Pinus

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Deshbandhu College
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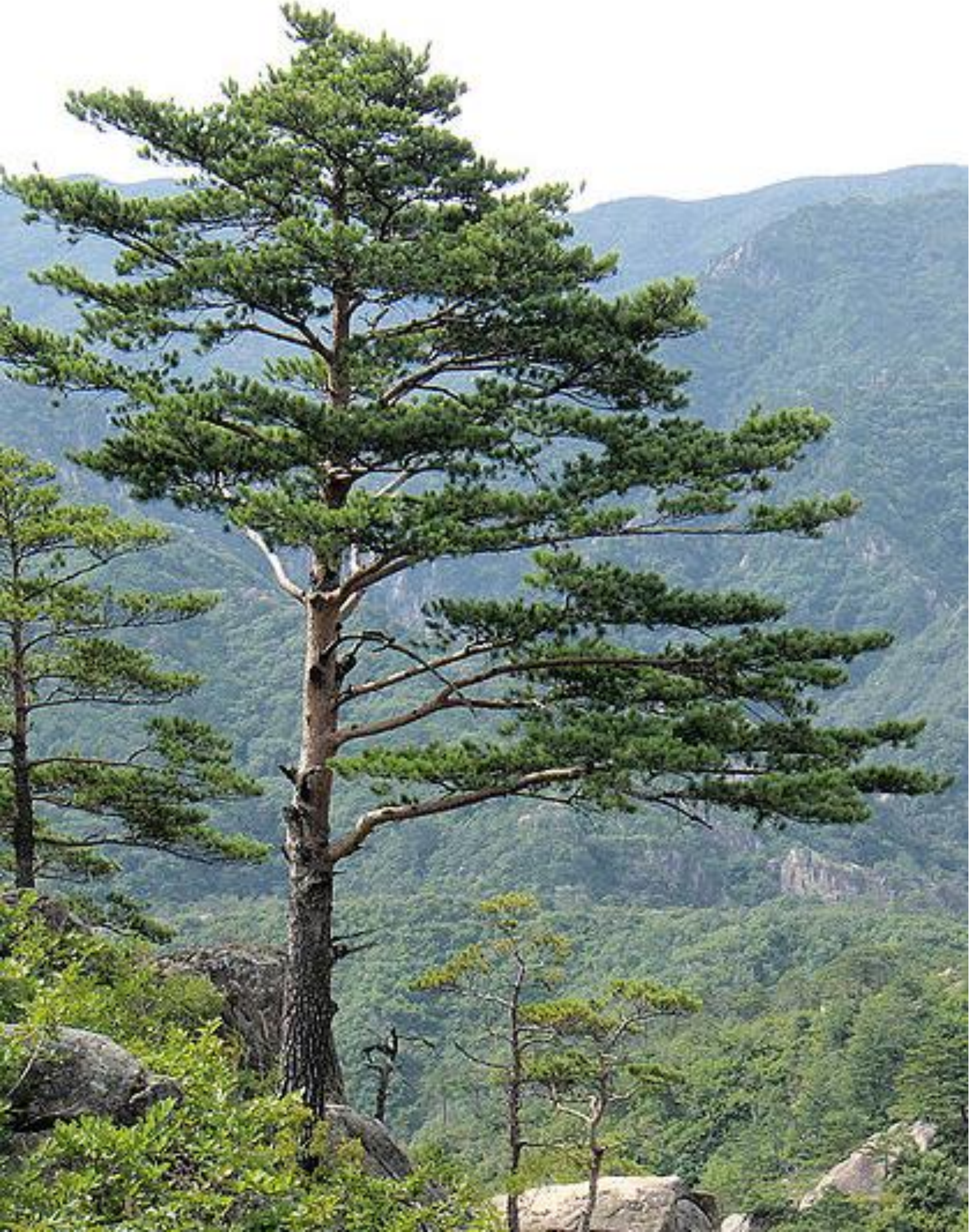
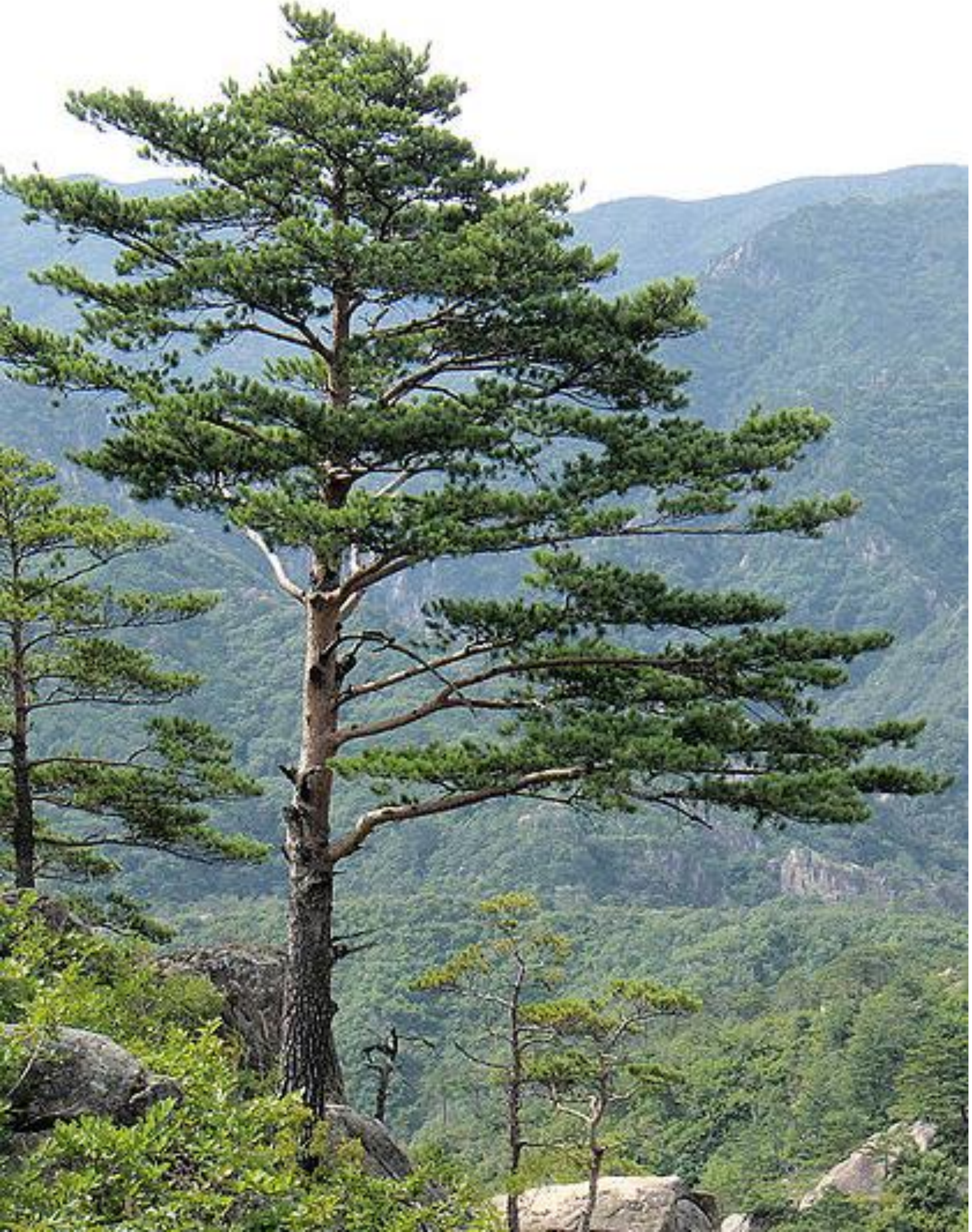
Source

- A textbook of botany (Singh, Pandey, Jain)
- Botany for degree students (P.C Vashishta)



PINUS

https://en.wikipedia.org/wiki/Pine



- Plant is sporophyte
- 70-200 ft generally
- Pyramid shape
- Divided into: root, stem, leaves

https://en.wikipedia.org/wiki/Pine

Branches of unlimited growth

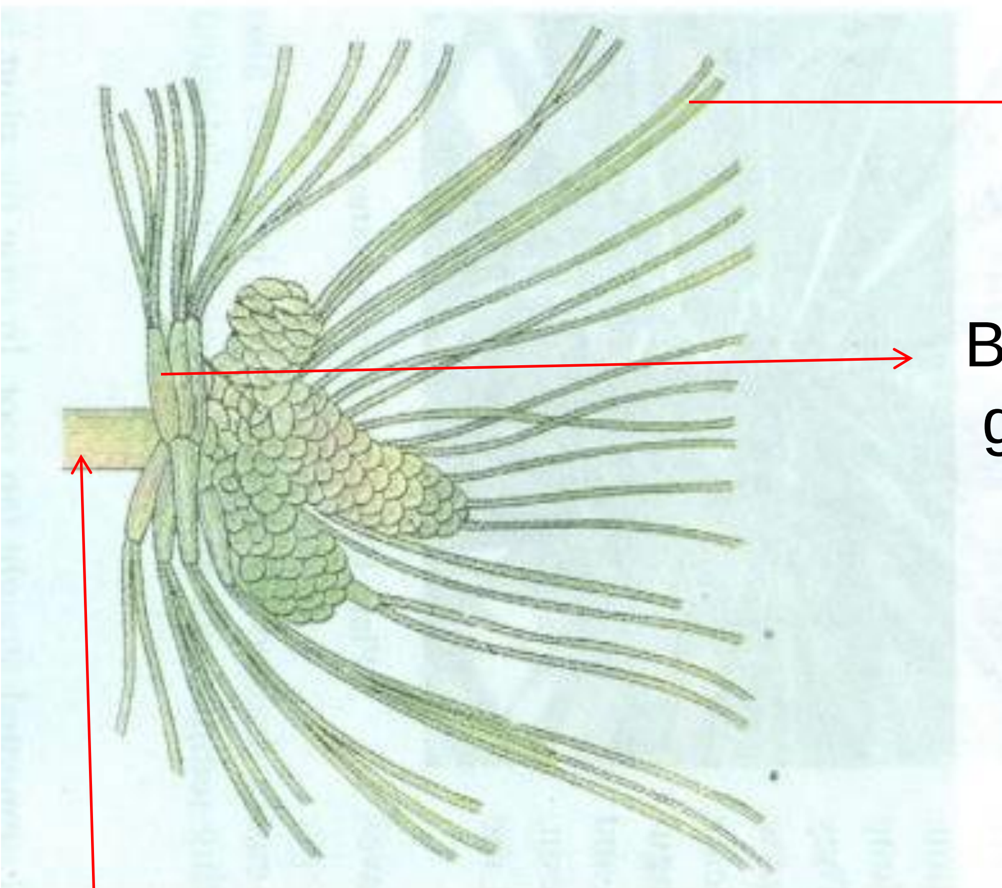
Main axis

https://en.wikipedia.org/wiki/Pine

2 Kinds of leaves

Needle / Pine or Pinus needle	**Scale leaves**
Smooth surface	Rough surface
Born on **dwarf branches called spur**	Born on long and dwarf shoots (both)
Occur in cluster if 1=monofoliar 2 3 4 5	
Base of each needle surrounded by thin, dry, membranous sheath	
Persisten=fall only when spur is shedas a whole (pine tree is evergreen)	Fall off as branches mature
	In axil of scale leaves on long shoots, arise male cones

Smalll size of leaf=xerophytic habitat character = slopes
winter

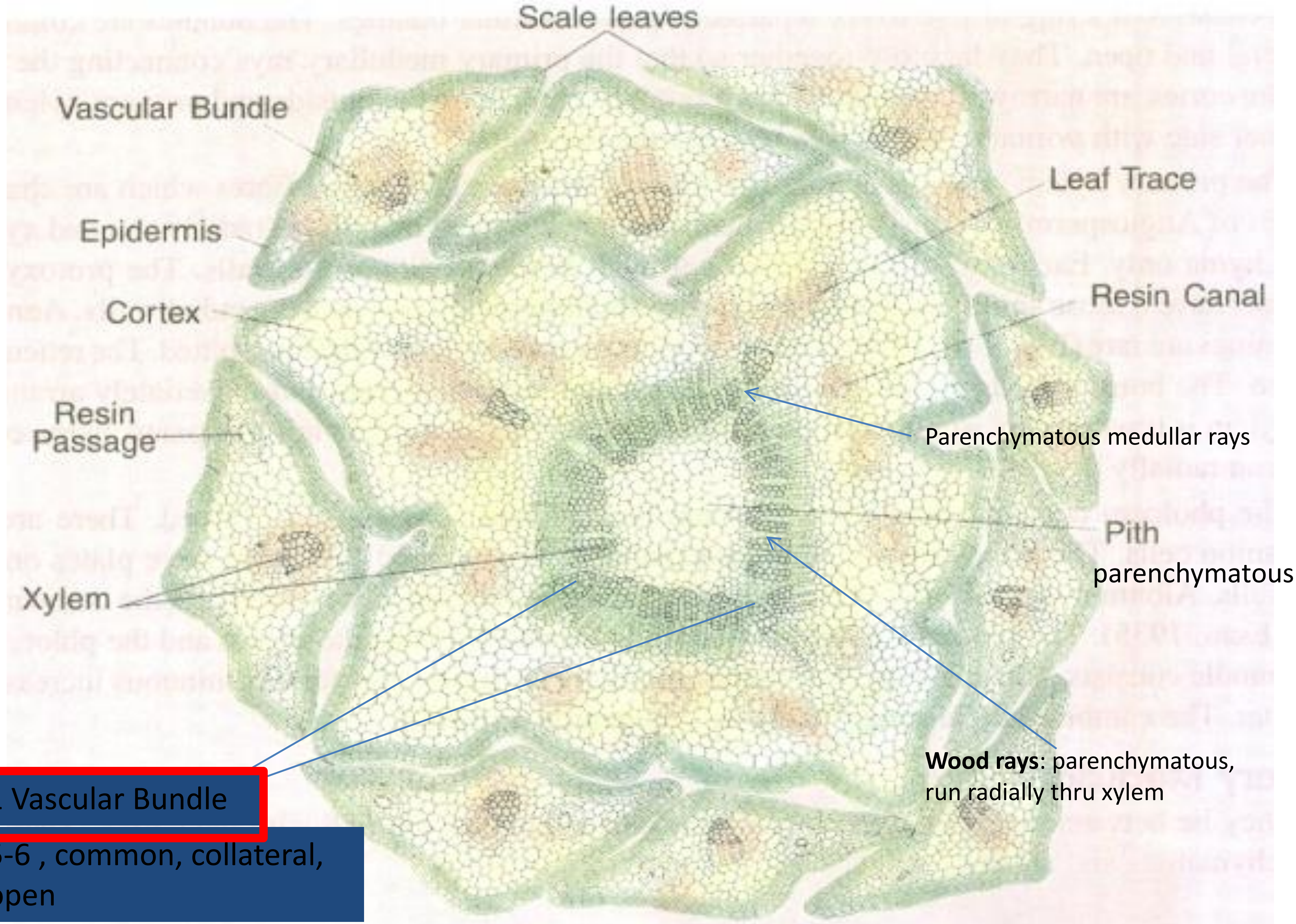

needles
Branches of limited growth dwarf shoots (spur)
Branches of unlimited growth / long shoots

Long shoots	Dwarf shoots
Arise in axil of scale leavesa on **main trunk**	Arise at regular intervals from long branches, in axil of scale leaves
Continue indefinitely by means of apical growth	definite growth (ephemeral)
Covered with brown bud scales	
One whorl develops every year, on regular intervals on main trunk	
Grows horizontally	
Gradually become shorter at apex—pyramid tree	
Each year, gives rise to dwarf shoots in axil of brown scale leaves	Terminates in a cluster of three green needles
Older parts have scars left by fallen dwarf shoots	
	In P. wallichiana, shoot is covered by 10-12 scale leaves cataphyll

In P. wallichiana,

Dwarf shoot is covered by 10-12 scale leaves or cataphyll

Prophylls	**Inner cataphylls**
2 outermost cataphylls	Innermost cataphylls are spirally arranged
smaller	larger



1 Vascular Bundle

5-6 , common, collateral, open

No vessel and wood fiber

Fig. 13.3. T.S. young stem of Pinus roxburghii.

