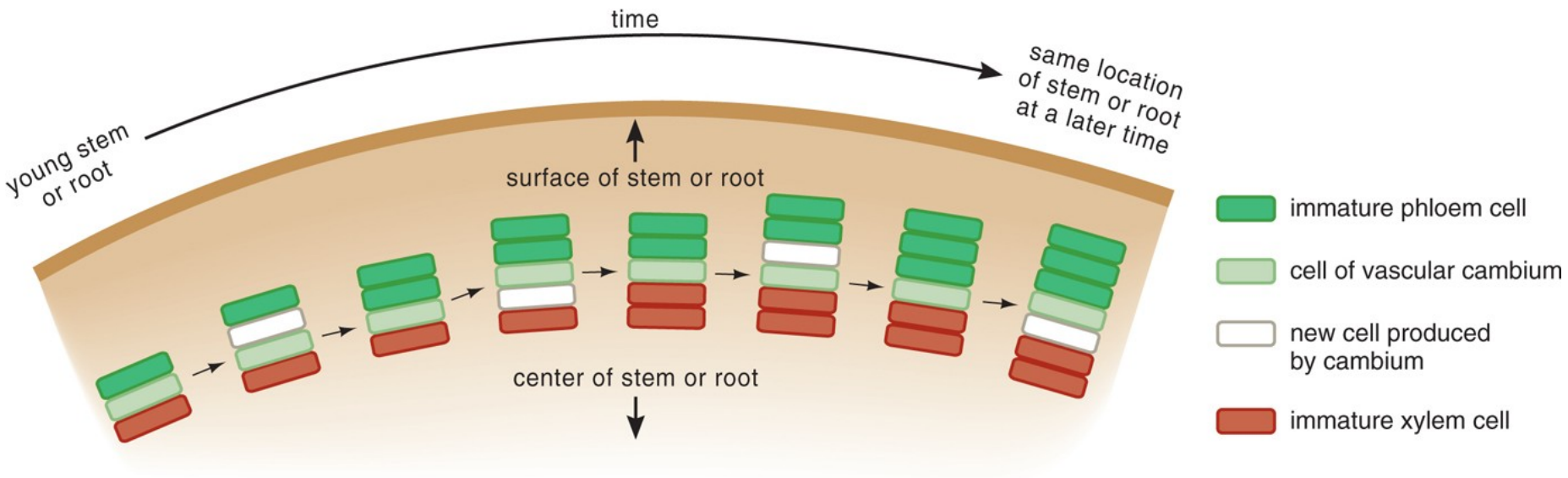


Primary and secondary stems (scheme)

