

Introduction to Botany. Lecture 31

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- 1 Questions and answers
 - Secondary stem



Previous final question: the answer

How does annulus work?



Previous final question: the answer

How does annulus work?

- When sporangium ripens (dries), all cell shrink
- But annulus has much thicker cell walls
- Consequently, it shrinks much slower and finally breaks sporangium wall

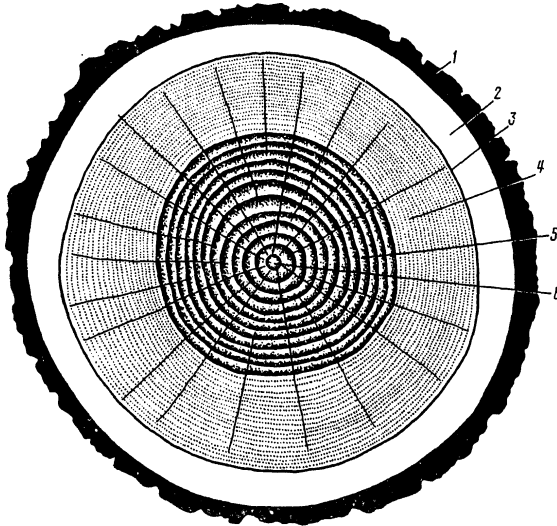


Questions and answers

Secondary stem



Secondary stem = bark + wood



1 cork, 2 bast, 1 + 2 = bark, 3 cambium, 4 + 5 wood, 4 **sapwood**, 5 **heartwood**, 6 pith (if any)



Bark, cork, periderm and wood

- **Bark** = secondary phloem (bast) + periderm + (optionally) epidermis
- **Periderm** = phellem (cork) + cork cambium (phellogen) + phelloderm
- **Wood** = trunk — bark, or simply secondary xylem + all remnants of central primary tissues



Cork cambium and origin of bark

- **Bark** is everything outside vascular cambium, therefore, bark = secondary phloem + periderm
- Each year new layer of cork cambium appear from parenchyma cells of secondary phloem
- Consequently, bark consists of multiple and mostly uneven layers



Renewal of bark in sea buckthorn (*Hippophaë rhamnoides*)

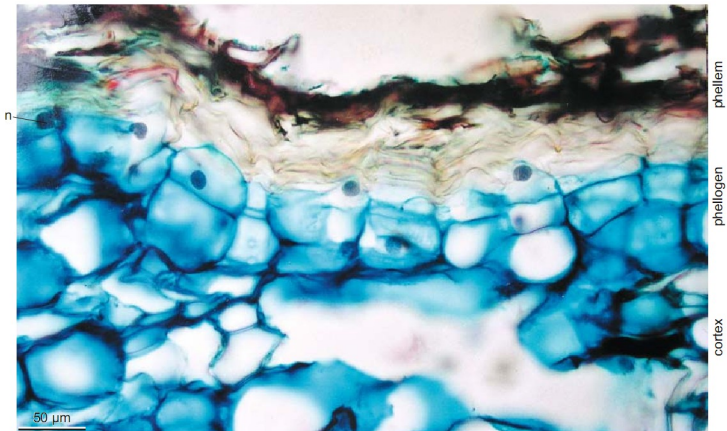


Periderm

- 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.)

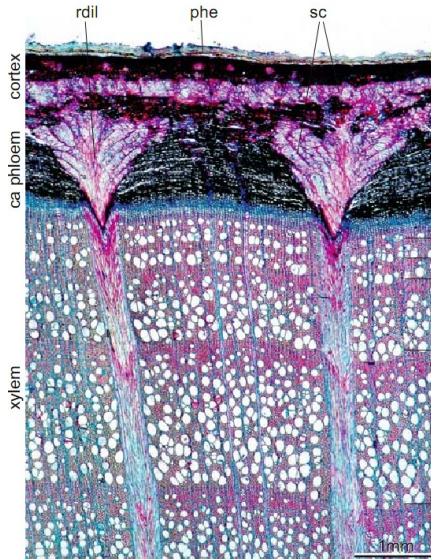


Secondary phloem (bast)