Vessels (non-porous)-softwood
Wood fiber absent

Primary xylem

Tracheids: have bordered pits on wall
Are 2 types:

1. Protoxylem (first tracheids): loose spiral thickenings, few small bordered pits

2. Metaxylem (late formed tracheids): reticulate, large and more numerous pits

no companion cells

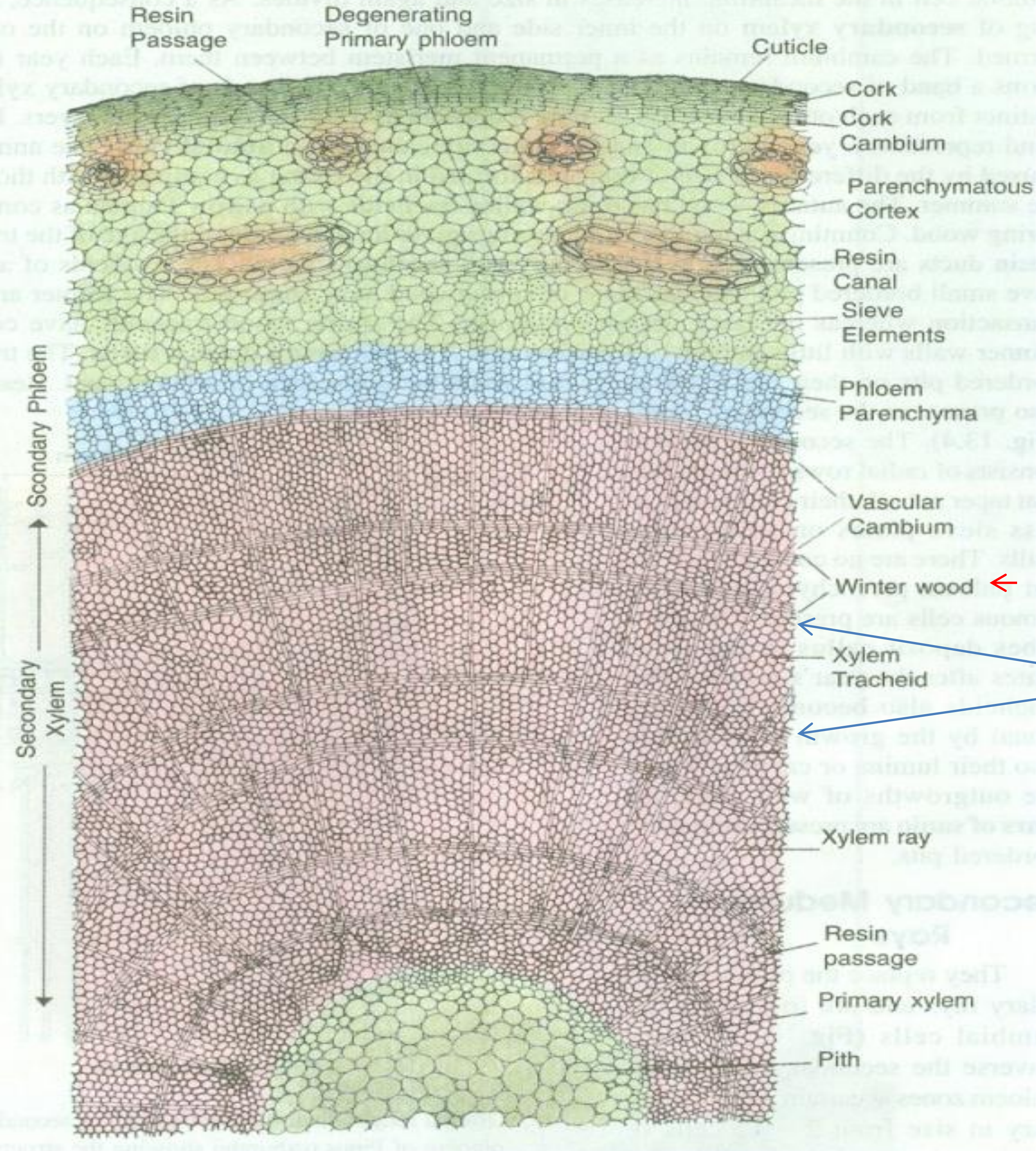
Primary phloem

- sieve tubes + phloem parenchyma + albuminous cells

- **Sieve tubes**: elongated and pointed cells with **seive plates** on side walls

Primary cambium

- b/w xylem and phloem
- Each bindle with single layer of meristematic cells
- Provides continous increase in girth
- Cambia divides continously in a tangential direction



.4. T.S. Portion of old stem of Pinus roxburghii showing details of secondary structure.

Like dicots!

A closed ring of cambia formed

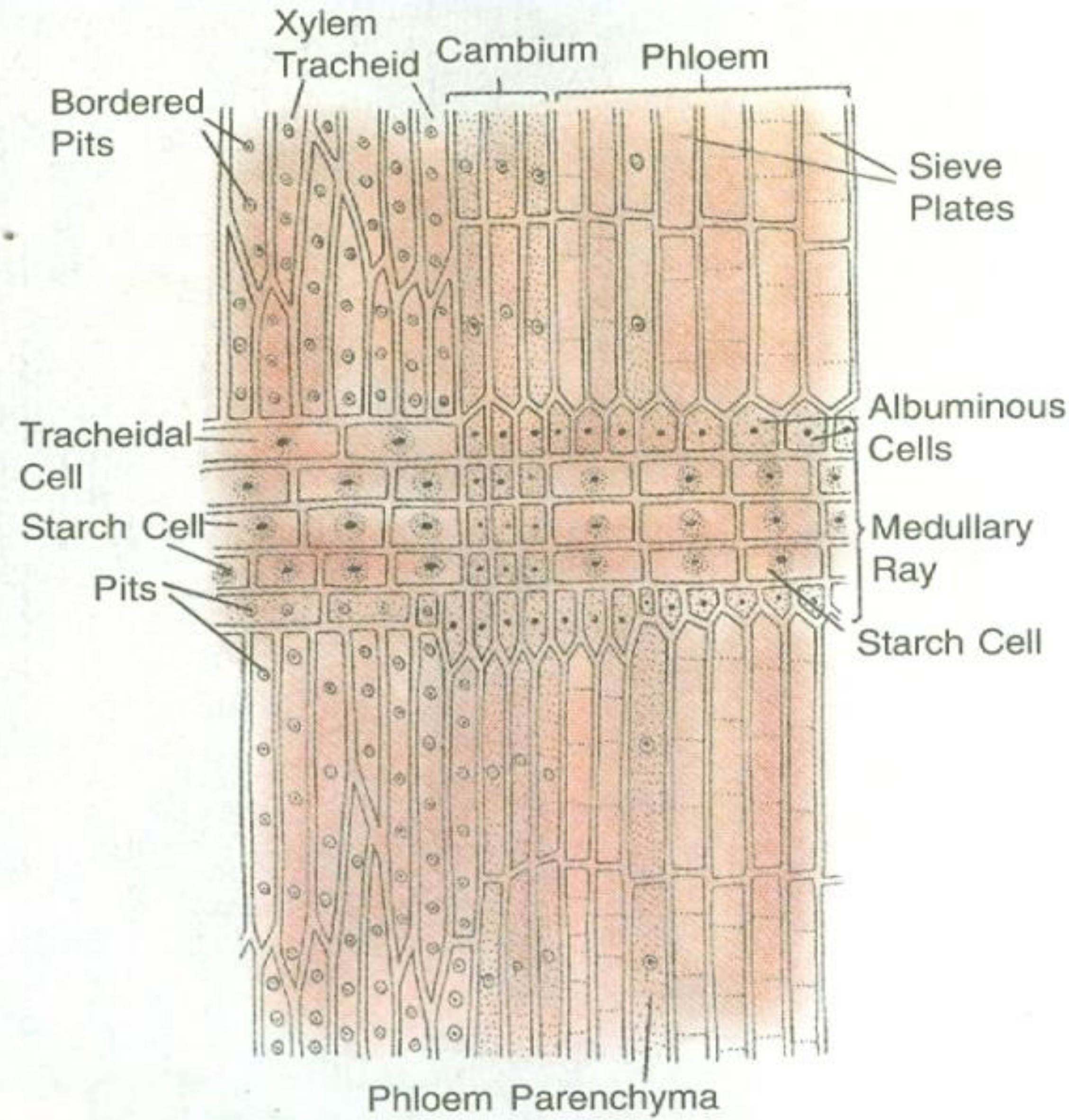
annual ring =Concentric rings of sec xylem

Winter wood

tracheids have thick walls, small bordered pits, squarish tracheids

Summer wood

Tracheid's thinner walls, only little lignification, polygonal cells.

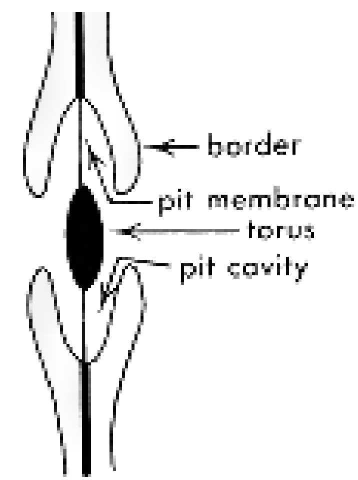


13.5. Radial longitudinal section (R.L.S.) of secondary wood and phloem of Pinus roxburghii showing the structure of secondary medullary ray.

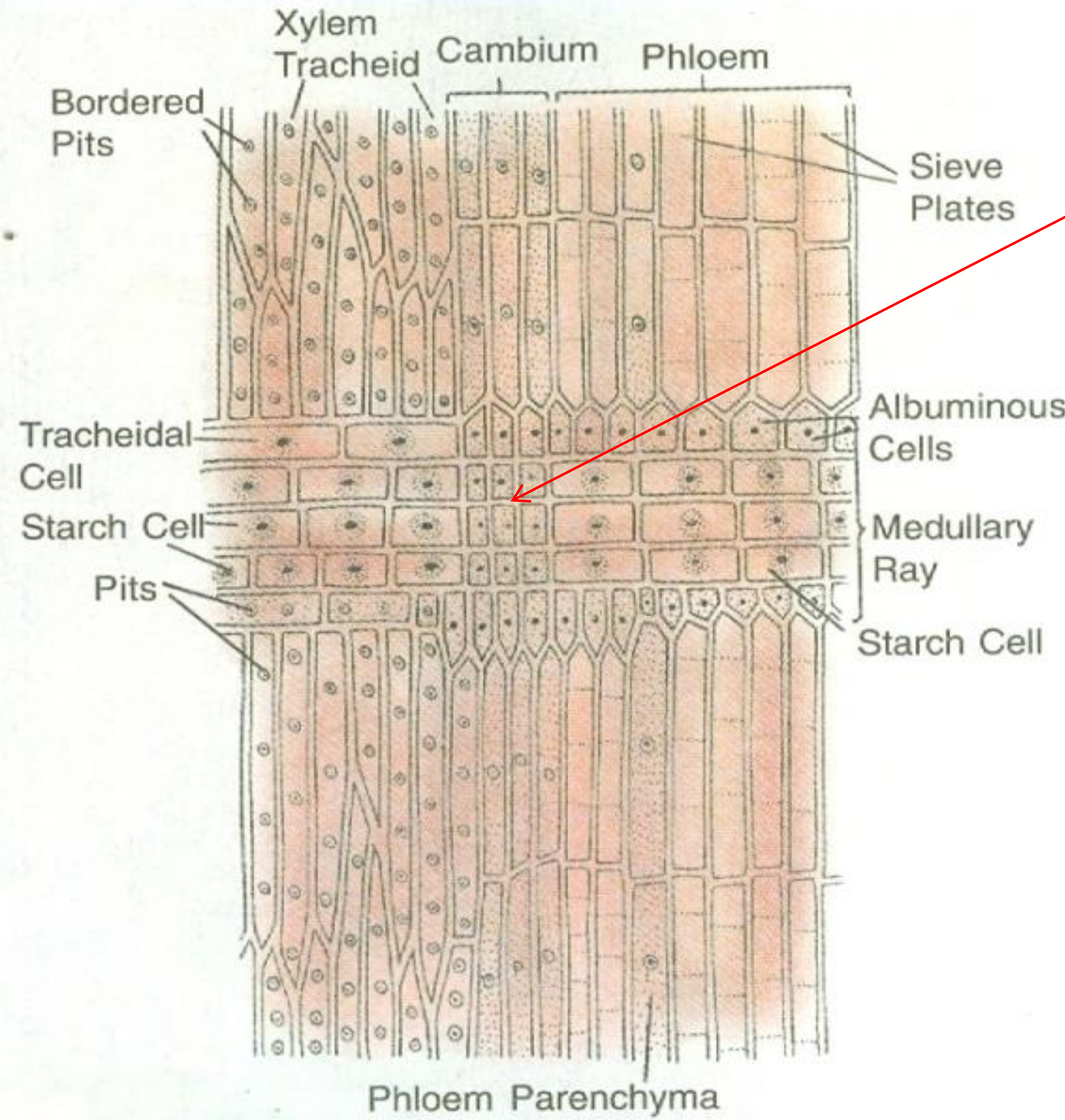
Tracheids:

Have bordered Pits

Pits have distinct torus



Torus: In bordered pits, and opposite pits, membrane may be thickened in its central potion. This thickening is called torus