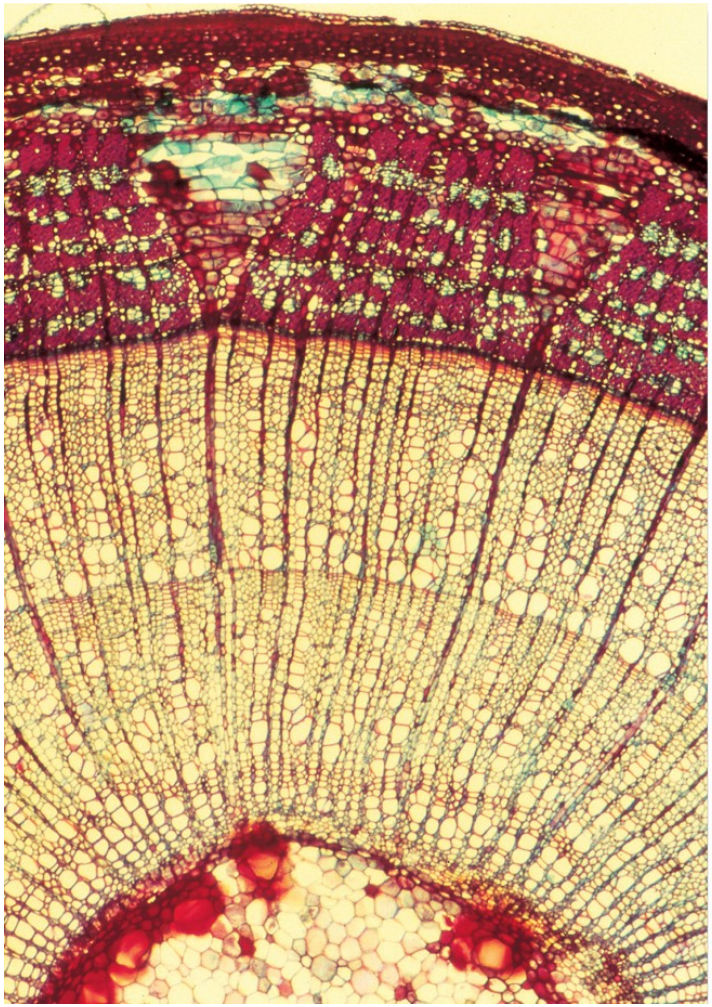


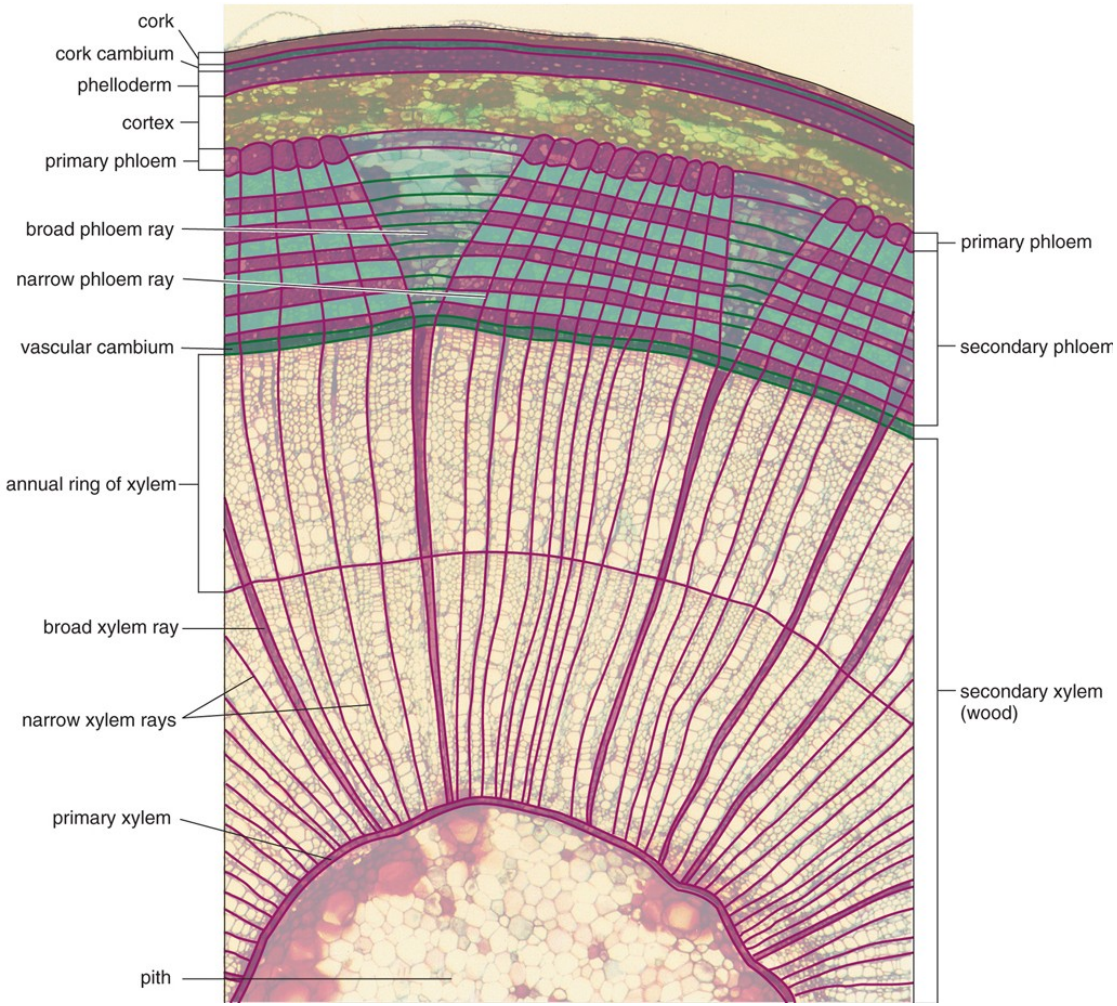


How cambium works



Secondary structure of stem (photo and explanations)

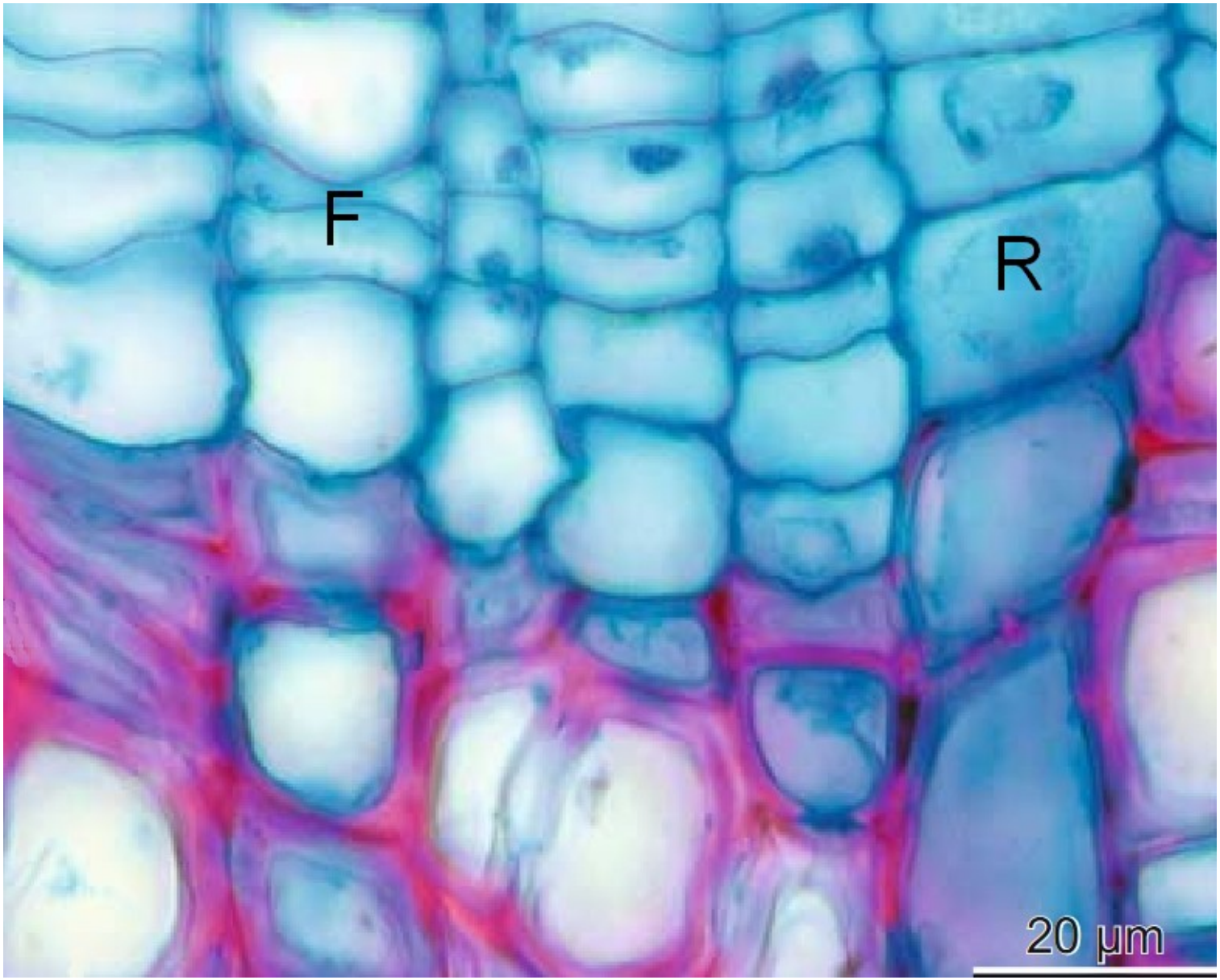




Secondary xylem and rays

- Secondary xylem, or wood, is the product of vascular cambium
- Some cambium cells are **fusiform initials**; they form axial vessel elements
- Other cambium cells are **ray initials**; they form rays (parenchyma + tracheids)
- **Rays** provide horizontal transport of water; **axial system** provide vertical transport

