MSC BOTANY
SEMESTER-1

ANATOMY

CAMBIUM

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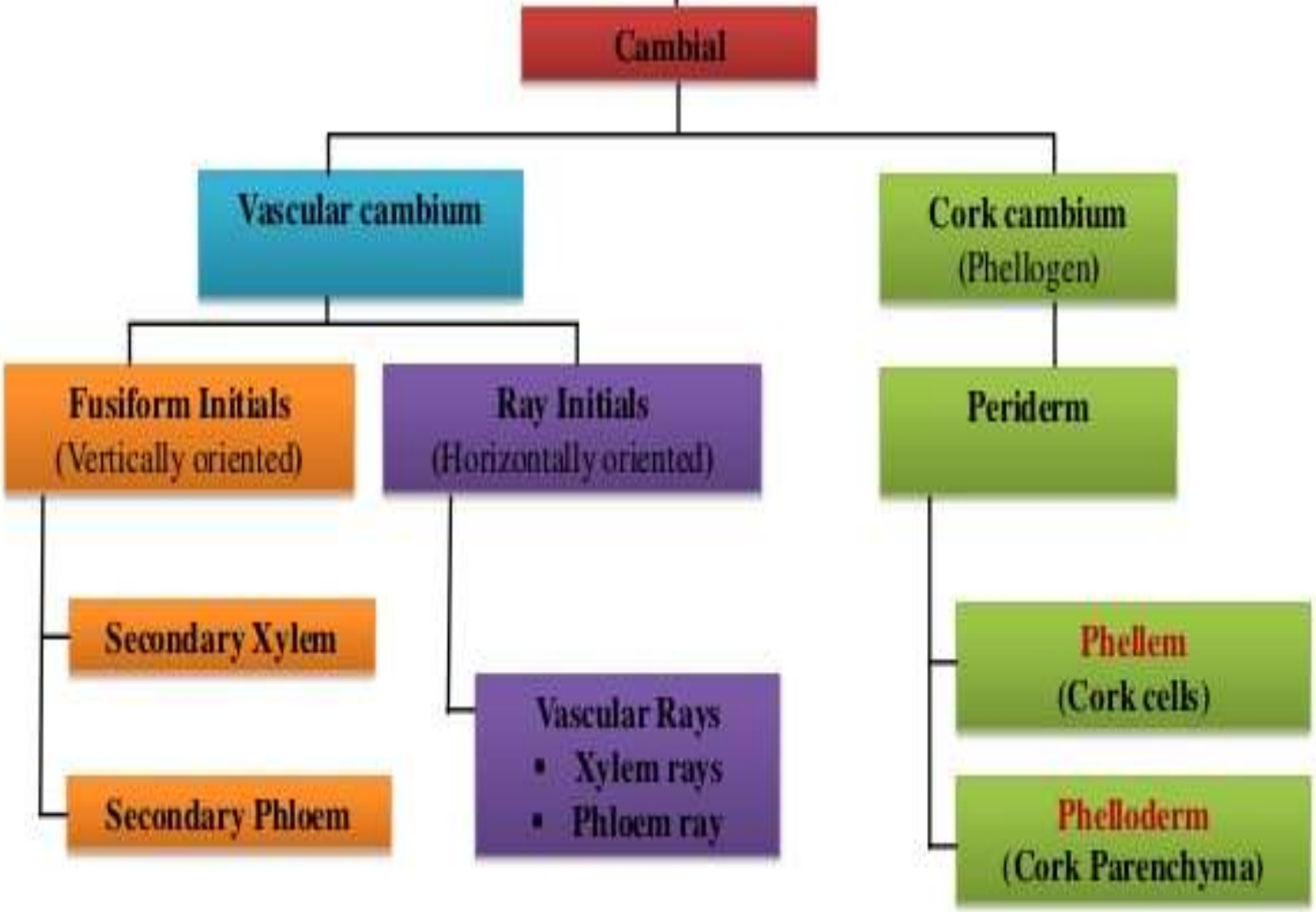
Development of vascular cambium in stem and pith