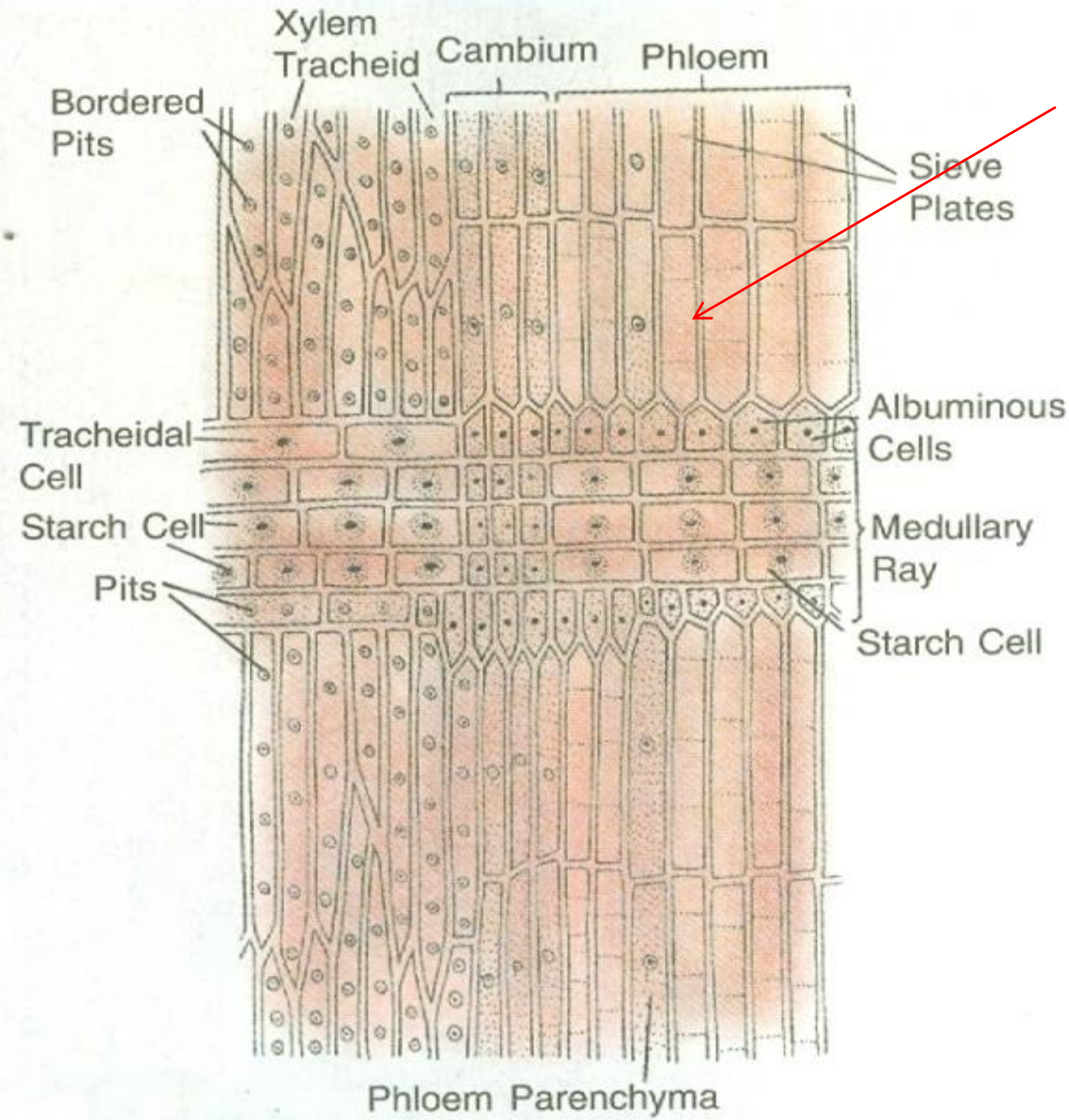
13.5. Radial longitudinal section (R.L.S.) of secondary wood and phloem of Pinus roxburghii showing the structure of secondary medullary ray.

Cambium:

Ray Tracheids absent

Medullary rays absent

Living cells with rich cytoplasm, nucleus

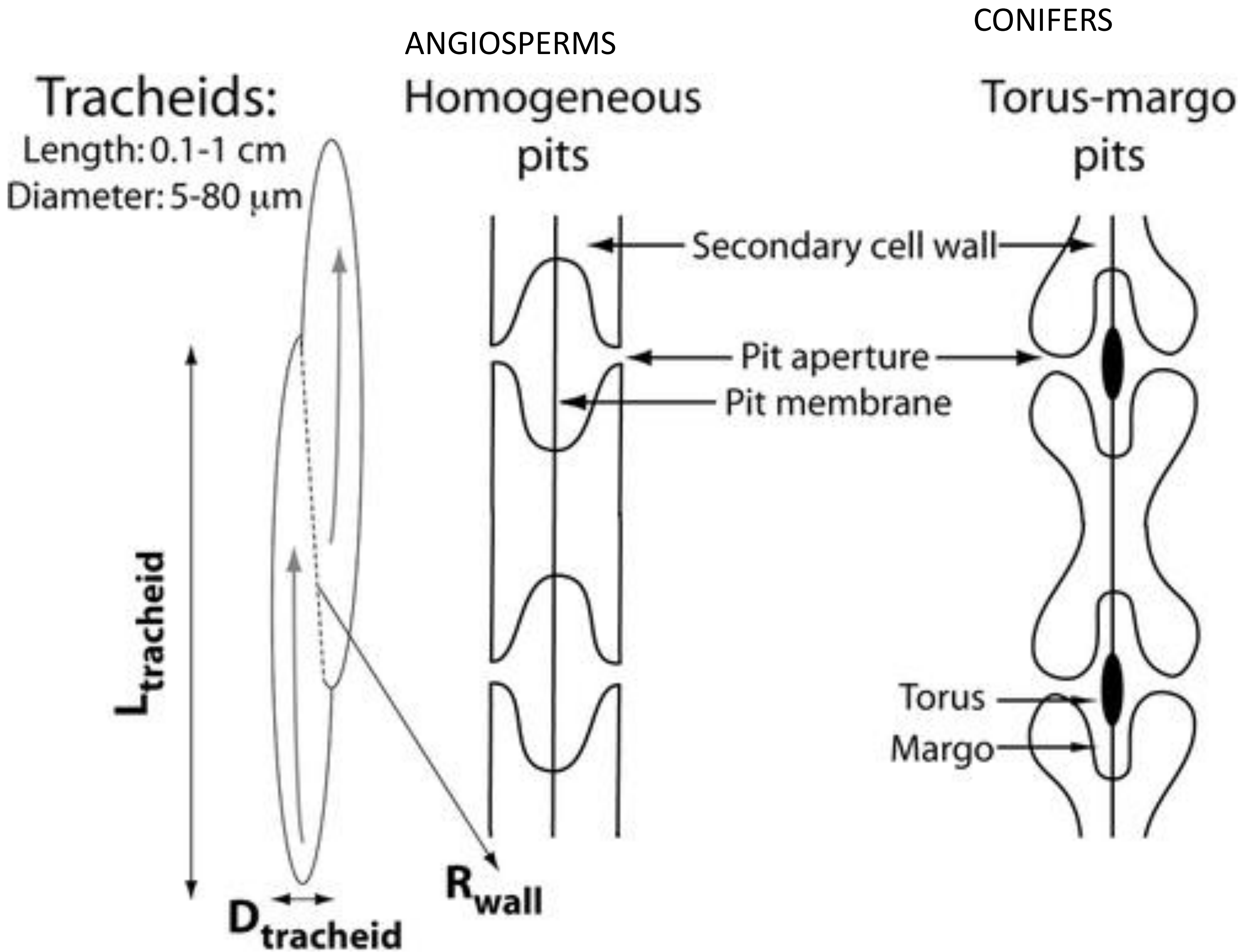


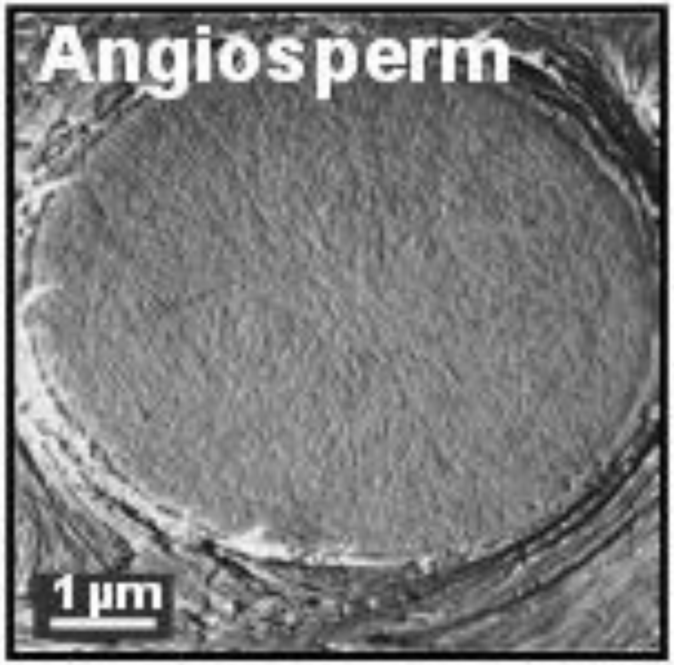
13.5. Radial longitudinal section (R.L.S.) of secondary wood and phloem of Pinus roxburghii showing the structure of secondary medullary ray.

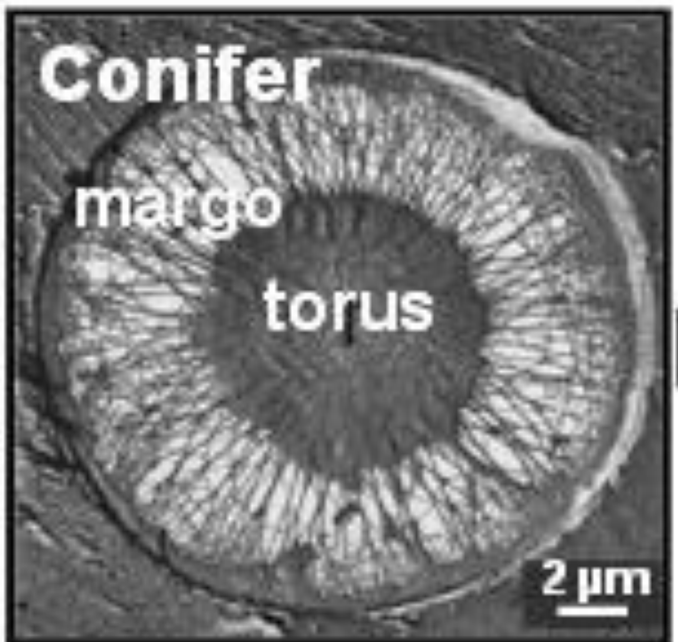
Phloem:

Instead of Tracheidal cells, **albuminous c**ells present

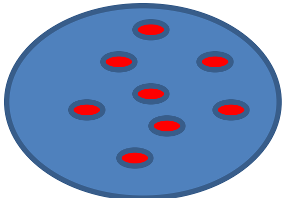
Starch cells present

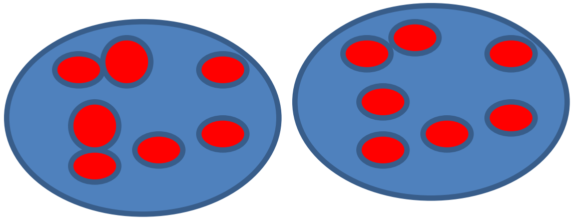

CONIFERS
ANGIOSPERMS
Tracheids:
Length: 0.1-1 cm
Diameter: 5-80 μm
Homogeneous pits
Torus-margo pits
Secondary cell wall
Pit aperture
Pit membrane
Torus
Margo
L tracheid
D tracheid
R wall


Angiosperm
1 µm


Conifer
margo
torus
2 µm

Sieve cells	sieve tubes
Sieve cells are the more primitive of the two main conducting cell types in phloem, and are found in most seedless vascular plants (e.g., ferns, club mosses, horsetails) and gymnosperms (conifers, *Gingko*, etc.).	The sieve-tube cells, also known as sieve-tube members, are the more advanced type of conducting cell
	are the only sieve element found in the phloem of angiosperms.
	The sieve tube is an elongated rank of individual cells, arranged end to end, and functioning to conduct food materials throughout the plant.
Sieve cells have relatively narrow, uniformly-sized pores in the sieve areas. [	The sieve areas of these cells are called sieve plates; the pores in sieve plates are generally larger and more variable in size than those in sieve cells





Secondary medullary rays

Replace pri. Medullary rays

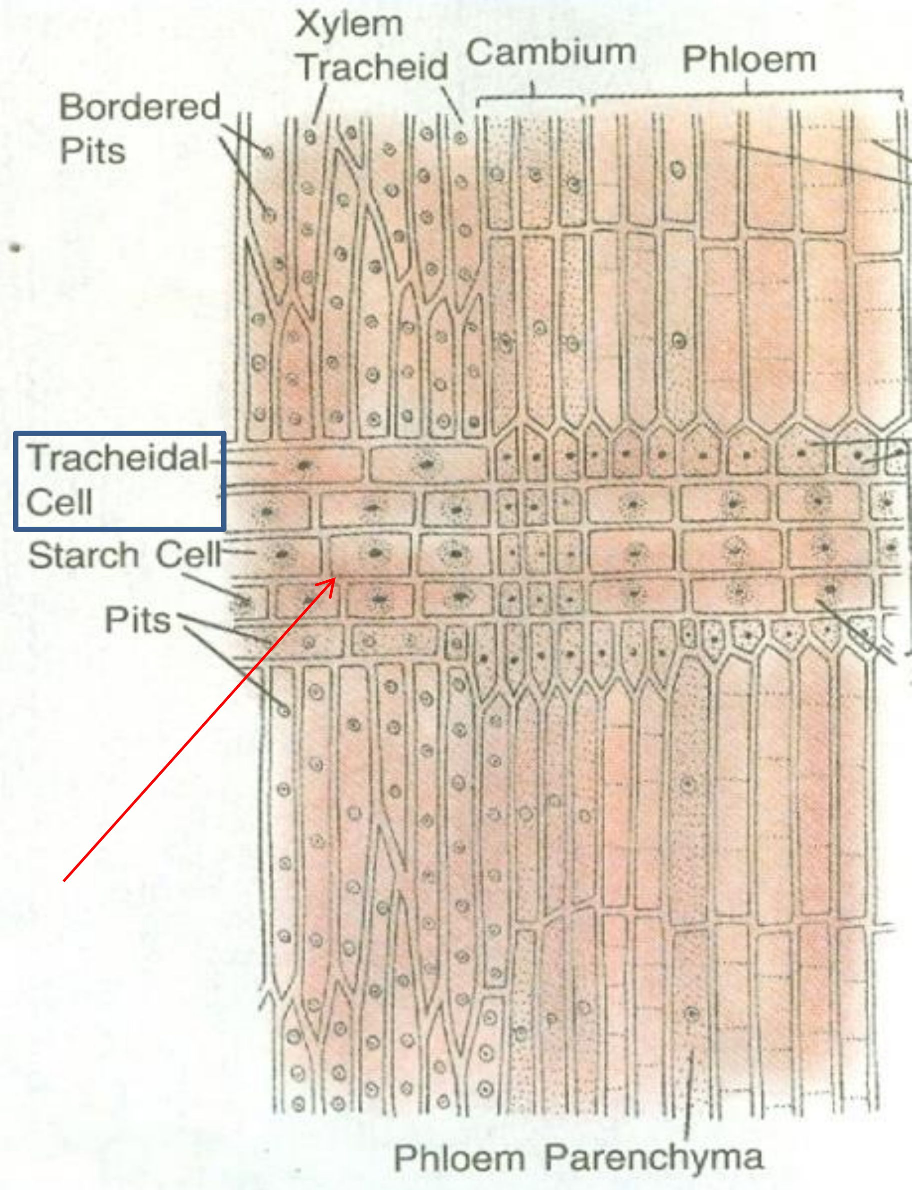
Formed by cambial cells

2-12 cells high

One cell broad

Shape: thick wall, rectangular parench. cells, have cytoplasm, a nucleus, starch grains have simple pits

Have **ray tracheids** on upper and lower margin.these are elongated horizontally