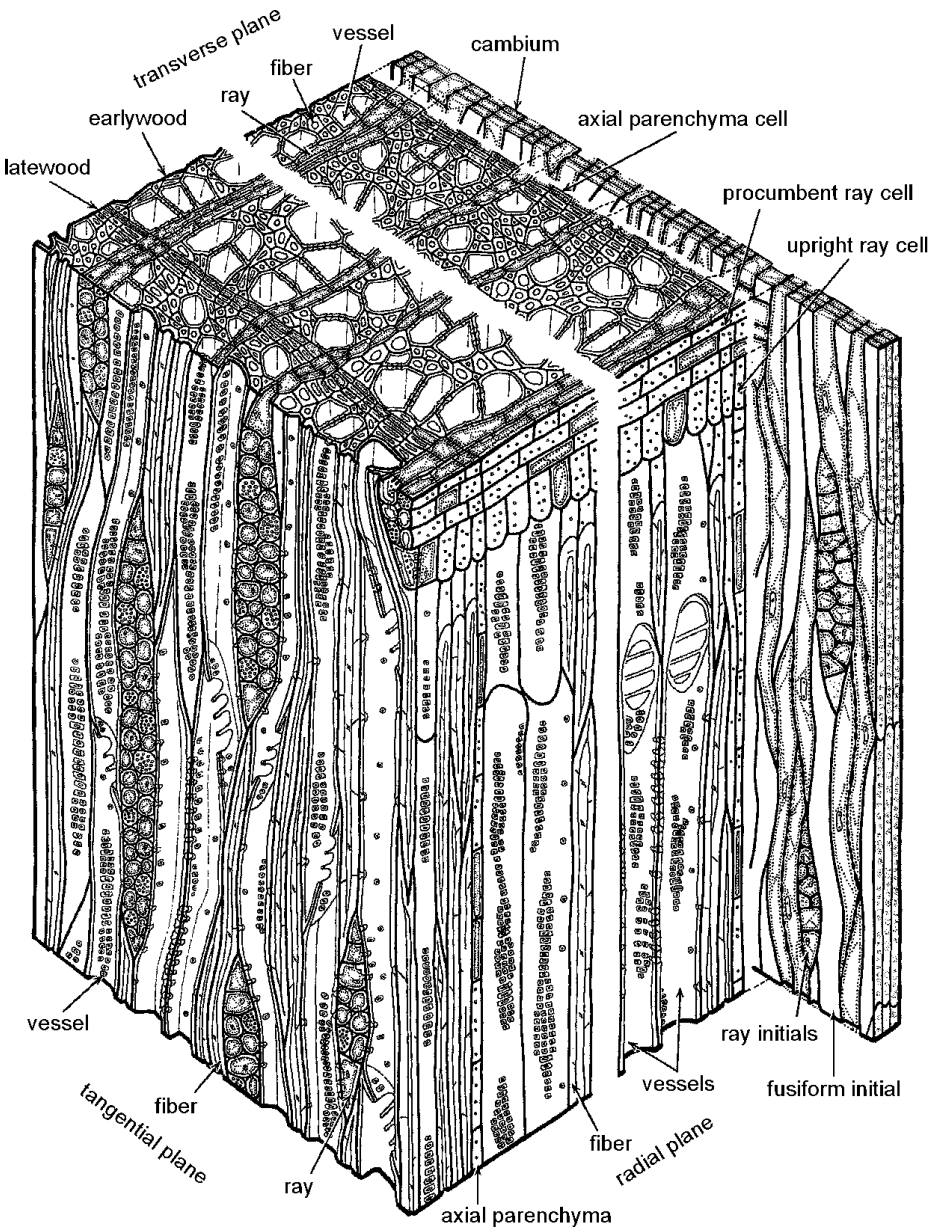
Fusiform and ray initials



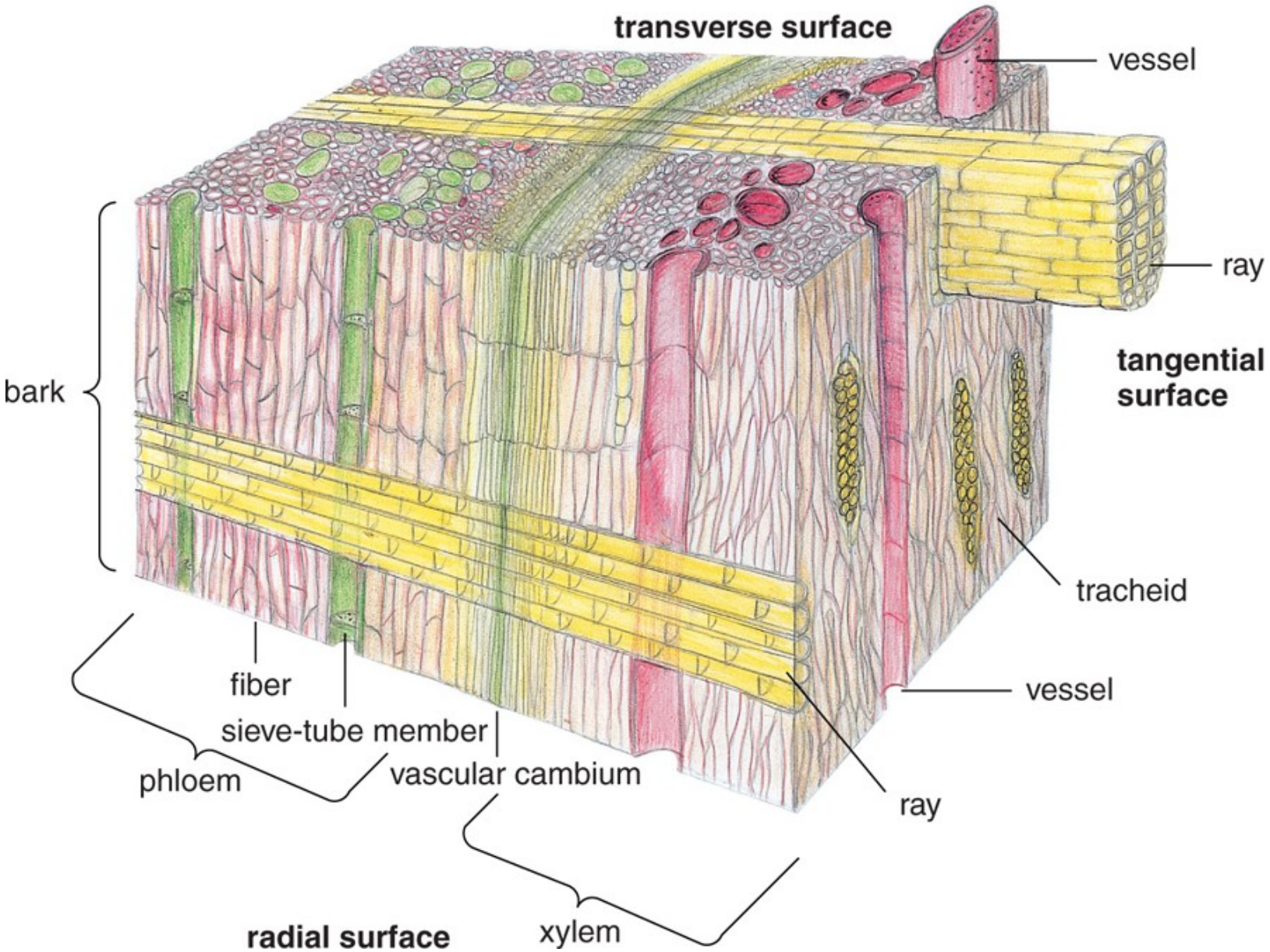
Three planes of view

- **Transverse** (cross-section)
- **Radial** (longitudinal section from center to periphery and perpendicular to stem surface)
- **Tangential** (longitudinal section parallel to stem surface)

Three plains of maple (*Acer* sp.) wood



Three plains again (the scheme)



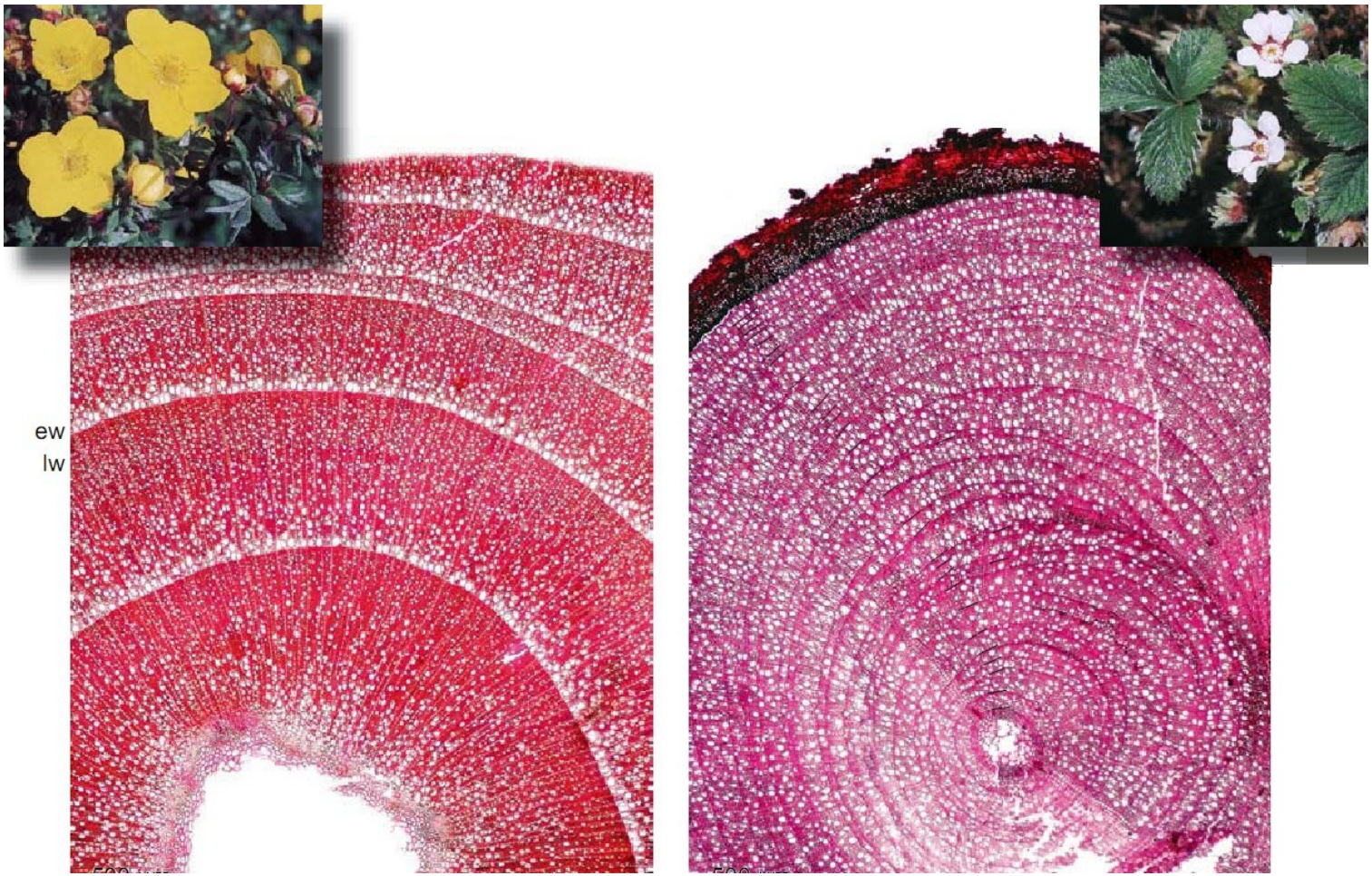
Earlywood and latewood

- **Earlywood** (springwood) contains more parenchyma and often have larger vessel elements
- **Latewood** (summerwood) often have small vessel elements and looks darker

Diffuse and ring porous wood

- In **ring porous** wood (like in red oak) bigger vessel elements concentrate in earlywood
- In **diffuse porous** wood larger vessel elements spread across early- and latewood (American elm)