- By the end of devonian period(350 million years ago) limited secondary growth existed in all major group of terrestrial plants
- A well organised cambium with definite ray initials were present at that time
- Vascular cambium evolved independently and plants became woody
- Limited secondary growth occurred in some extinct ferns . This is believed to have resulted from unifacial cambium – producing only sec. xylem nothing to outer side

- The vascular cambium is a lateral meristem that forms sec. vascular tissues. It is formed during sec. growth
- In woody dicots and gymnosperms , the vascular tissues of the stem and root exist only for a short period of time and their function is taken over by the sec. vascular tissues
- In herbaceous angiosperms- vascular cambium is absent

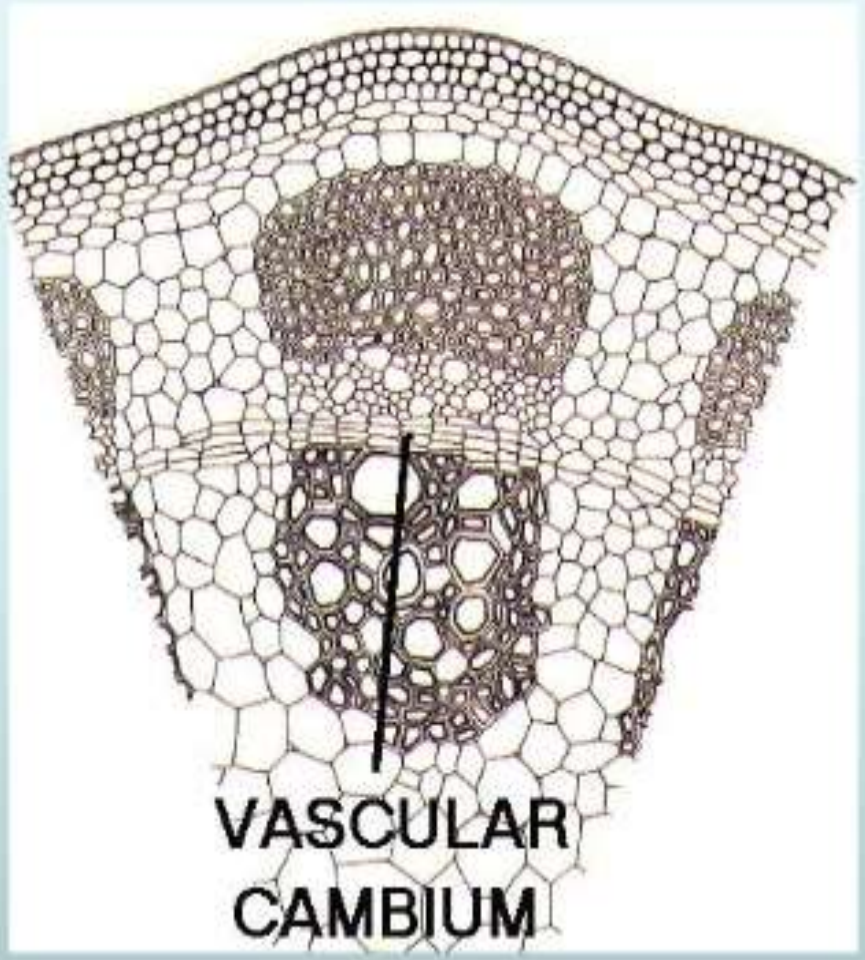
- In herbaceous plants , especially in monocots , all procambium in the stem differentiates into vascular tissues , so there is no cambium in the vascular bundles (closed vascular bundles)
- But in woody plants (dicots) a portion of procambium in the stem remains meristematic even after the completion of primary growth . It forms a cambium within the vascular bundle(open VB)
- It is called fascicular cambium or intrafasicular cambium. It is primary meristem