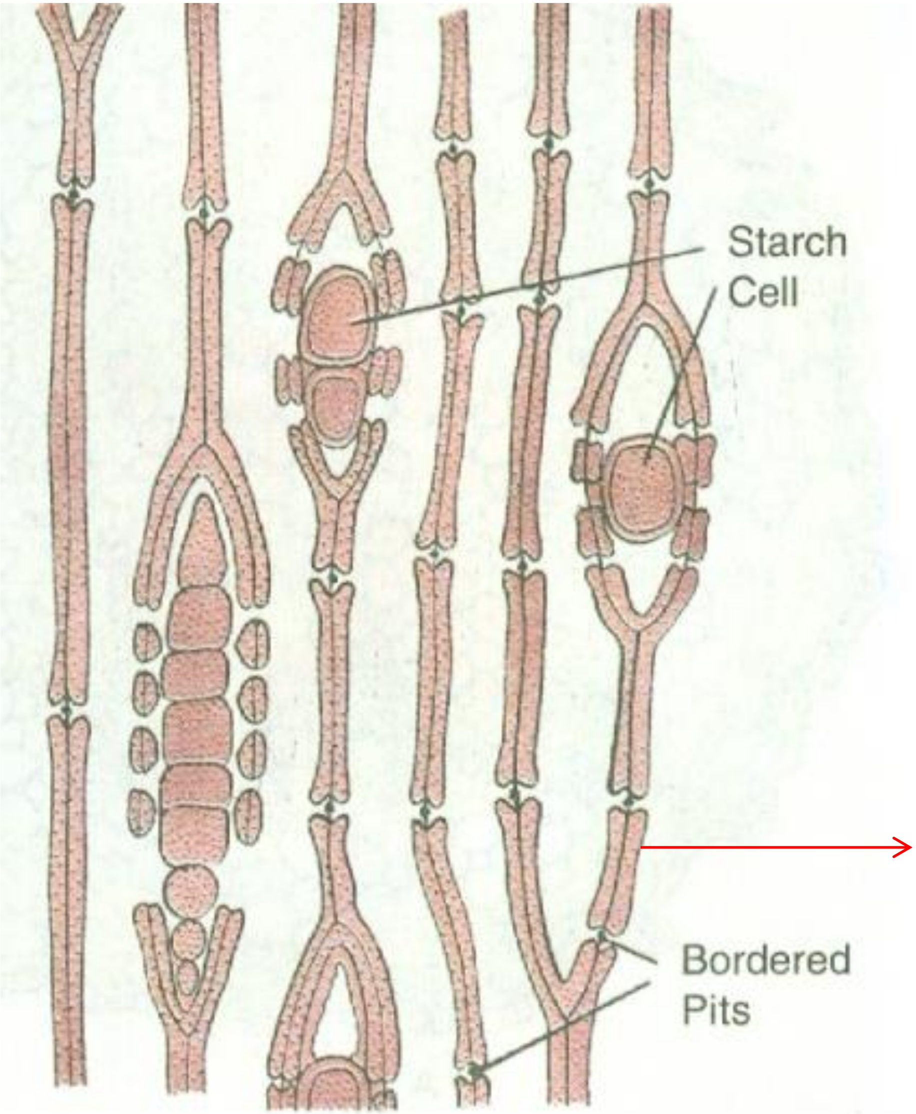


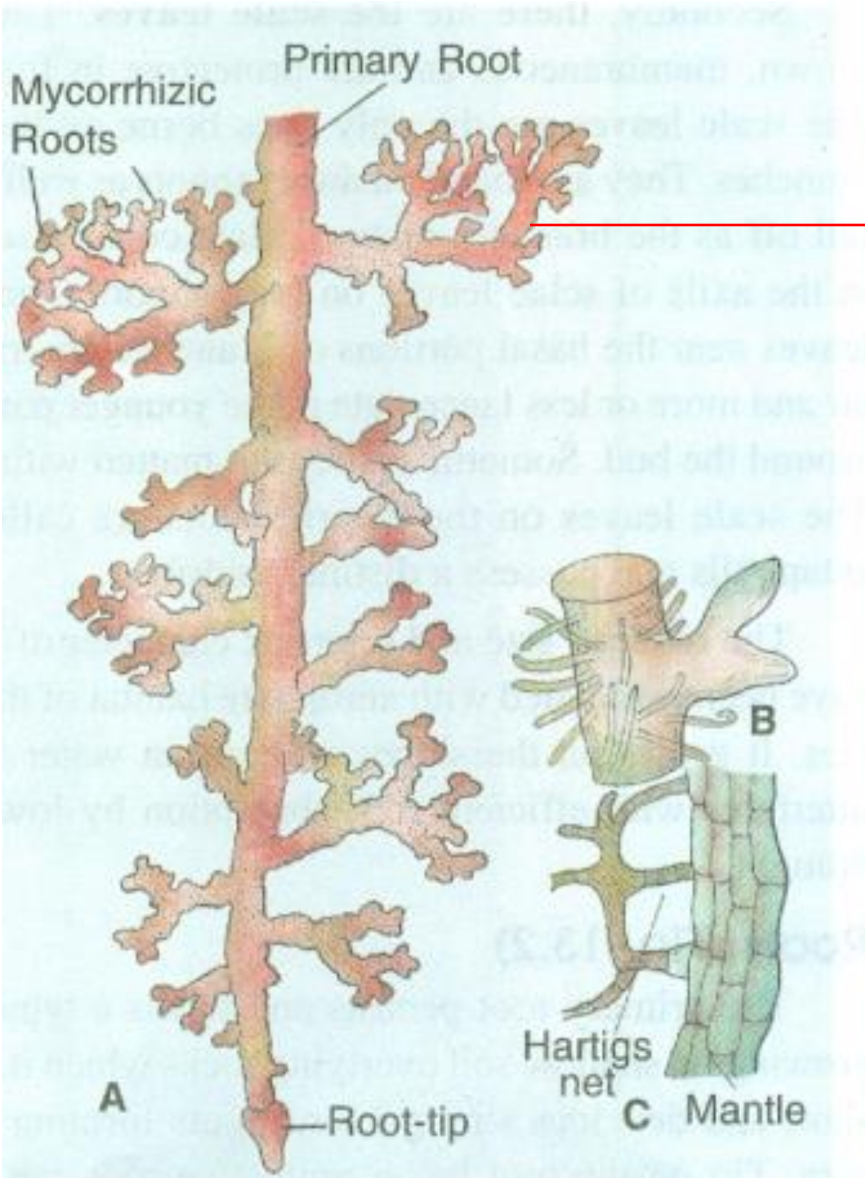
Fig. 13.6. Tangential longitudinal section (T.L.S.) of secondary wood showing the medullary rays of P. roxburghii.

Tracheids interrupted by rays

Uniseriate rays
Ray cells have starch

Bordered pits on radial walls of tracheids

Tracheids



Forking of Root

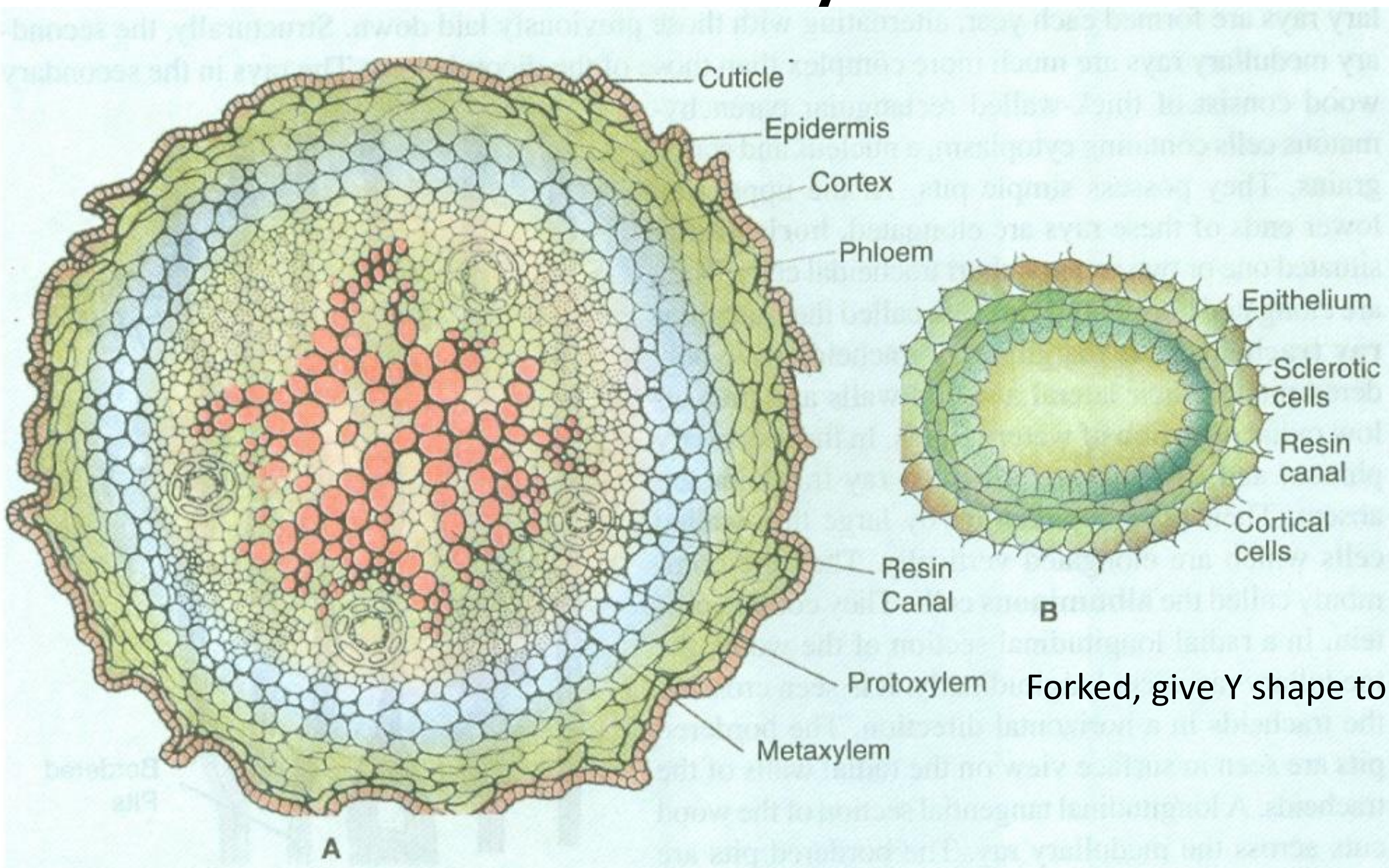
Root hair not well developed

Epiblem replaced by fungal hyphae

Mycorhhizal roots:
short, thick
Lack root hair
Lack root cap
More extensively branched
covered with fungal hyphae

A: primary tap root with mycorrhiza B: ectotrophic mycorrhiza C: T.S of B

Primary Root



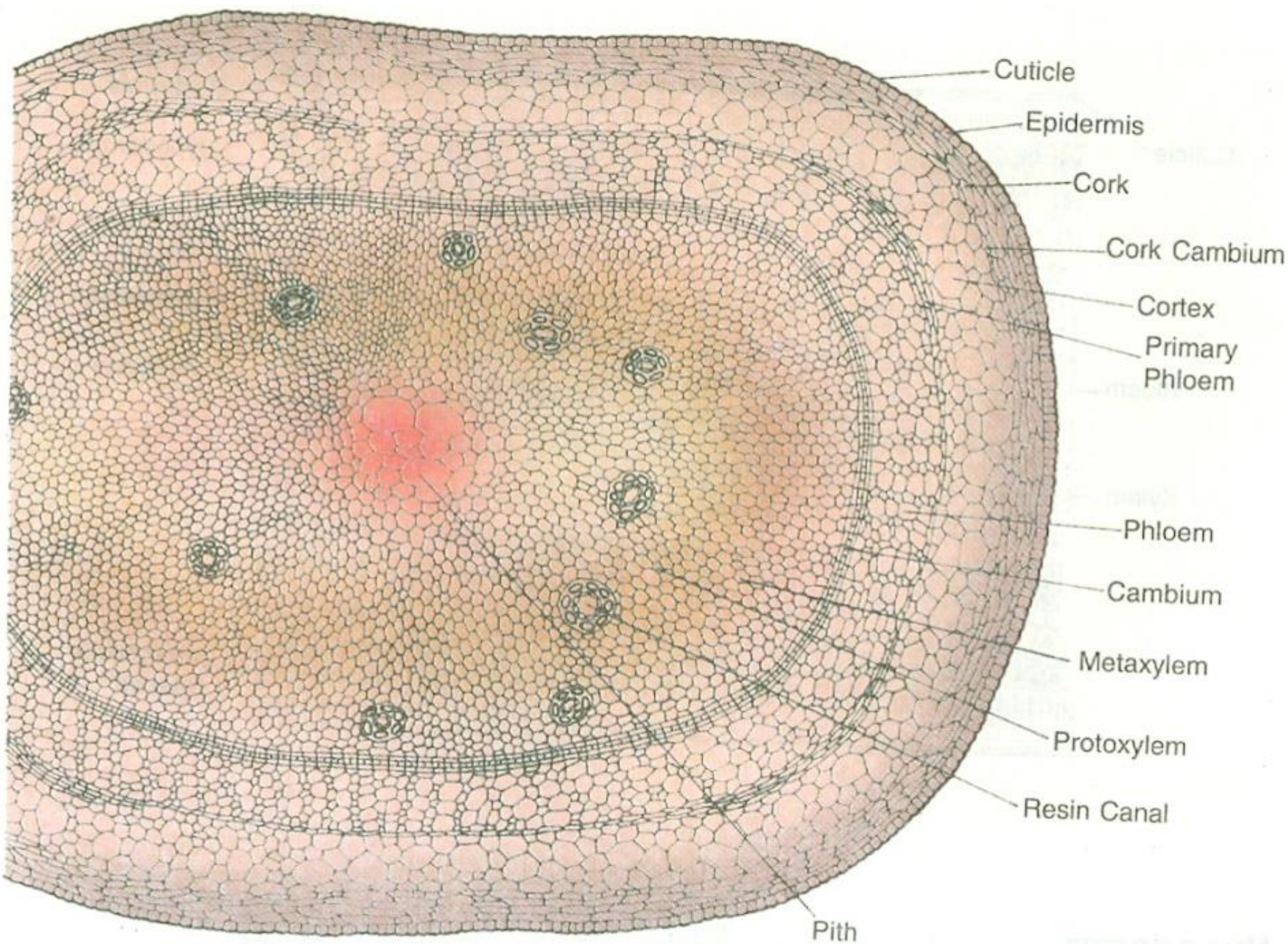
Forked, give Y shape to xylem bundles

Endodermis : single layered, brown-orange color, suberized.
Pericycle: many layered. Cells with starch and tannin
Stele: xylem bundles=triarch or tetrarch (upto 6), exrach
phloem bundles=eq no. of phloem bundles

Mycorrhizal root

- Hyphae run between cortical cells
- Fungal cells lie thickly in intercellular spaces
- No fungus in endodermis
- When they are present over surface of root, gives appearance of an outer pseudo-parenchymatous tissue.

Secondary growth in roots



Secondary growth in stem and root

Stem	Root
Annual rings distinct and **broad**	Annual rings are also distinct but **narrow** as compared to stem.
Shorter , thin walled tracheids	Tracheids are longer and thick-walled as compared to stem
Cork cambium arise in **cortex.** Forms periderm/cork to outside. Periderm or cork to outside.	Cork cambium arise in **pericycle**. Forms periderm/cork to outside. Thick layer of cork separates stele from cortex. Cortex dies and disappear as bark.
Conjoint and collateral arrangement of vascular elements	**radial** arrangement of vascular elements as in stem
Bordered pits	Possess bordered pits like those in stem.