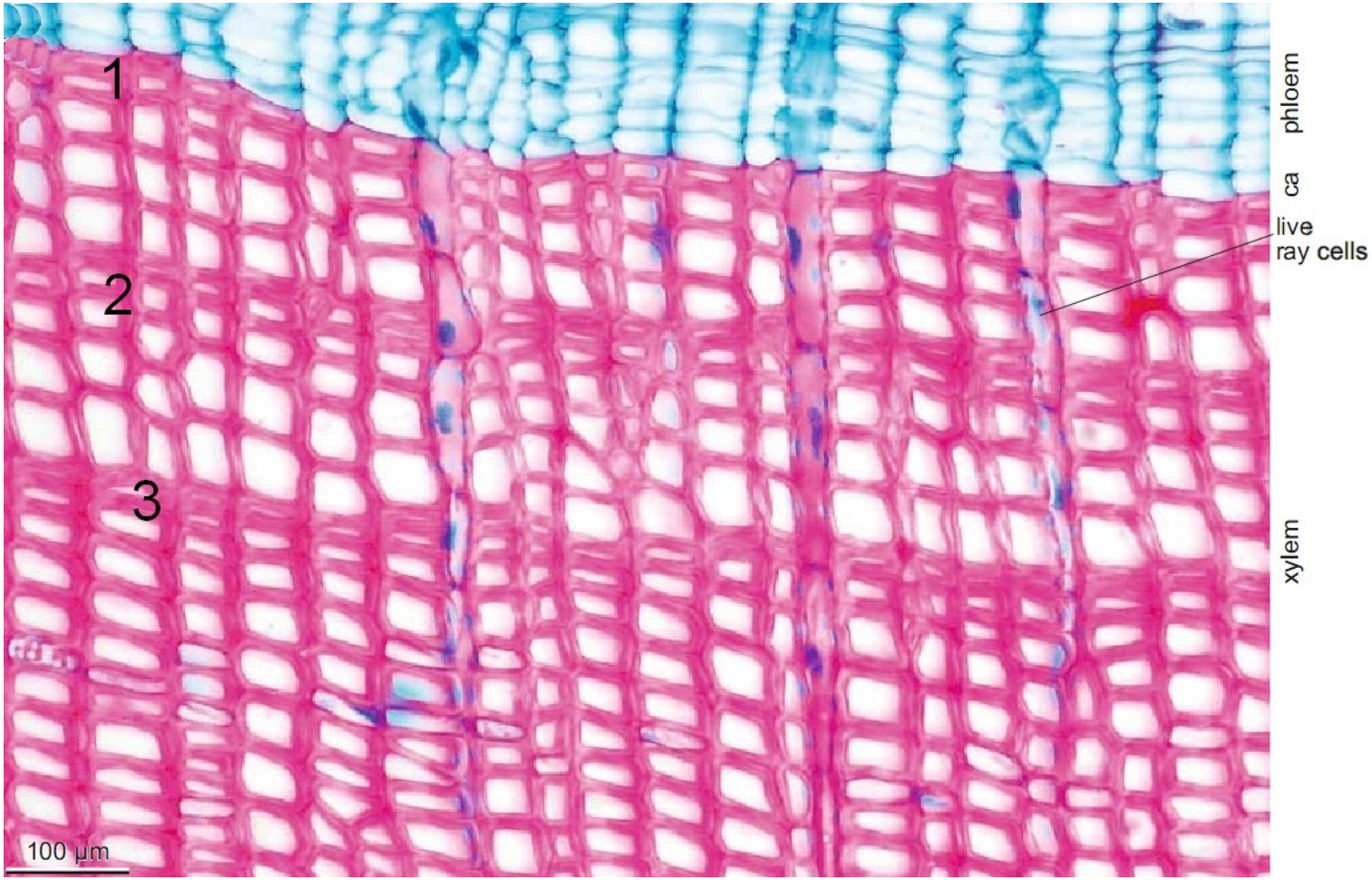
Diffuse and ring porous wood in two species of cinquefoil (*Potentilla* spp.)



Annual rings

- Interleaving early- and latewood from to sequential years form an impression of annual ring
- “Ring” is just a layer of darker (i.e., smaller) cells
- Tropical trees do not form annual rings

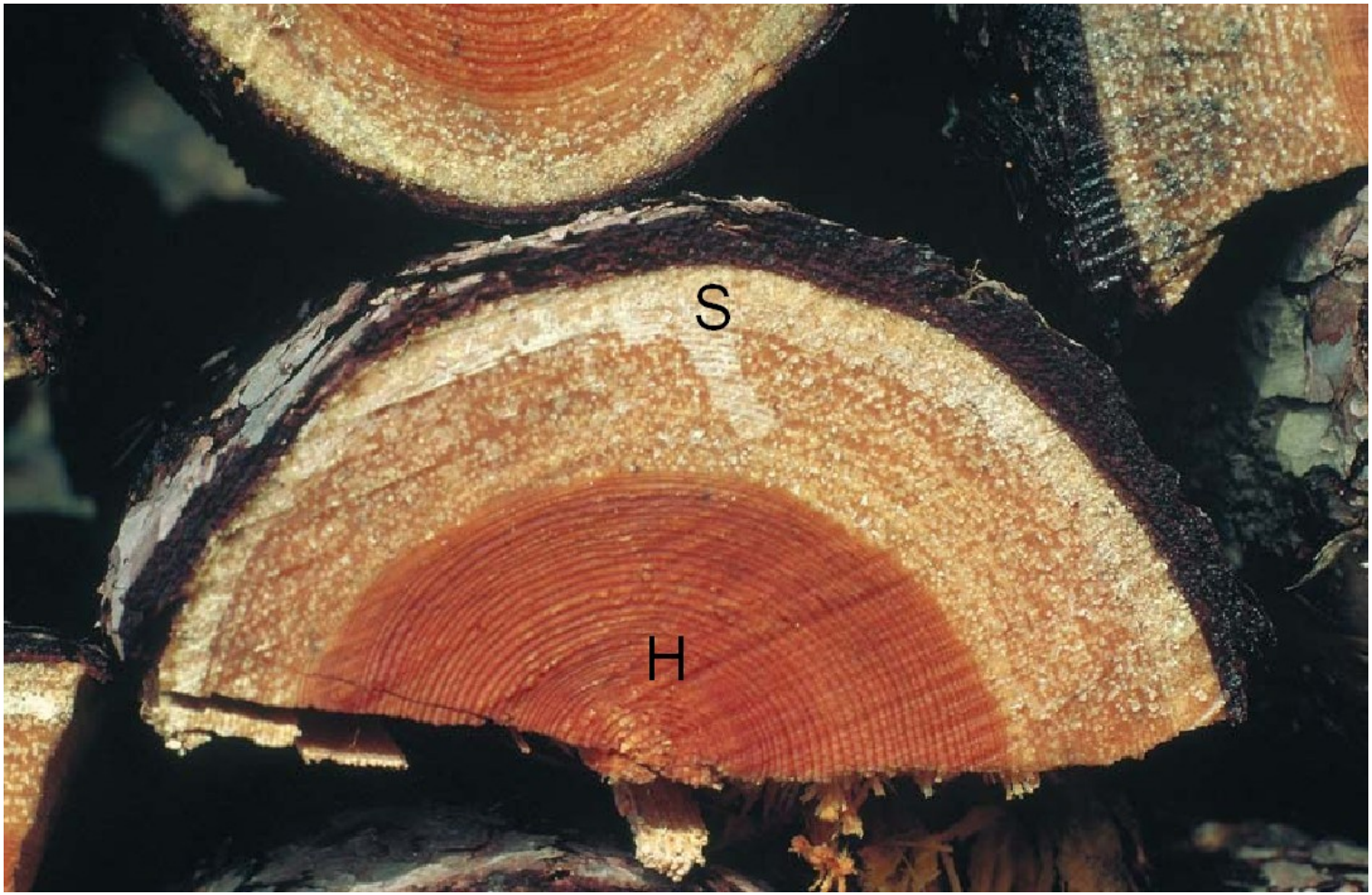
Annual rings in juniper (*Juniperus* sp.)