SECONDARY GROWTH



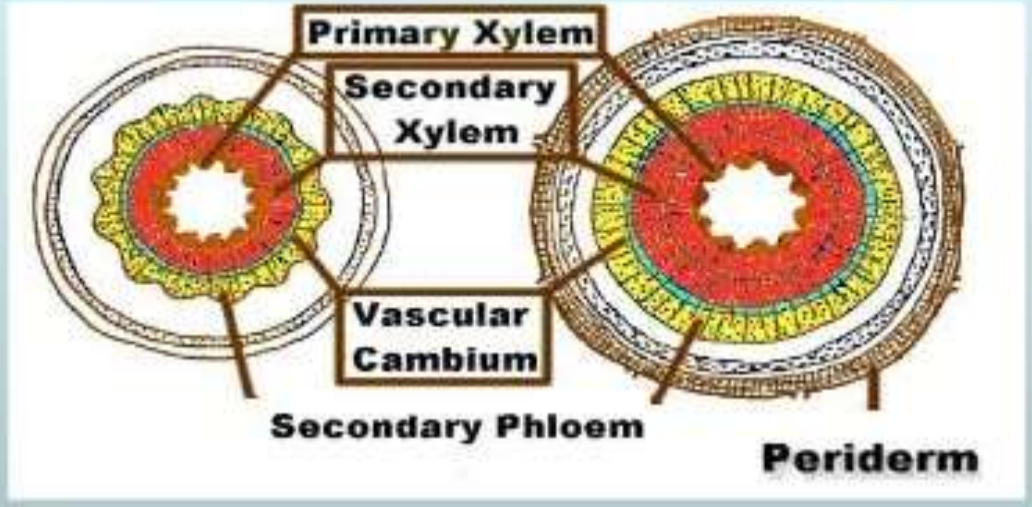
- During sec. growth – parenchyma cells between VB becomes meristematic and forms the interfasicular cambium. So it is sec. meristem
- Interfasicular and intrafasicular cambium join- form a hollow cylinder of cambium. After several months both the cambia becomes identical and this ring is now called vascular cambium

VASCULAR CAMBIUM



VASCULAR CAMBIUM

- The **vascular cambium** (pl. cambia or cambiums) is a lateral meristem in the **vascular** tissue of plants.
- The **vascular cambium** is a cylindrical layer of **cambium** that runs through the stem of a plant that undergoes secondary growth.



- Dicot roots have undifferrentiated procambial cells between primary xylem and primary phloem . This is called conjuctive tissue. It becomes meristematic and gives rise to vascular cambium. A part of vascular cambium is derived from the pericycle arching over the primary xylem .thus vascular cambium is completely secondary in origin. In the beginning the vascular cambium is wavy in outline – then becomes circular- activity becomes uniform

Structure of vascular cambium

- **Unique Features of cambial cell**
- 1. intense vacuolation
- 2. walls of the cell possess primary pit with plasmodesmata
- 3. radial walls(especially of xylem and phloem mother cells) are thicker than longitudinal wall
- 4. division of cambial cell is pridominantly periclinal

Difference between procambium and vascular cambium

- 1. Procambial cells have globed ends in radial view whearas cambium have flat ending
- 2.The protoplast of procambial cells stain deeply but those of cambial cell donot stain strongly
- 3. Procambium is not differentiated into long and short cells but cambium consist of long fusiform and short ray initials

- During the growing period the cambial initials, together with their immediate derivatives, form the cambial zone or cambial region
- It is a continuous , multilayered cylinder
- Some of the inner layers are xylem mother cells , and some of the outer layers are phloem mother cells
- During periods of activity and growth the cambial region contains many layers , but during dormancy it contains only a few