DIFF

SIM

2 Kinds of leaves

Needle / Pine or Pinus needle	**Scale leaves**
Smooth surface	Rough surface
Born on **dwarf branches called spur**	Born on long and dwarf shoots (both)
Occur in cluster if 1=monofoliar 2 3 4 5	
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Smalll size of leaf=xerophytic habitat character = slopes
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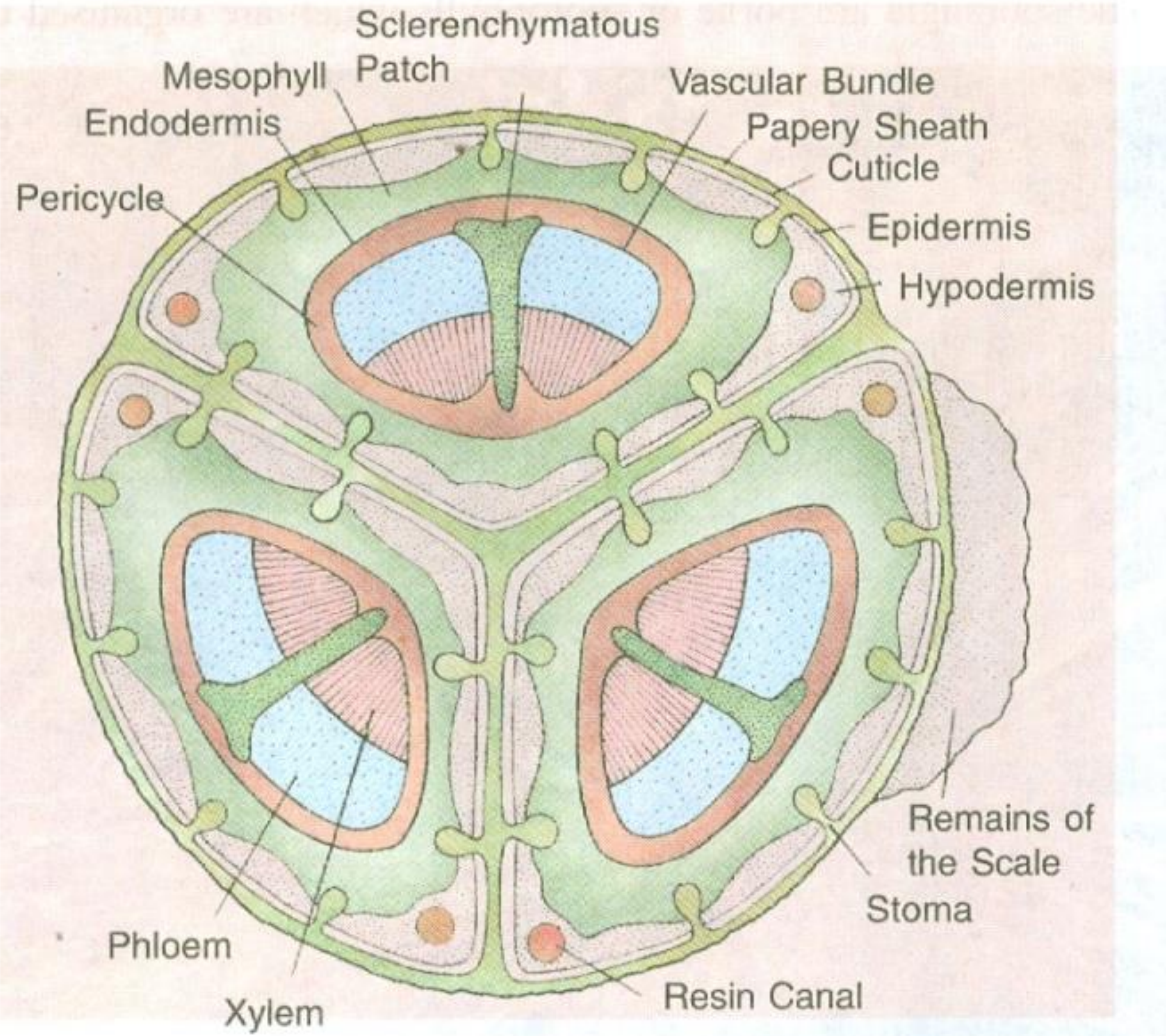
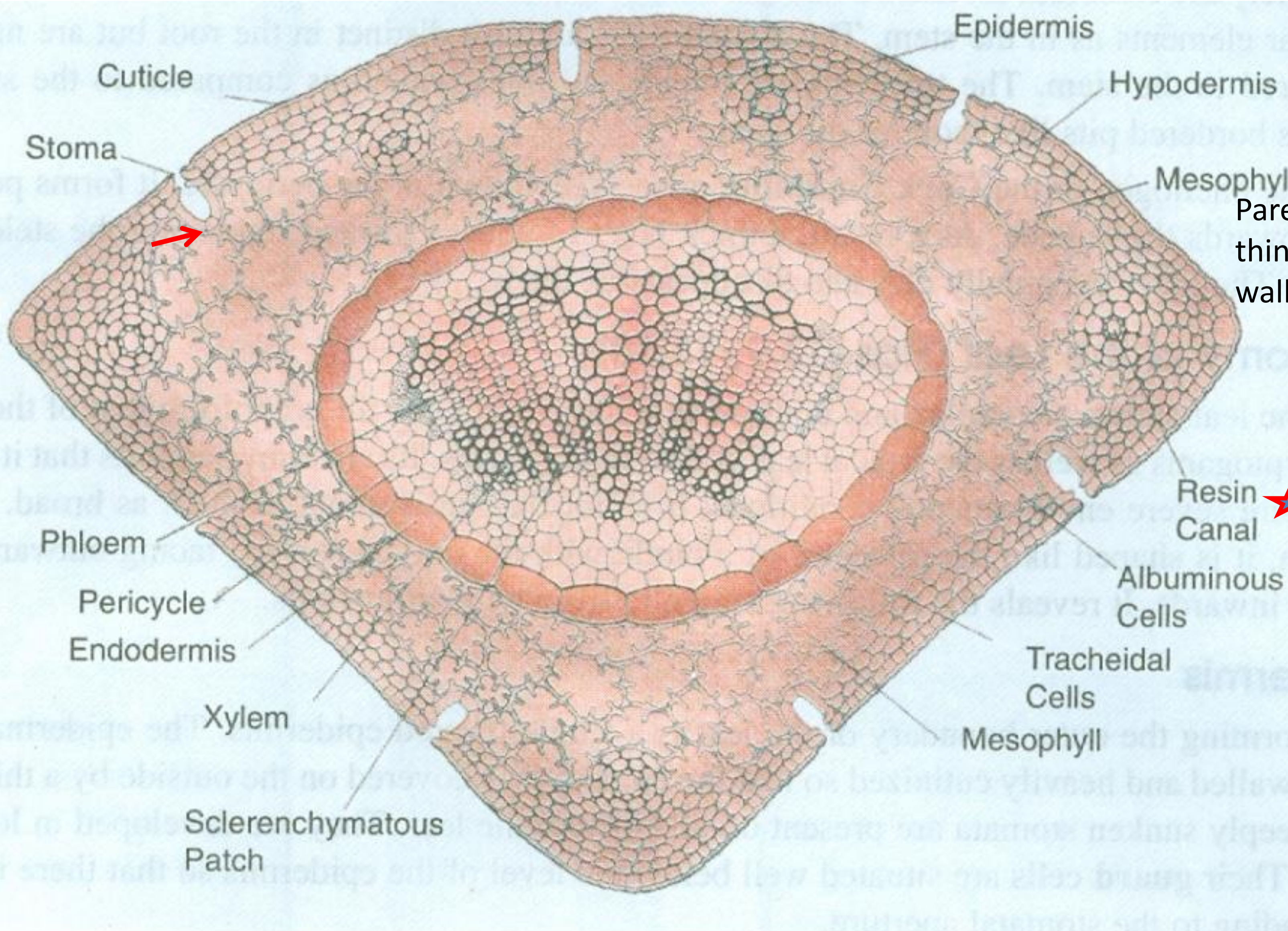

Sclerenchymatous Patch
Mesophyll
Endodermis
Pericycle
Vascular Bundle
Papery Sheath
Cuticle
Epidermis
Hypodermis
Remains of the Scale
Stoma
Resin Canal
Phloem
Xylem

Single layer, Thick wall, heavy cutinized



Parenchymatous, thin wall, chl, cell wall infolding

Fig. 13.9. T.S. needle of P. roxburghii showing detailed internal structure.

End of Anatomy of Pinus

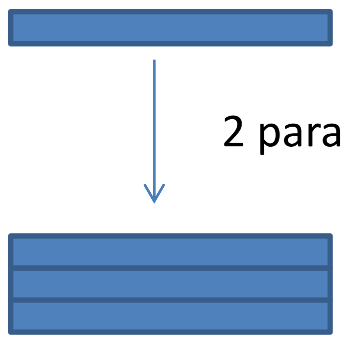
Stem sec crowth

Some cells in cortex

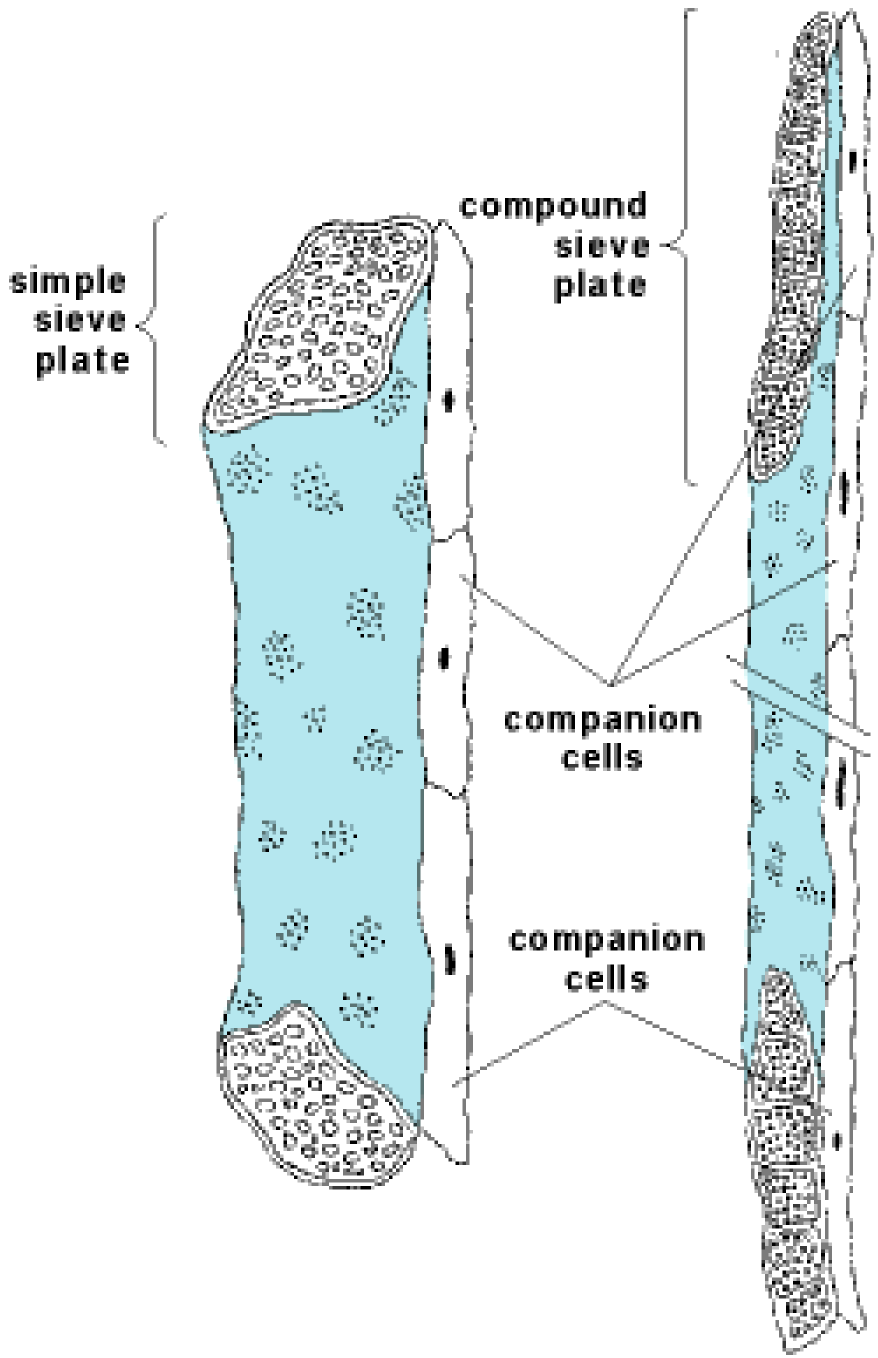
become meristematic

Cork cambium

(single layer)