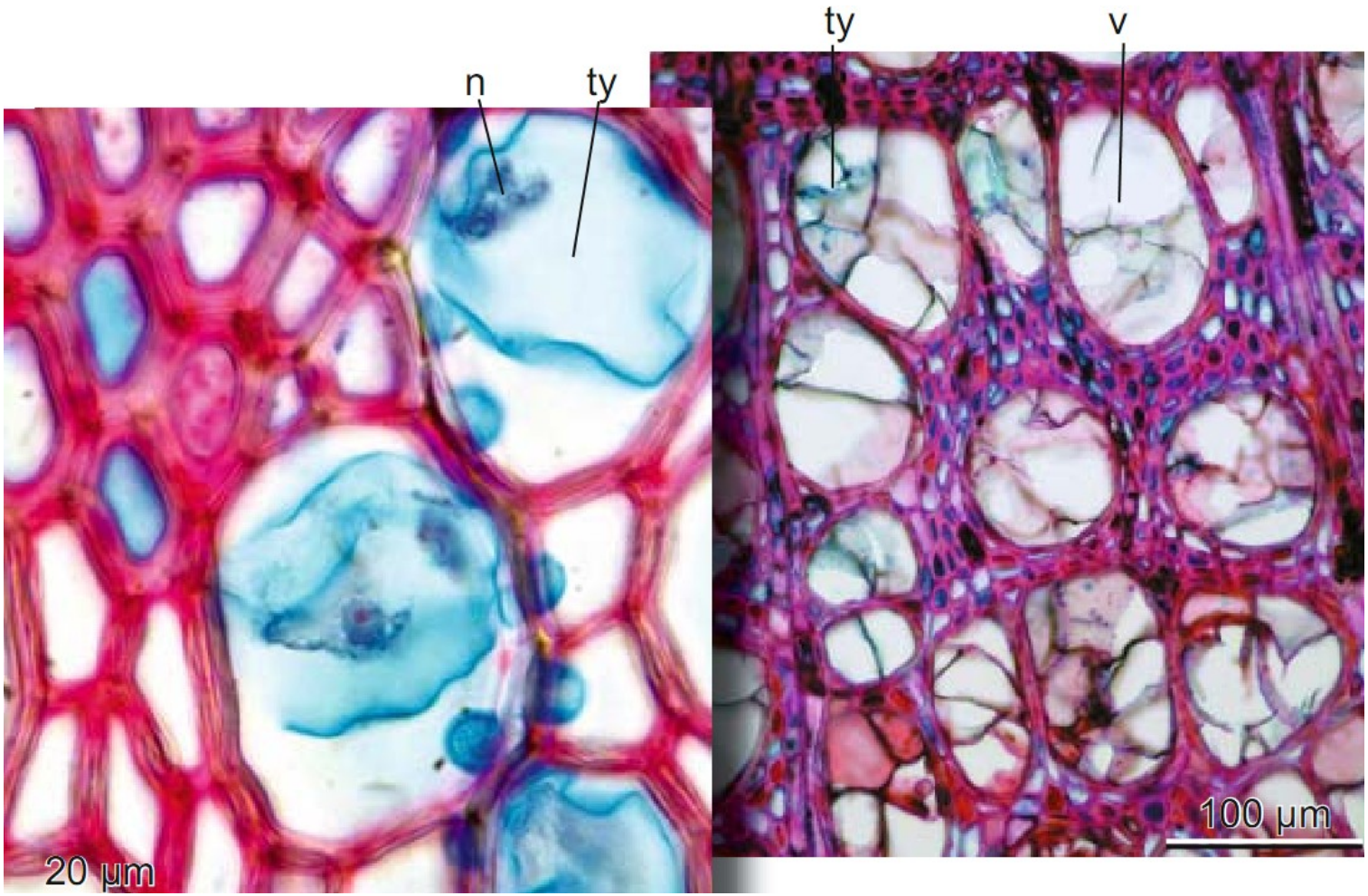
Sapwood and heartwood

- **Sapwood** is a peripheral layer of working xylem, it usually has relatively light color
- **Heartwood** is a central, non-functional, old, dark-colored xylem

Sapwood and heartwood of European pine (*Pinus sylvestris*)