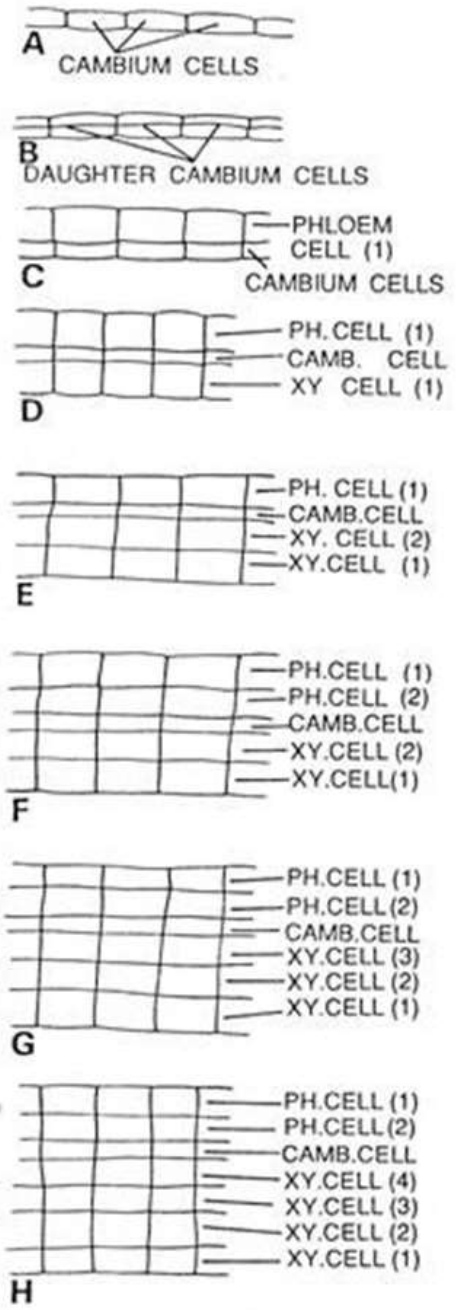
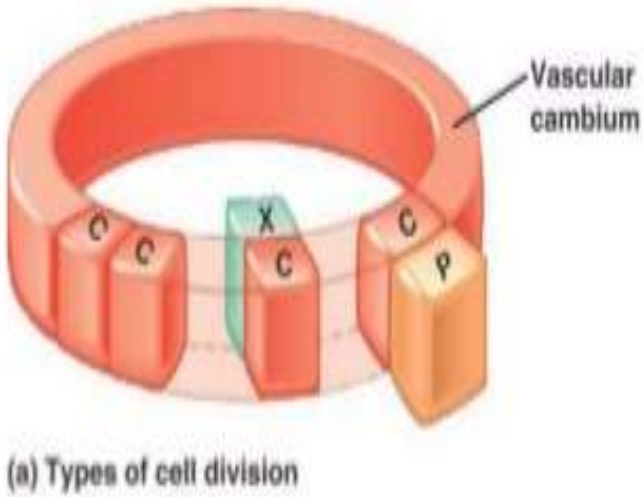
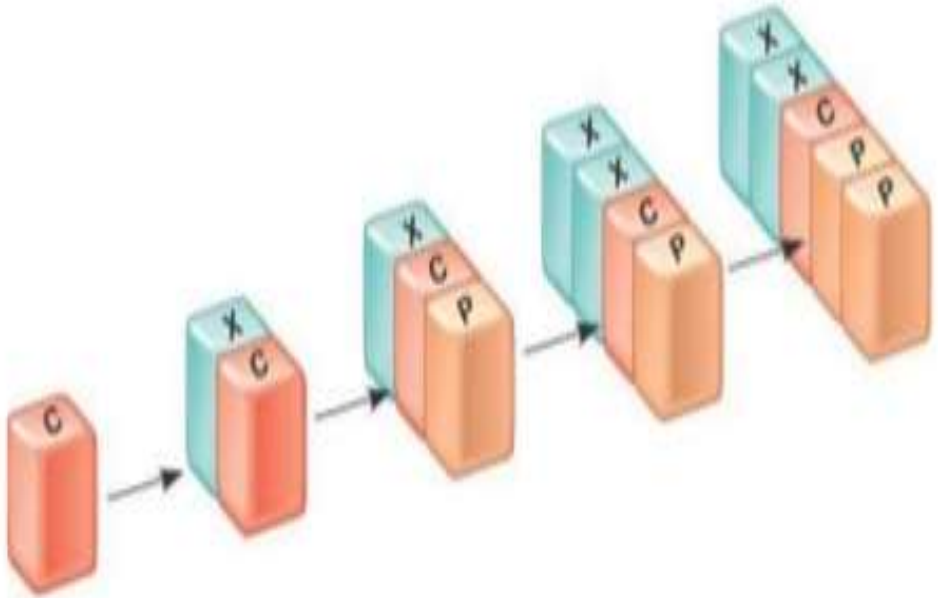


Fig. 39.3. The cambium. A—H, diagrams showing the formation of xylem and phloem by the cambium, and changes in position of