2 parallel walls formed


simple
sieve
plate
compound
sieve
plate
companion
cells
companion
cells

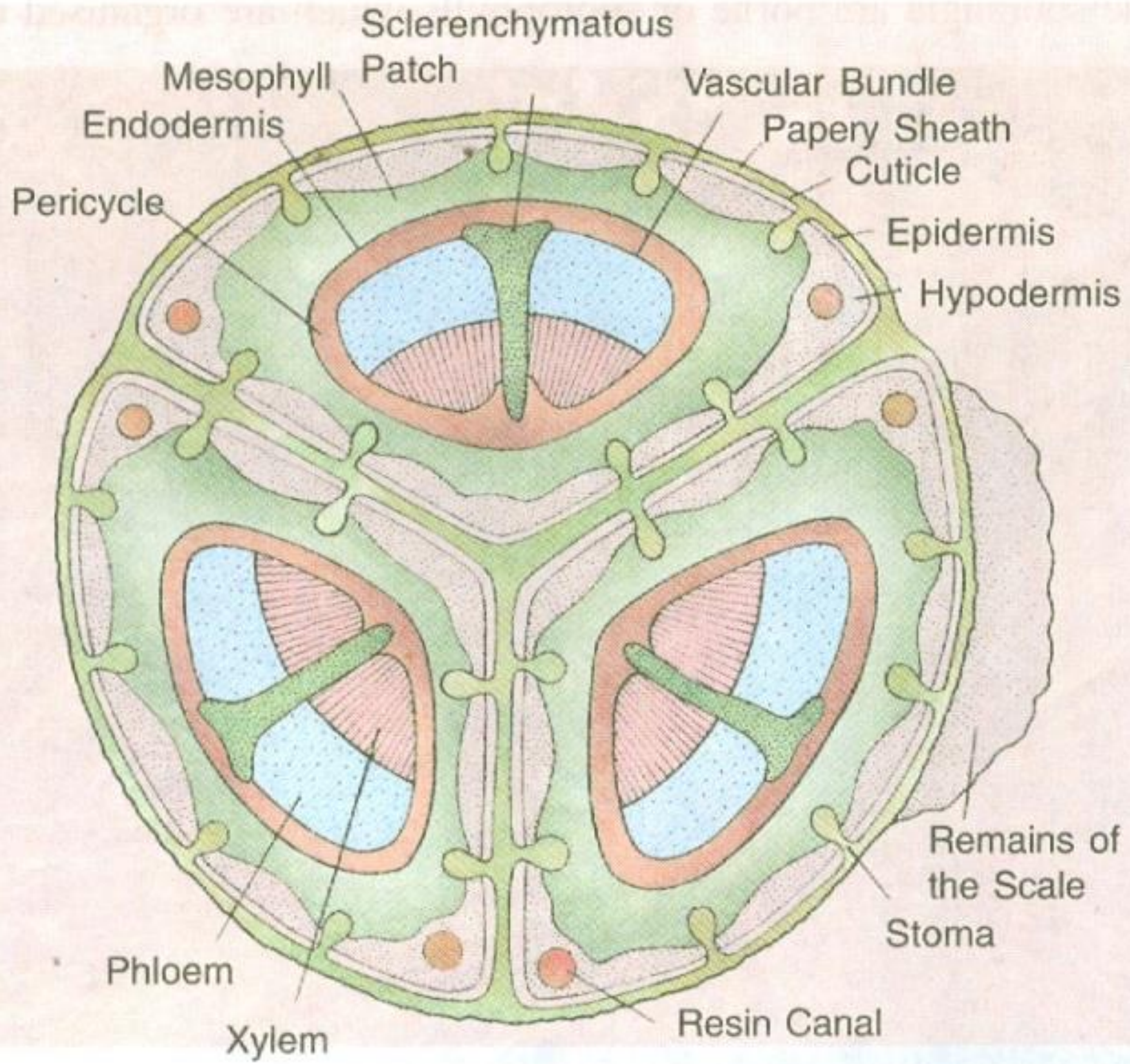


Fig. 13.11. T.S. tip of dwarf shoot showing three needles in transection

Single layer, Thick wall, heavy cutinized

Parenchymatous, thin wall, chl, cell wall infolding

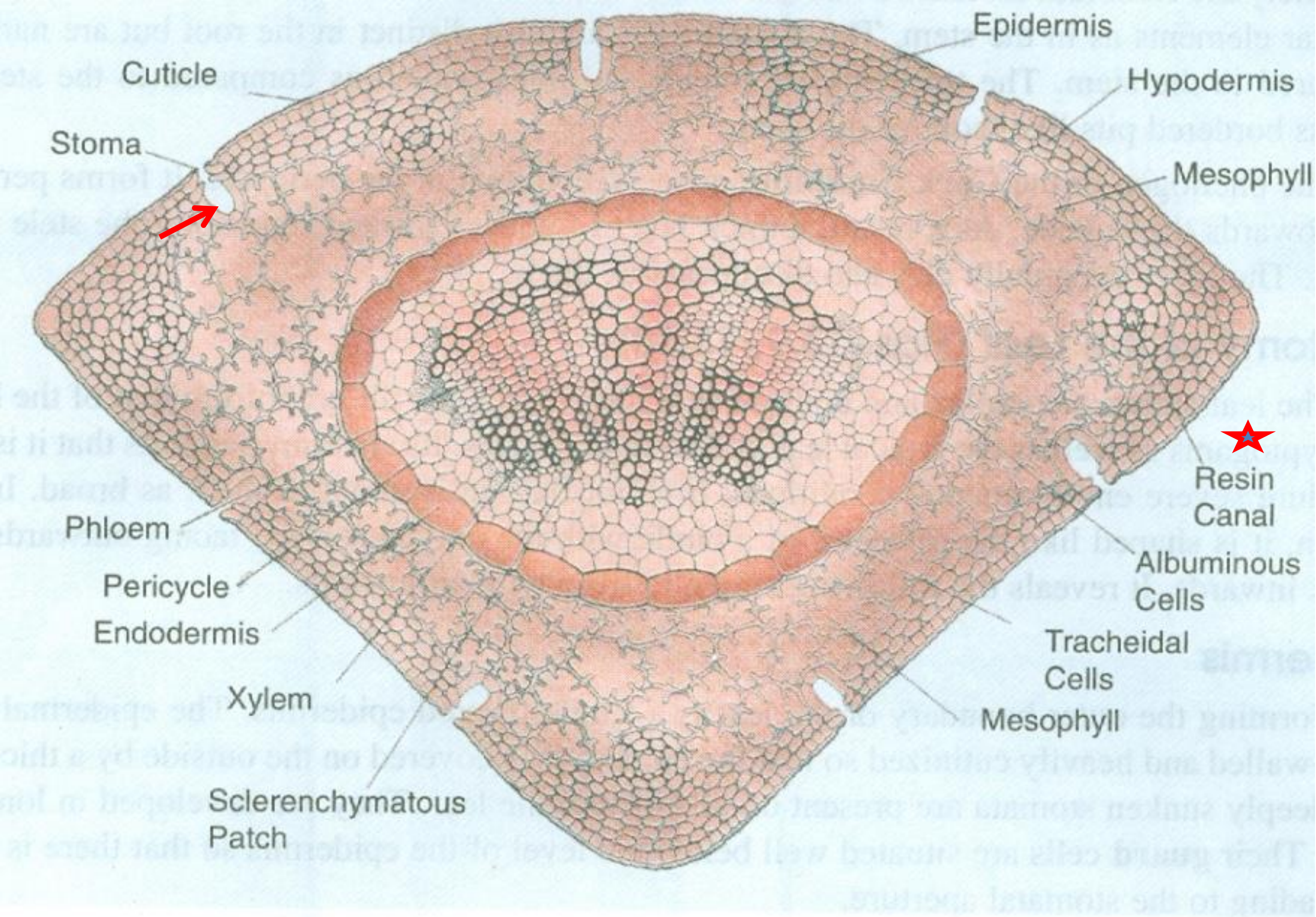
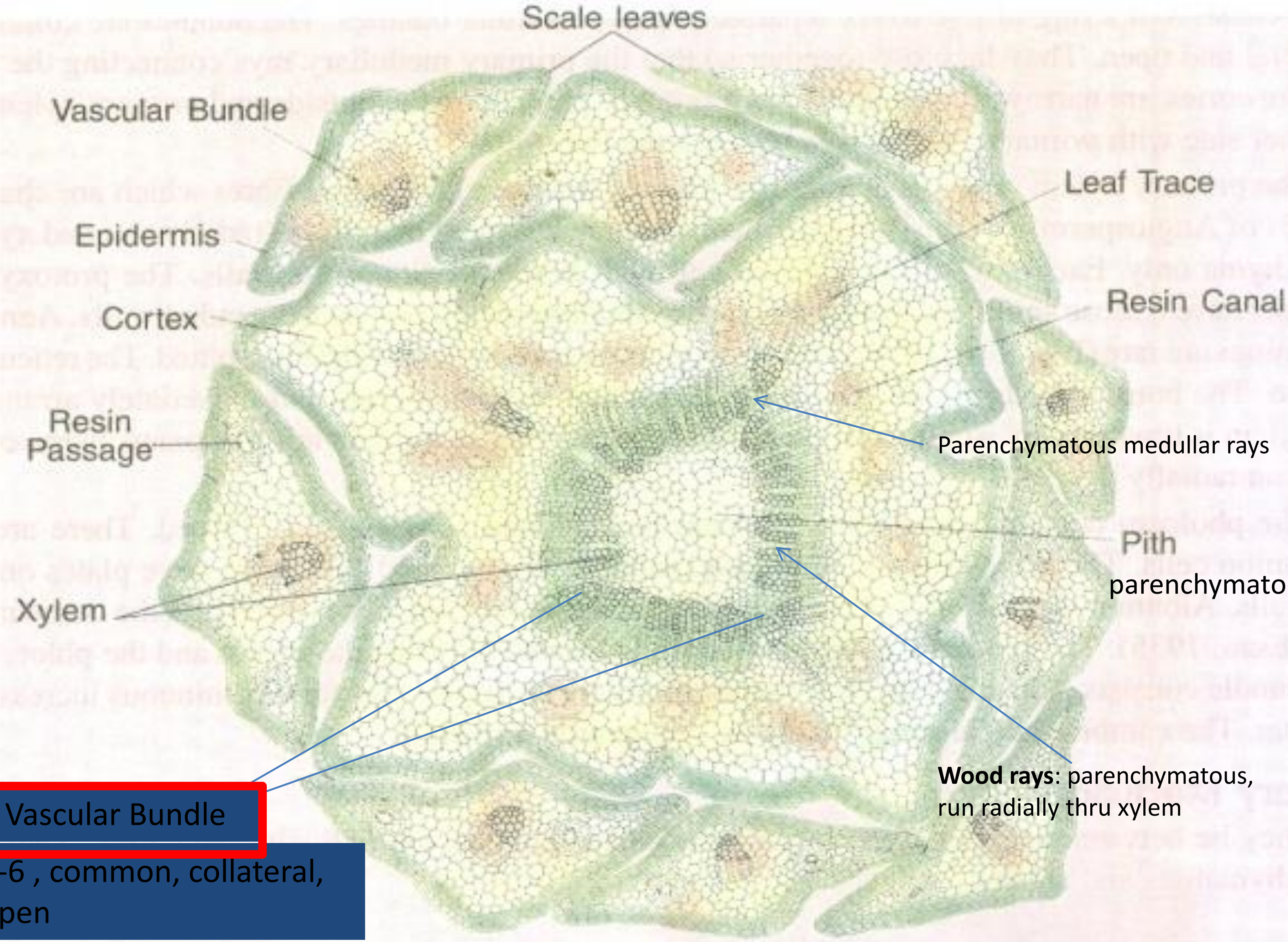


Fig. 13.9. T.S. needle of P. roxburghii showing detailed internal structure.

Complex, unusual str.
Anatomy suggests, adapted to endure severe environment condition.
Shape=tri-sector of circle
Epidermis= Single layer, Thick wall, heavy cutinized
Hypodermis=1 or more layer, thick wall (sclerenchymatous). There are air spaces in hypodermis below stomata.
Sunken stomata: guard cells below level of epidermis
Mesophyll: not fiff. Into spongy and palisade parenchyma, thin wall cell with chlorophyll, cell wall infoldings to incr absorptive, aerating, excreting fn of **protoplast**….thus compensate for reduced leaf surface for photosynthesis.
Resin duct similar in str. To those of stem.
Endodermis=1 layered endodermis, large and oval cells, have casparian strips
Pericycle=many layer, parench cells with starch:

1. albuminous cells (rich in protein). Attached with phloem of VB. Pass cmpds from mesophyll to phloem
2. cells resembling tracheids (tracheidal cells)…elongated radially…carry H_2O from xylem to mesophyll

1,2 =transfusion tissue. Makes up for poor devt of vascular tissue.
Thus pericycle constitutes transfusion tissue + sclerenchymatous fibres.
Vascular bundles:2 in number

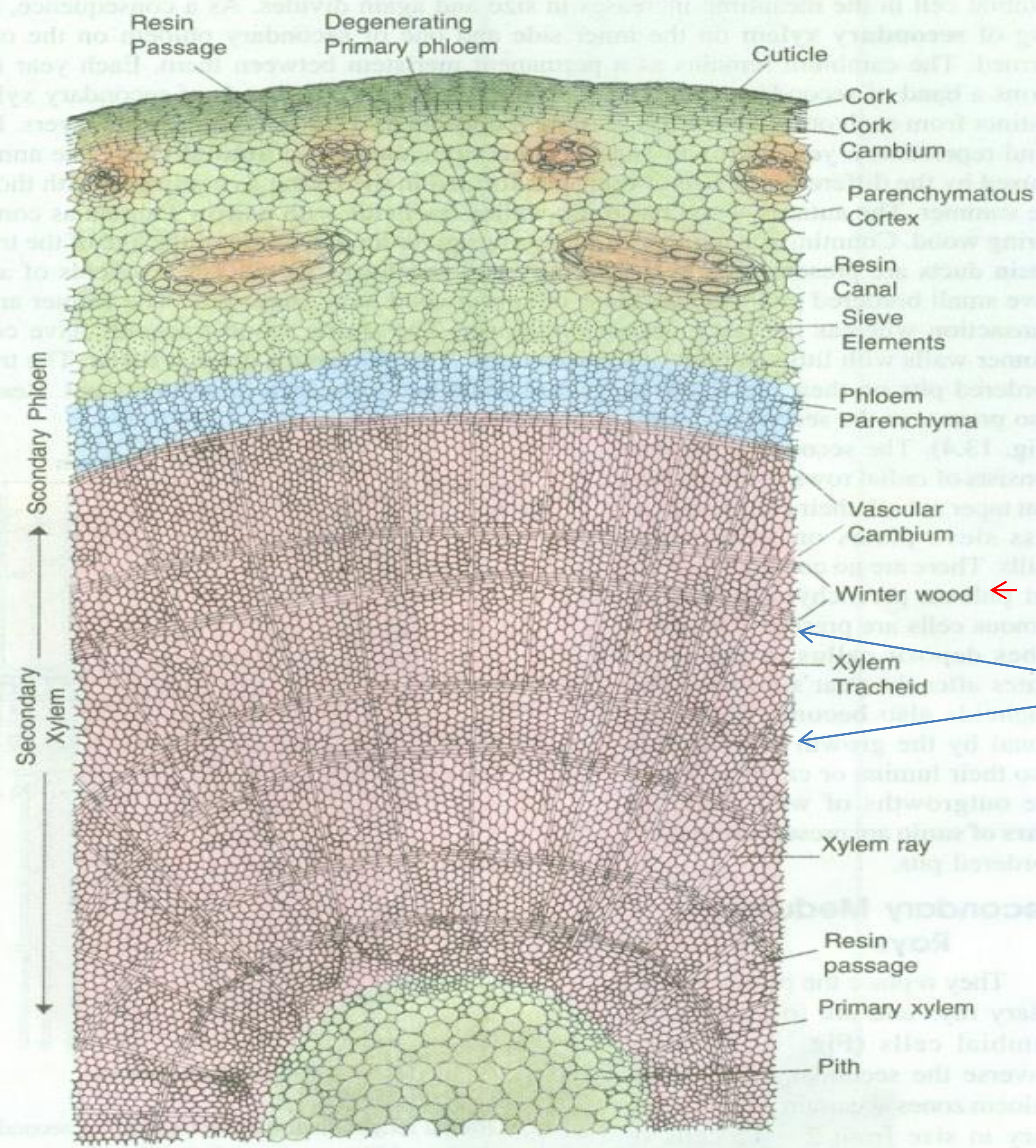


1 Vascular Bundle

5-6 , common, collateral, open

No vessel and wood fiber

Fig. 13.3. T.S. young stem of Pinus roxburghii.



.4. T.S. Portion of old stem of Pinus roxburghii showing details of secondary structure.