Tyloses



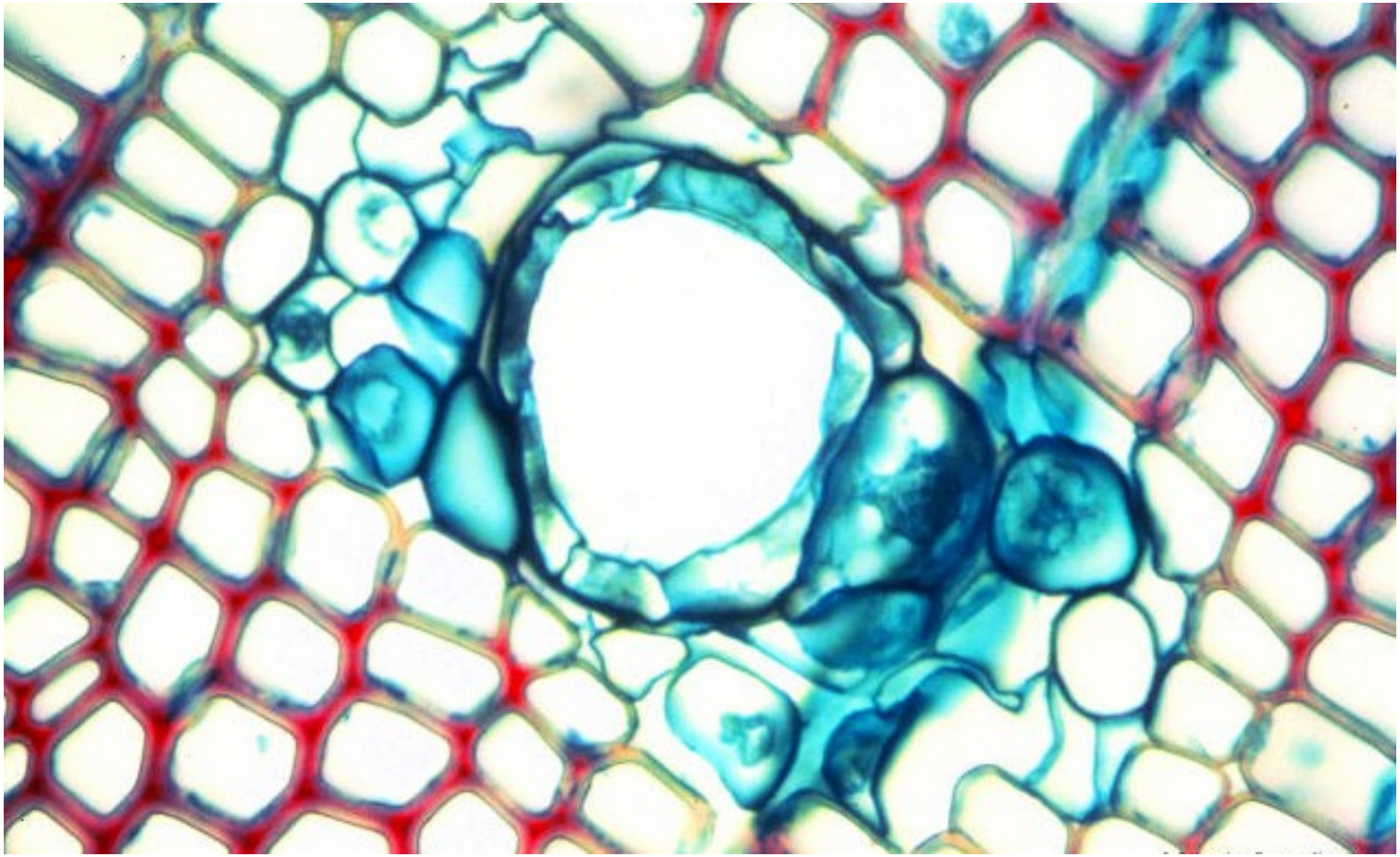
Tyloses control the winter functioning of vessels

Conifer wood

- Simpler structure, few cell types
- Simple rays
- Sometimes have **resin ducts**; resin secreted by epithelial cells

Ginkgo (*Ginkgo biloba*) wood (not a conifer, but gymnosperm)

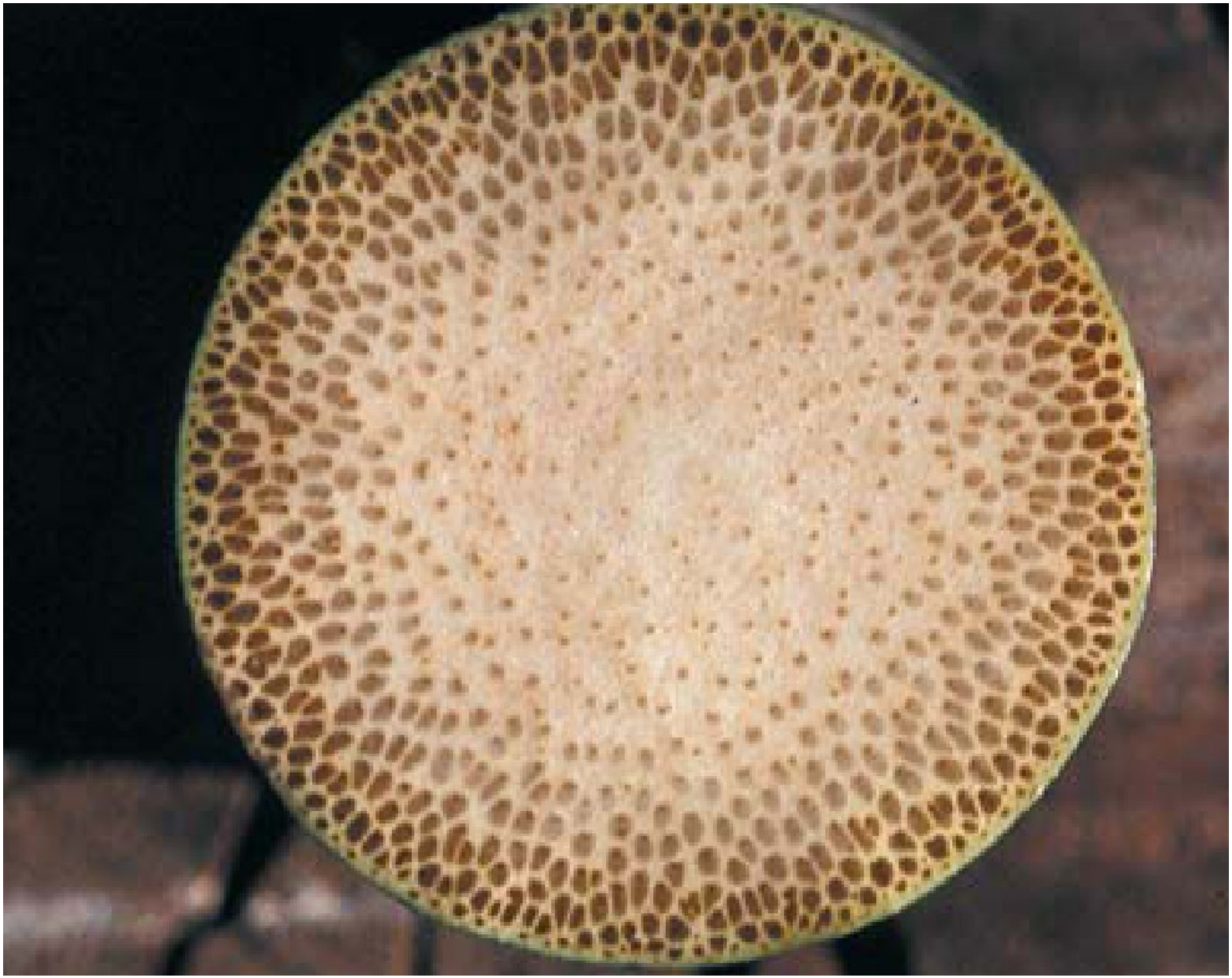
Resin duct in pine wood (©BSA)