Development Of The Vascular Cambium Over Time



(a) Types of cell division



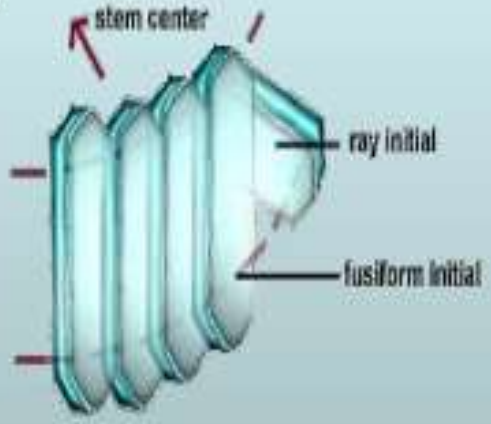
(b) Accumulation of secondary growth

- The entire cambial zone is referred to as cambium because it is difficult to distinguish between initials and neighbouring cells derived from it
- There are 2 opinions regrding number of layers in it:
- 1. Hartig(1853) thought cambium consist of 2 layers (biseriate) . Inner layer contributing to xylem and outer layer to phloem– not accepted
- 2. Sanio (1873) – cambium consist of single layer-activity is bifacial – produces derivatives to both directions – accepted

CELL TYPES OF VASCULAR CAMBIUM

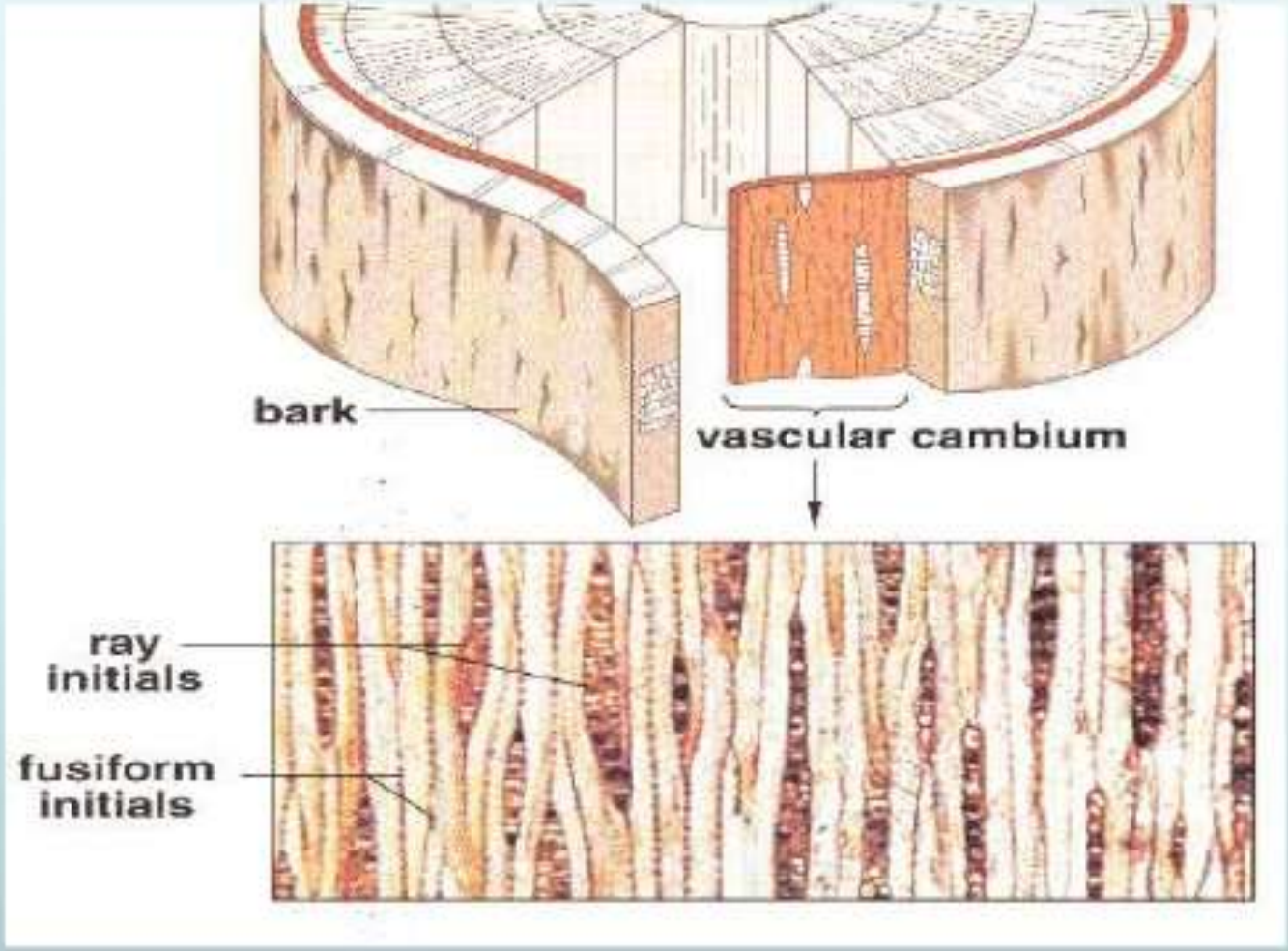
TYPES OF CELLS

Vascular cambium is a very thin layer that lies between the primary xylem inside and primary phloem on outside. They contain meristematic cells that can form the secondary xylem inside and secondary phloem outside. There are two kinds of meristematic cells called **fusiform initials** which are vertically elongated and **ray initials** which are horizontally elongated.



- Two types of cells : 1. fusiform initials and 2. ray initials
- Fusiform initials elongated cells with pointed ends
- Their length can vary during the year
- Length of fusiform initial change with age , nutrient conditions climatic conditions and plant vigour

FUSIFORM INITIALS & RAY INITIALS



Interconversion of fusiform and ray initials

- Fusiform initials can be converted into ray initials in gymnosperms and dicots
- This is necessary to prevent the distance btn neighbouring rays from becoming too great
- The ratio of fusiform initials to ray initials tend to be high
- In many sps. 90% of vascular cambium consist of fusiform initials

Conversion of fusiform to ray initial can occur by:

1. The very tip may be cut off the from a fusiform initial by a special transverse division
2. A single small cell may be cut off from the side of a fusiform initial
3. A declining fusiform initial may be reduced to a single ray initial