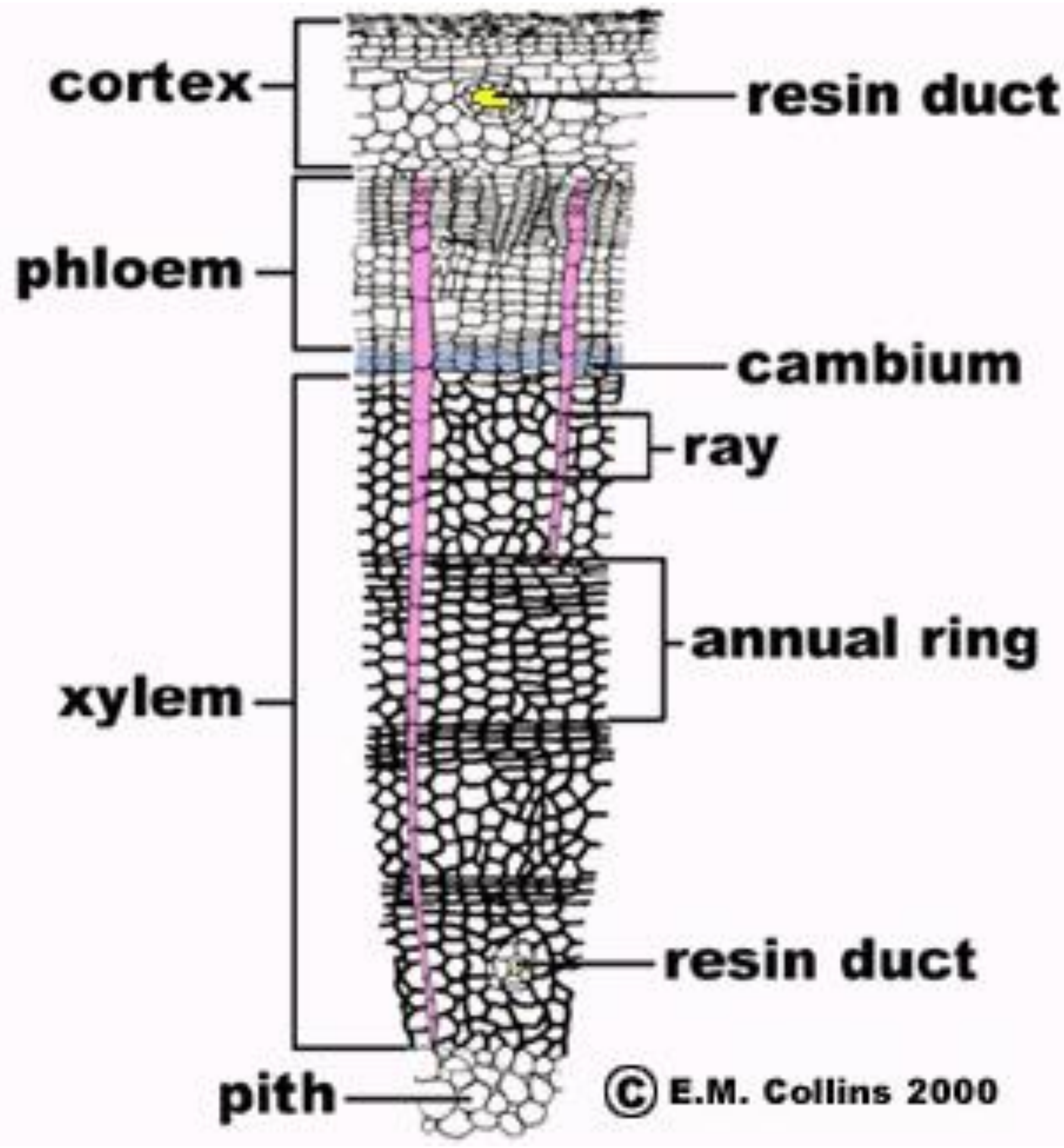
Like dicots!

A closed ring of cambia formed

annual ring =Concentric rings of sec xylem

Winter wood
tracheids have thick walls, small bordered pits, squarish tracheids

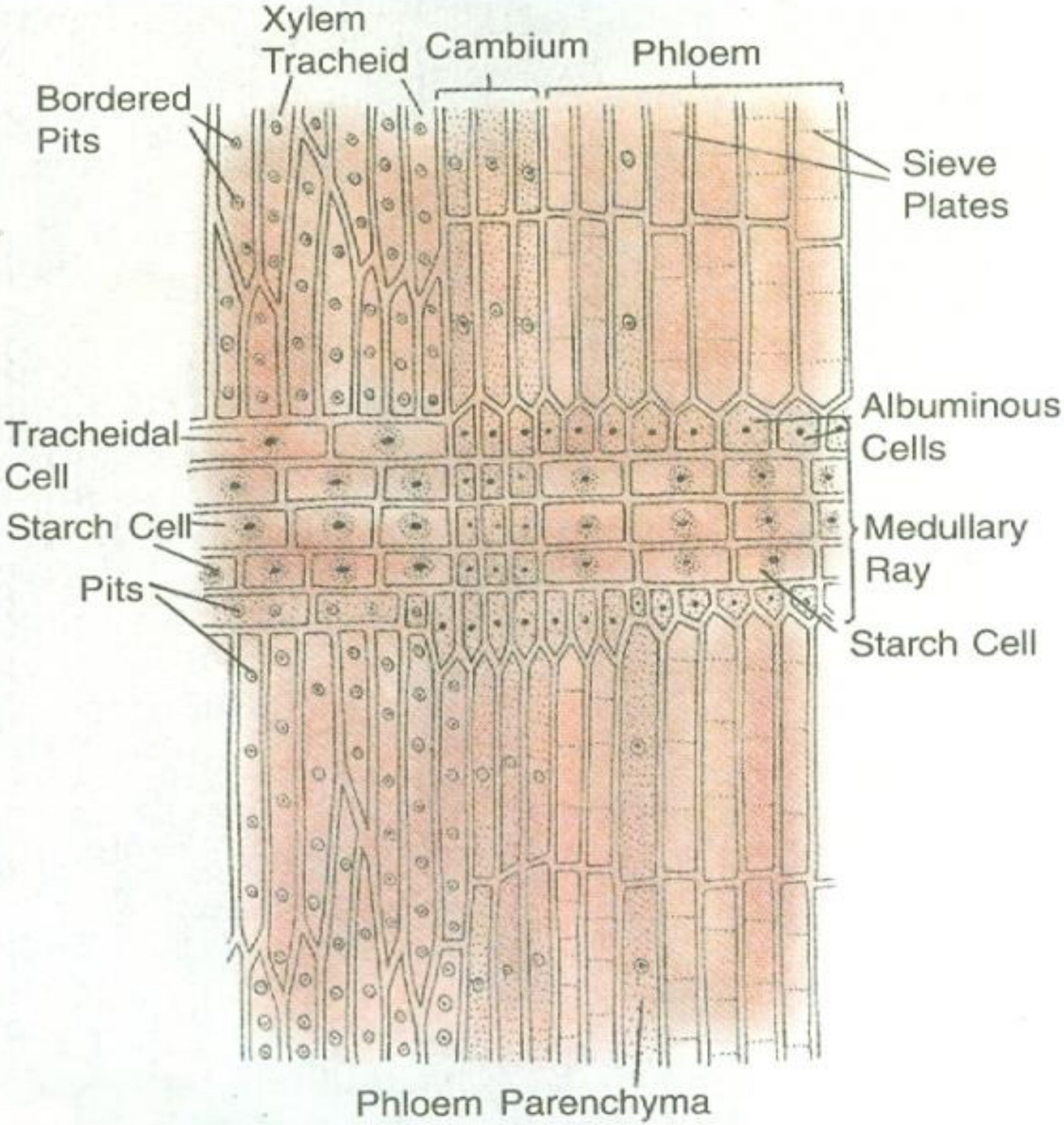
Summer wood
Tracheid's thinner walls, only little lignification, polygonal cells.


cortex
resin duct
phloem
cambium
ray
annual ring
xylem
resin duct
pith
© E.M. Collins 2000

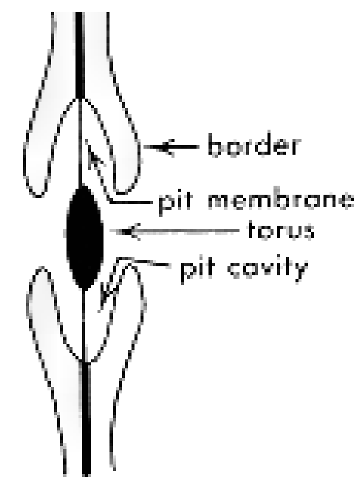
Tracheids:

Have bordered Pits

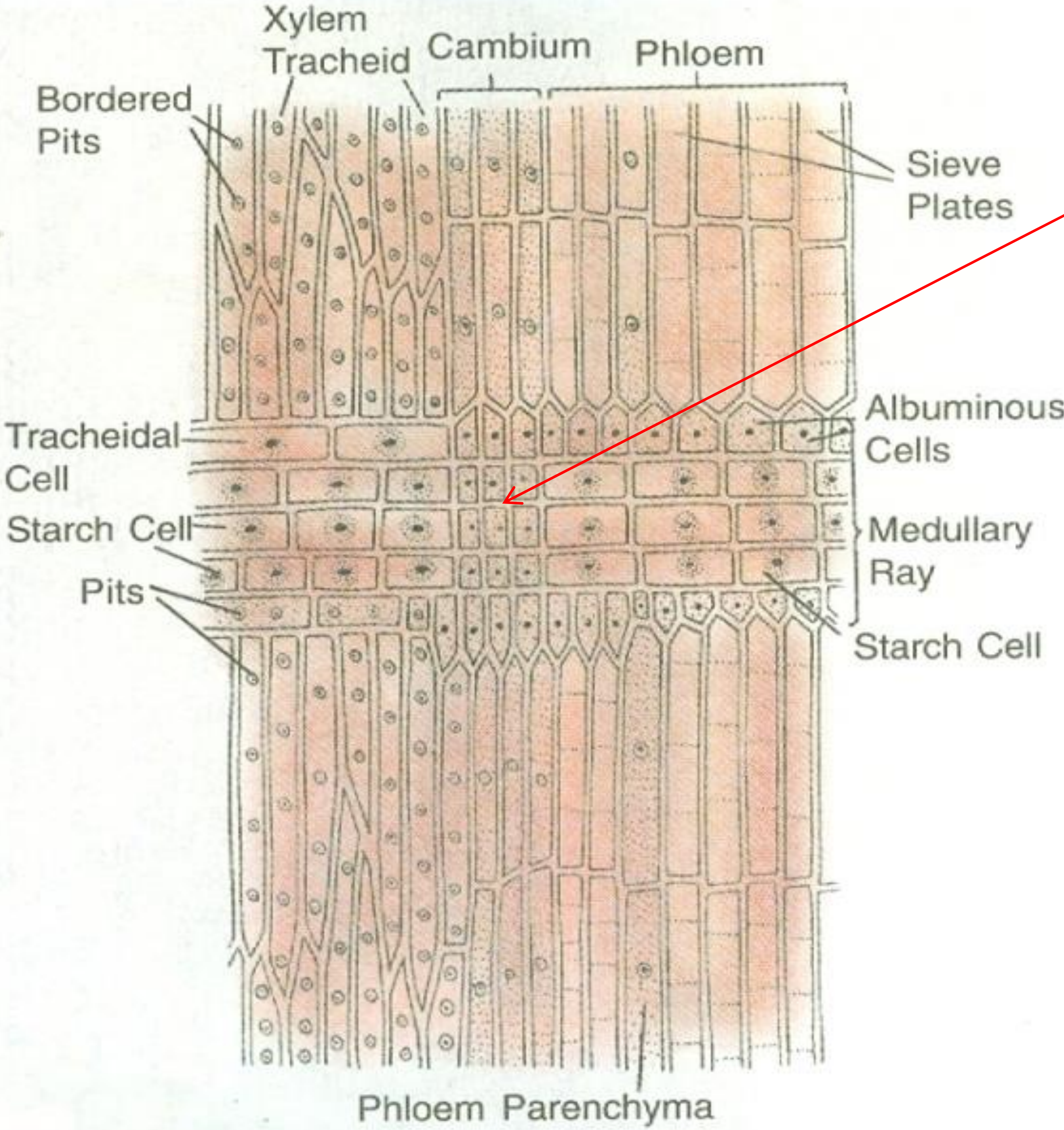
Pits have distinct torus



13.5. Radial longitudinal section (R.L.S.) of secondary wood and phloem of Pinus roxburghii showing the structure of secondary medullary ray.



Torus: In bordered pits, and opposite pits, membrane may be thickened in its central potion. This thickening is called torus



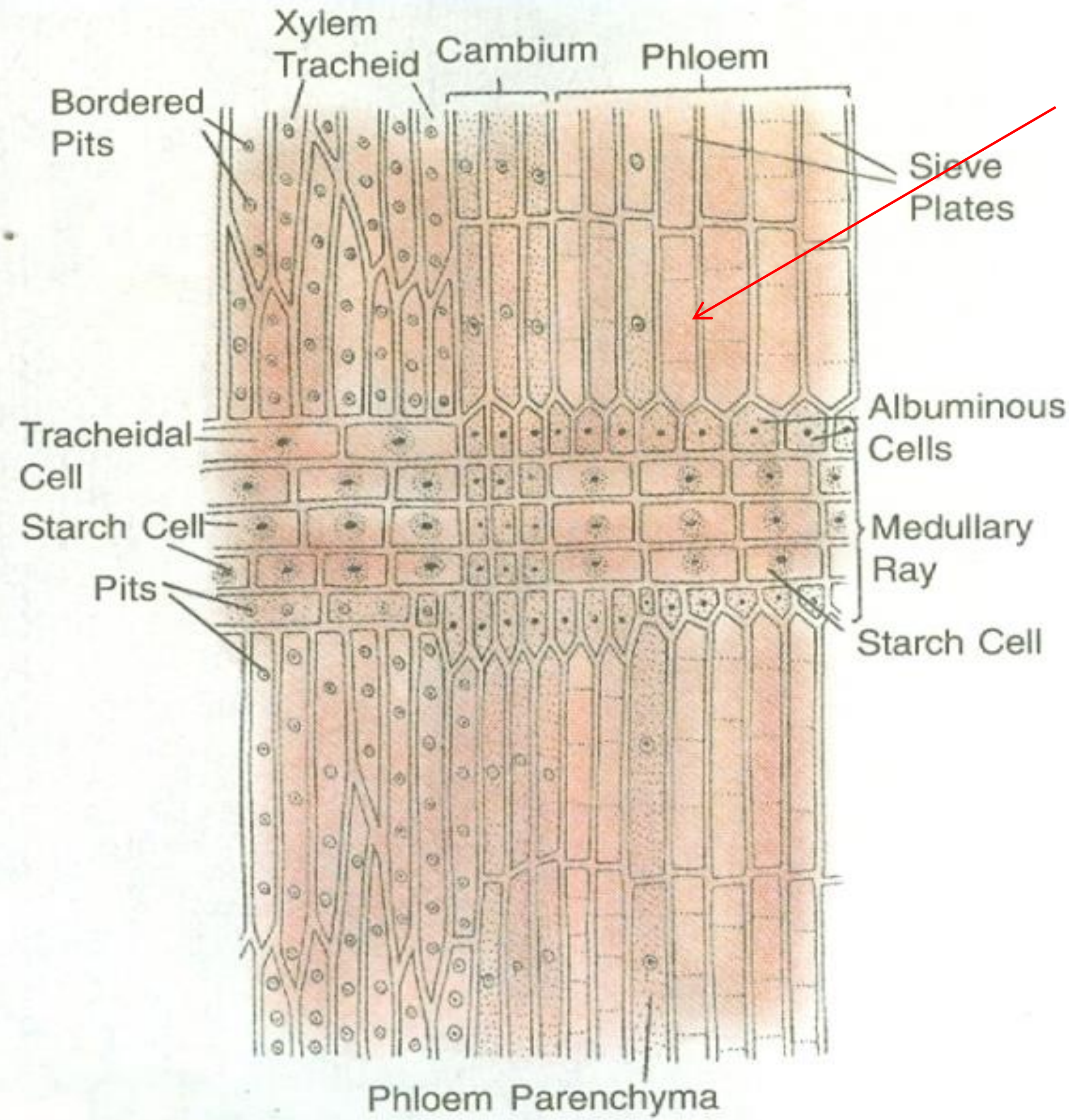
13.5. Radial longitudinal section (R.L.S.) of secondary wood and phloem of Pinus roxburghii showing the structure of secondary medullary ray.