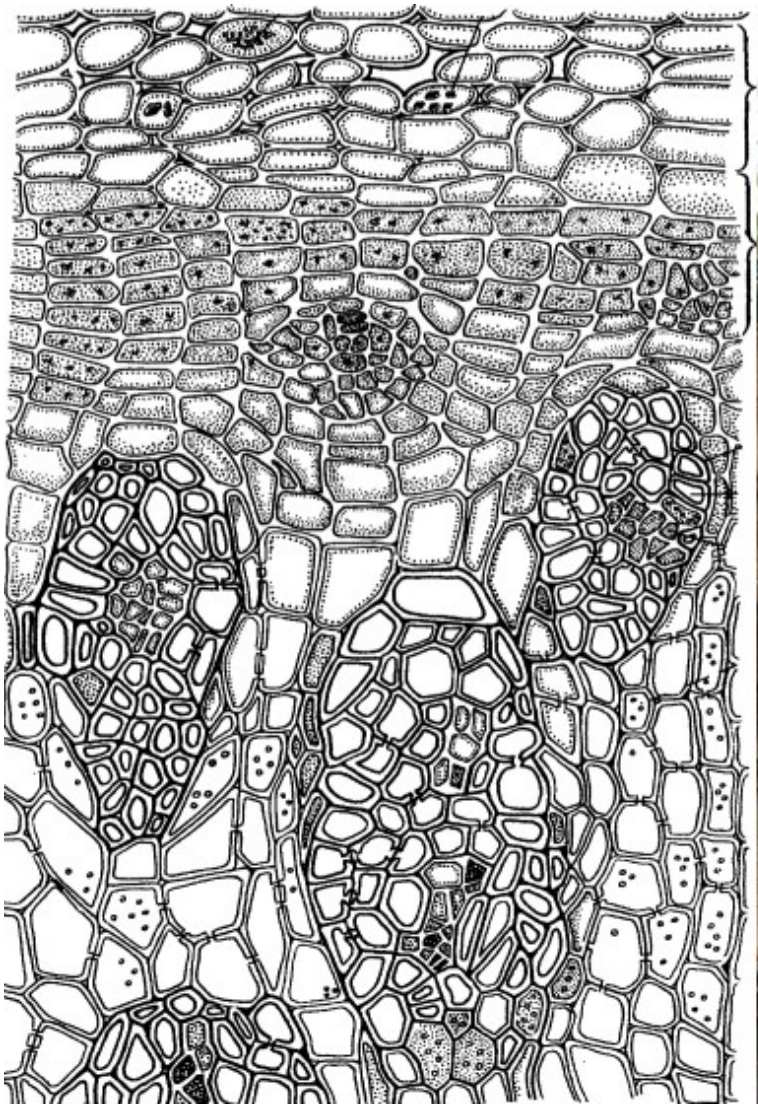
Monocot “wood”

- Most of monocots do not have lateral meristems and therefore have no true wood
- Palms have only primary tissues; their trunk widens from bottom to top
- Some monocots (dragon trees) have **anomalous secondary growth**

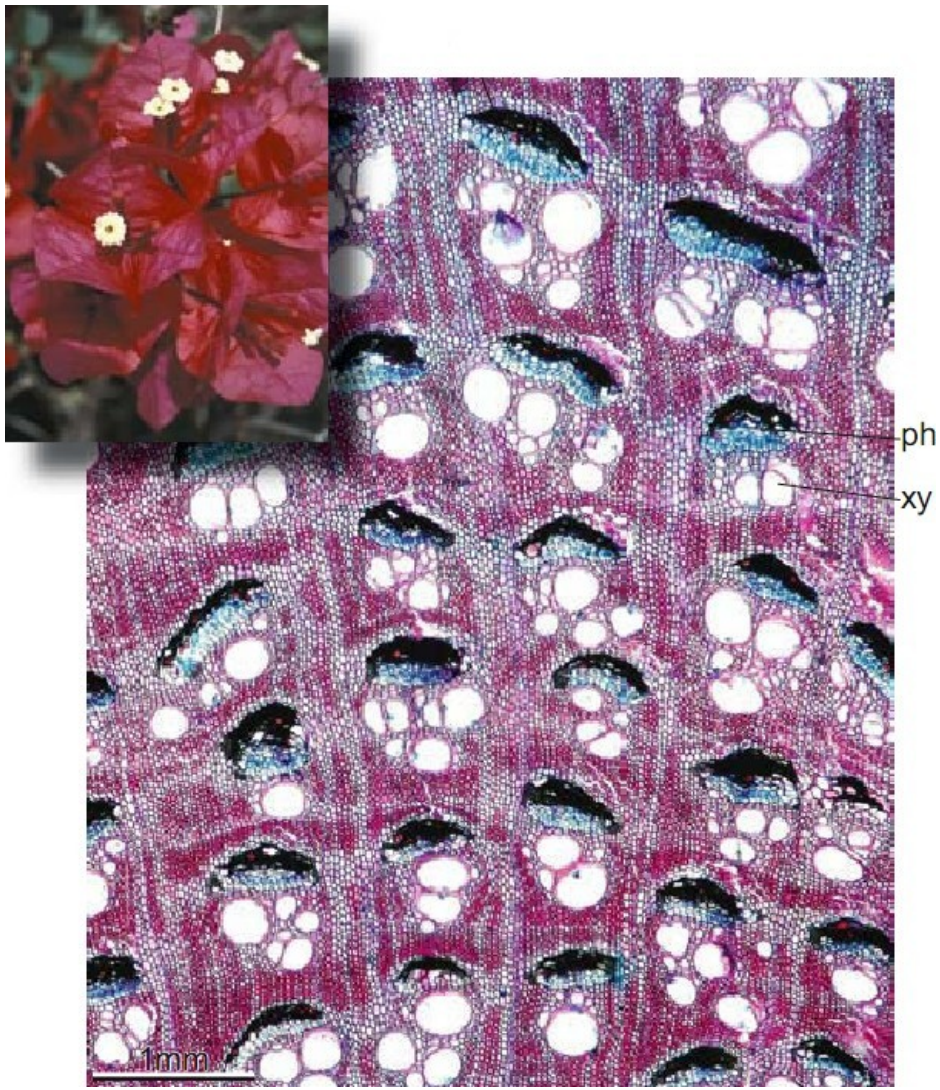
Cross section of palm (*Phoenix canariensis*) trunk



Dragon tree (*Dracaena draco*) and its anomalous cambium



Anomalous secondary growth in Bougainvillea (*Bougainvillea spectabilis*)



For Further Reading

A. Shipunov.
Introduction to Botany [Electronic resource].
2015.
Mode of access:
http://ashipunov.info/shipunov/school/biol_154