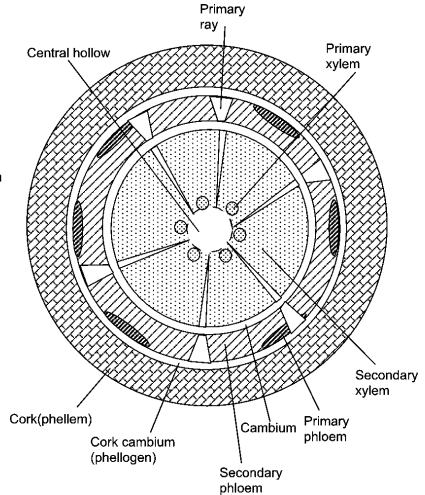
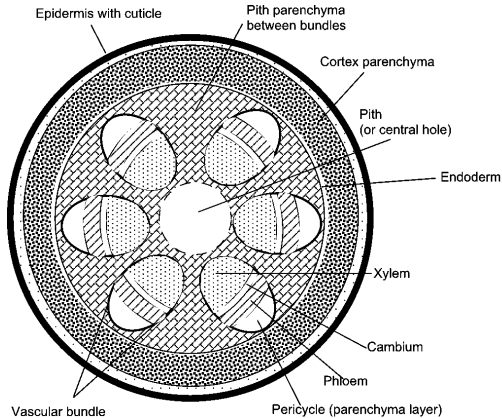
- Forms outside vascular cambium
- Rich of fibers
- Does not form annual rings
- Has rays of parenchyma cells, sometimes wedge-shaped (**dilated**)



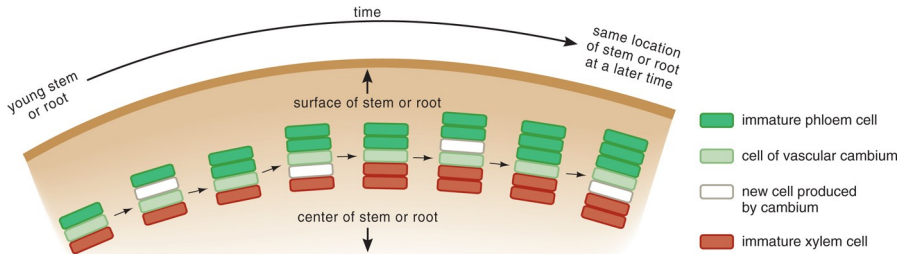
Dilated rays in beech (*Fagus* sp.) stem



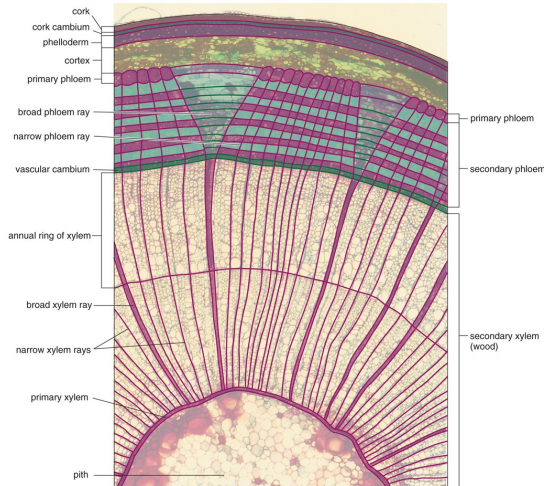
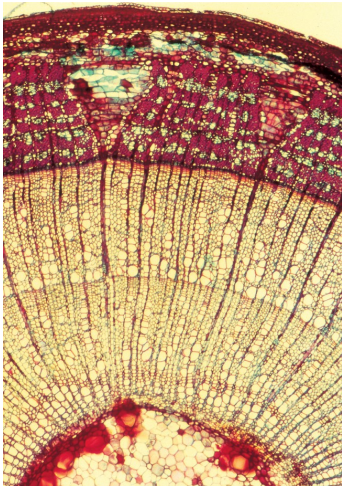
Primary and secondary stems (scheme)



How cambium works



Secondary structure of stem (photo and explanations)