4. The entire surface of a fusiform initial may be segmented by transverse divisions to form, a tier of ray initials
5. Half of the fusiform initial may divide to form ray initials

- ✓ The ability of fusiform initials to convert to ray initials is important
- ✓ to maintain proper horizontal conduction through the wood, bark and cambial zone , new rays must be produced periodically

In dicots , the ray initials can begin to elongate and convert themselves to fusiform initials . This does not happen in gymnosperms .

This conversion is important in preventing rays from becoming too massive and creating large areas of weak parenchyma in wood

- Groups of ray initials can also be broken by the intrusive growth of fusiform initials from the periphery of the group into the mass of ray initials . Thus a mixture of fusiform and ray initials occur in some dicots. **These are called aggregate rays.**
- They have the shape of a giant ray ,but are actually mixtures of fusiform initials and ray initials

Types of cambium:

- Two types of cambium can be distinguished on the basis of the arrangement of the fusiform cells as seen in longitudinal section.
- Storied cambium
- Non storied cambium

- Storied or Stratified cambium - in which the fusiform initials are arranged in horizontal rows so that their ends are approximately at the same level . According to Bailey this cambium is phylogenetically advanced

- Non-storied or non-stratified cambium - in which the fusiform initials partially overlap one another. It is phylogenetically primitive. Seen in fossil pteridophytes, gymnosperms and primitive dicots

INFECTED CAMBIUM

In a variety of parasitic angiosperms, endophytic absorptive tissue that penetrates the host are able to infect the vascular cambium . This doesnot damage the cambium which continues to function normally.

The parasitic cells themselves also become cambial in nature and they cut off cells to both interior and exterior. Since the growth of the parasite matches that of the host ,new secondary xylem and phloem of the host are automatically infected as they are produced

THANK YOU