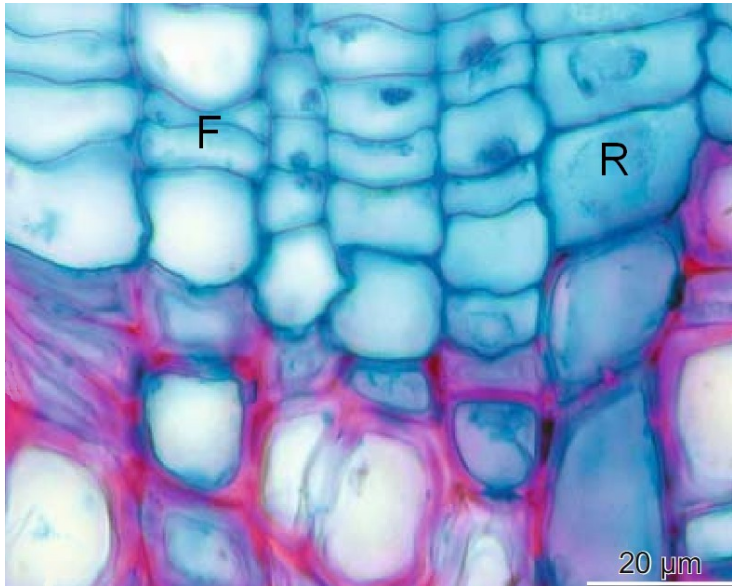


Secondary xylem and rays

- 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

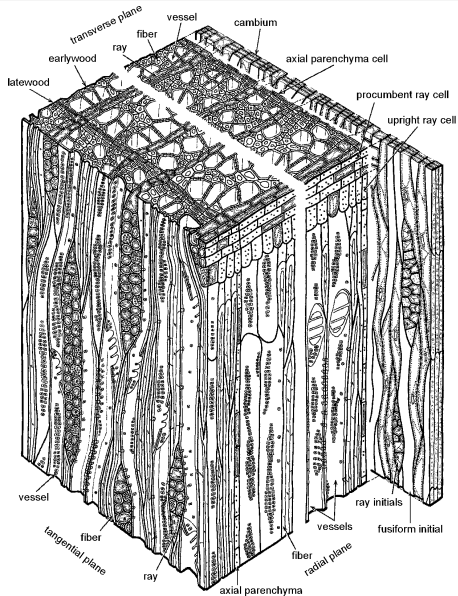


Three planes of view

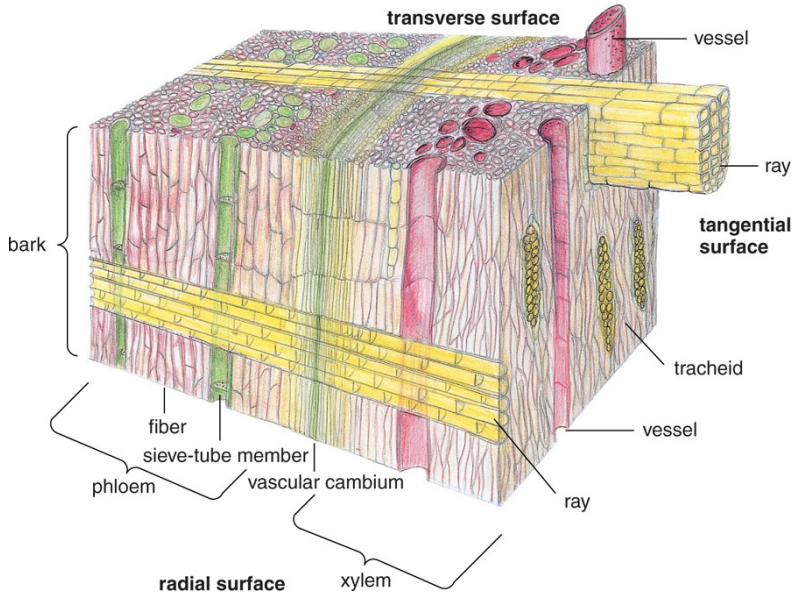
- **Transverse** (cross-section)
- **Radial** (longitudinal section from center to periphery and perpendicular to stem surface)
- **Tangential** (longitudinal section parallel to stem surface)



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



Three plains again (the scheme)



Final question (2 points)



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What is the difference between fusiform initials and ray initials?



Summary

- **Sympodial** branching is evolutionary more advanced than **monopodial**
- **Bark** consists of secondary phloem and cork
- **Wood** is a secondary xylem



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

2010—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_154



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.

Plant Biology. 2nd edition.

Thomson Brooks/Cole, 2006.

Chapter 5.