Cambium:

Ray Tracheids absent

Medullary rays absent

Living cells with rich cytoplasm, nucleus



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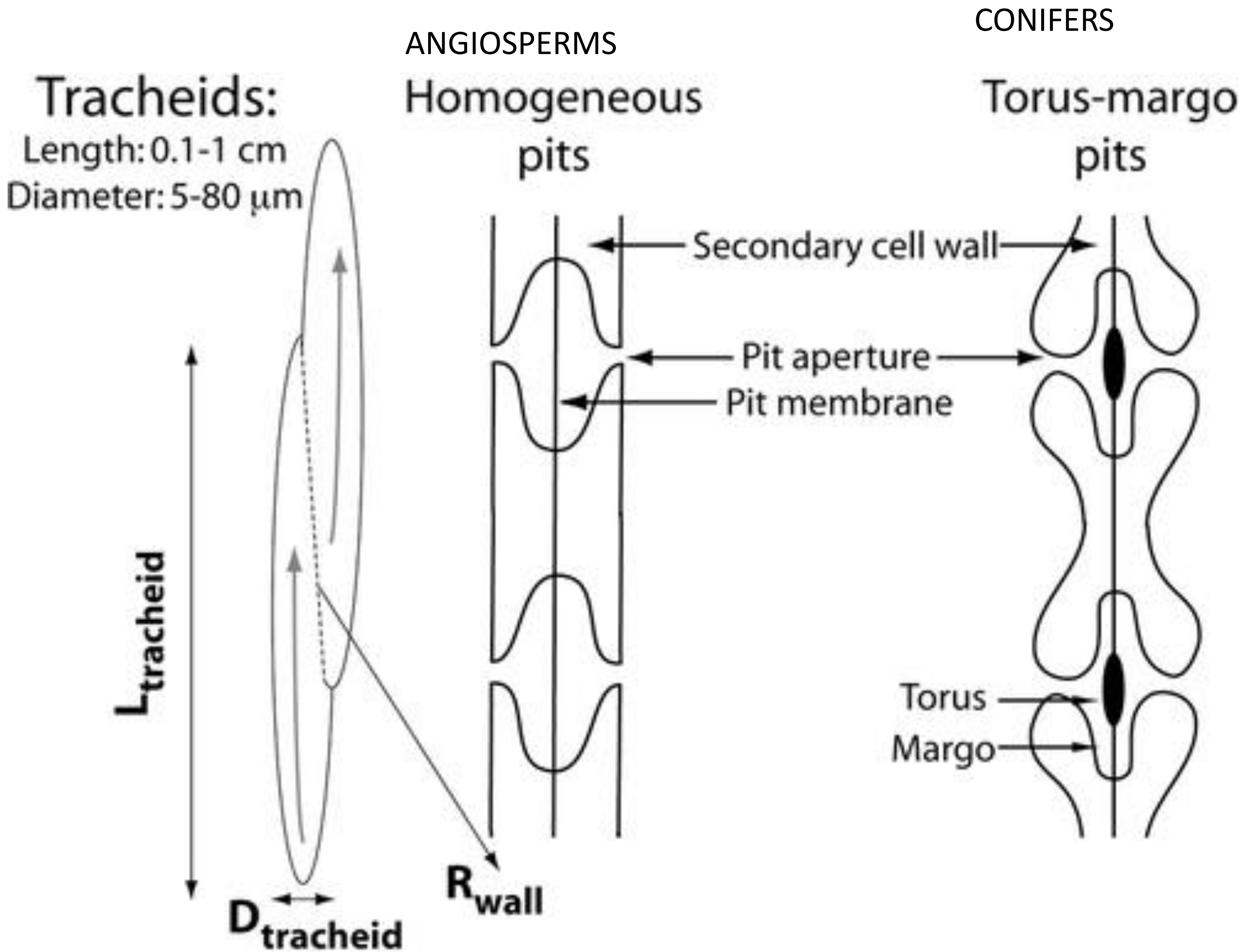
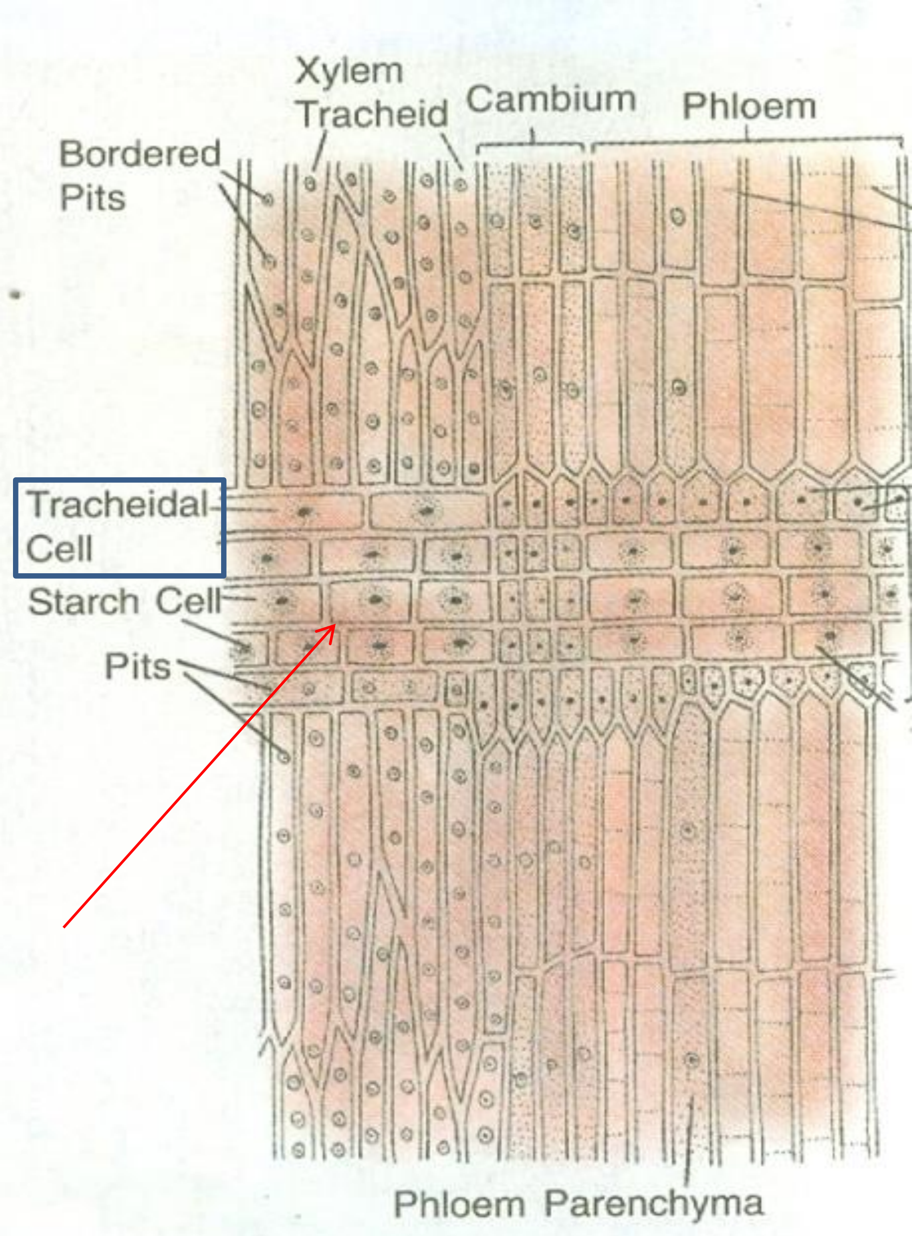
Phloem:

Instead of Tracheidal cells, **albuminous c**ells present

Starch cells present


ANGIOSPERMS
CONIFERS
Tracheids:
Length: 0.1-1 cm
Diameter: 5-80 μm
Homogeneous pits
Torus-margo pits
Secondary cell wall
Pit aperture
Pit membrane
Torus
Margo
$L_{tracheid}$
$D_{tracheid}$
R_{wall}

Secondary medullary rays
Replace pri. Medullary rays
Formed by cambial cells
2-12 cells high
One cell broad
Shape: thick wall, rectangular parench. cells, have cytoplasm, a nucleus, starch grains have simple pits
Have **ray tracheids** on upper and lower margin.these are elongated horizontally



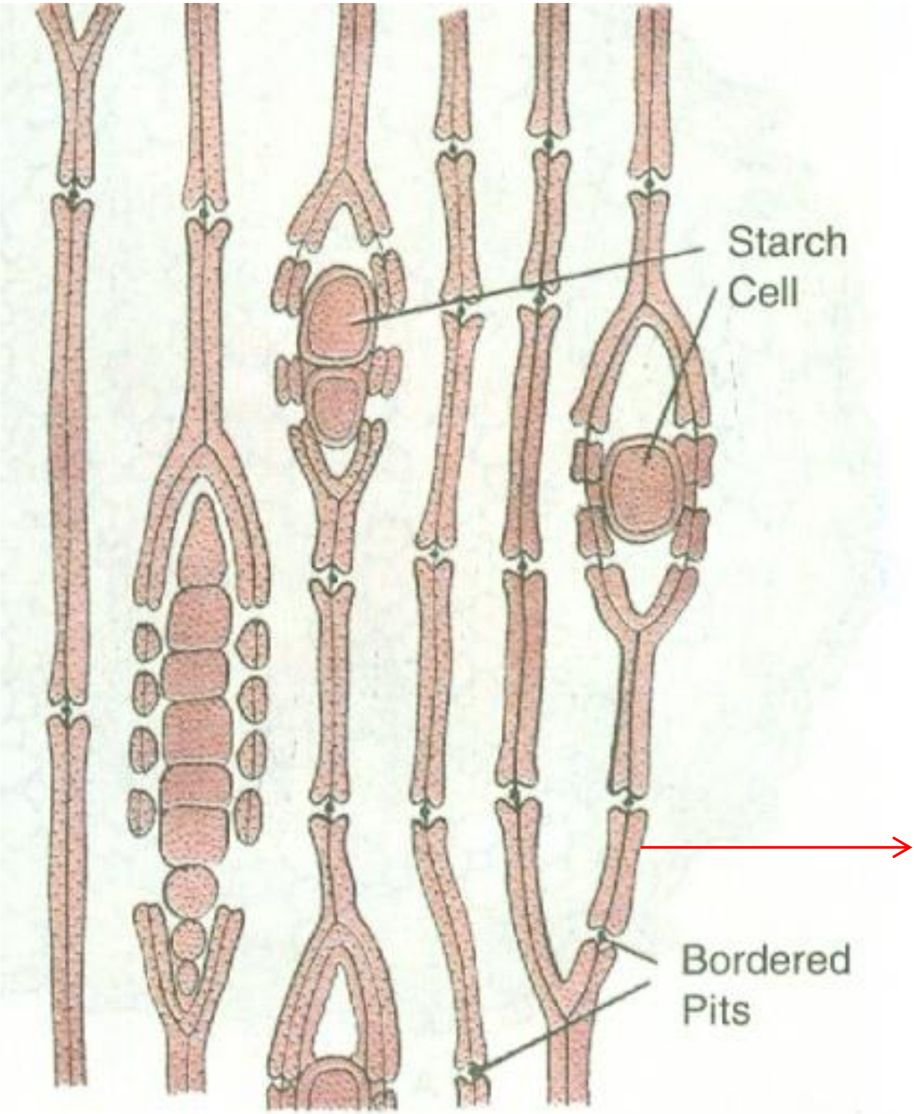


Fig. 13.6. Tangential longitudinal section (T.L.S.) of secondary wood showing the medullary rays of P. roxburghii.

Tracheids interrupted by rays

Uniseriate rays
Ray cells have starch

Bordered pits on radial walls of tracheids

Tracheids

Secondary growth in stem and root

	Stem	Root
	Annual rings distinct and **broad**	Annual rings are also distinct but **narrow** as compared to stem.
DIFF	Shorter , thin walled tracheids	Tracheids are longer and thick-walled as compared to stem
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	Conjoint and collateral arrangement of vascular elements	**radial** arrangement of vascular elements as in stem
SIM	Bordered pits	Possess bordered pits like those in stem.

LS Female Cone

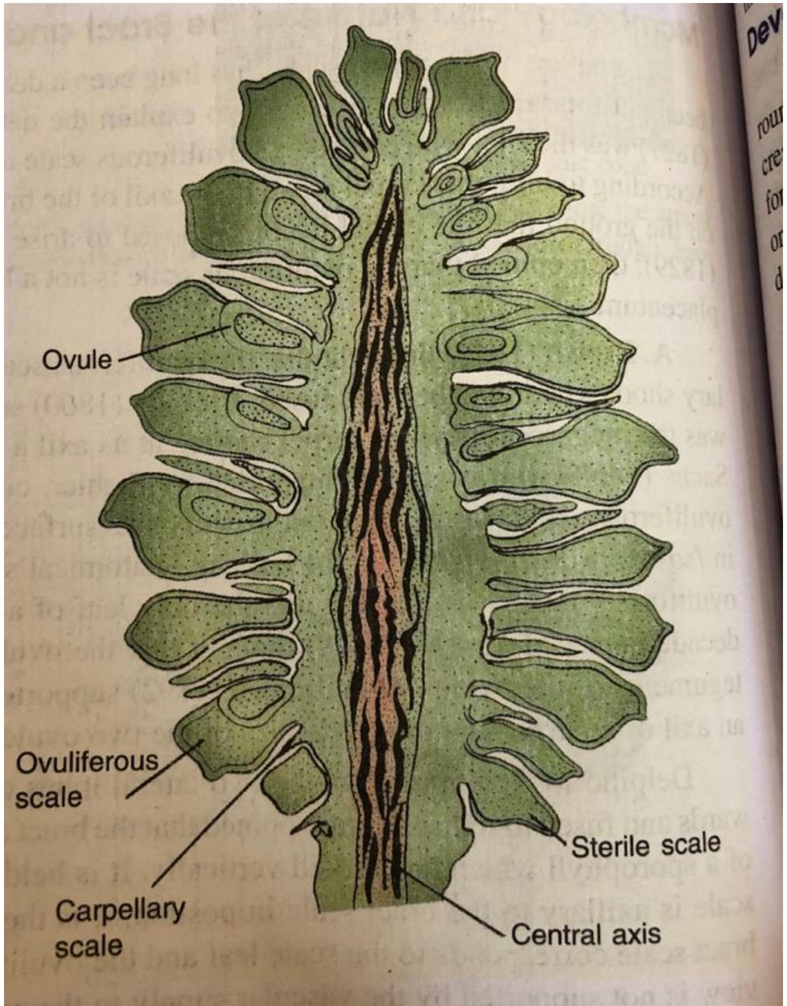

Fig. 13.28. V.S. mature female cone of Pinus roxburghii.

Male cones

Fig. 13.14. A cluster of male cones of pinus roxburghii.

Pollen Grains: winged

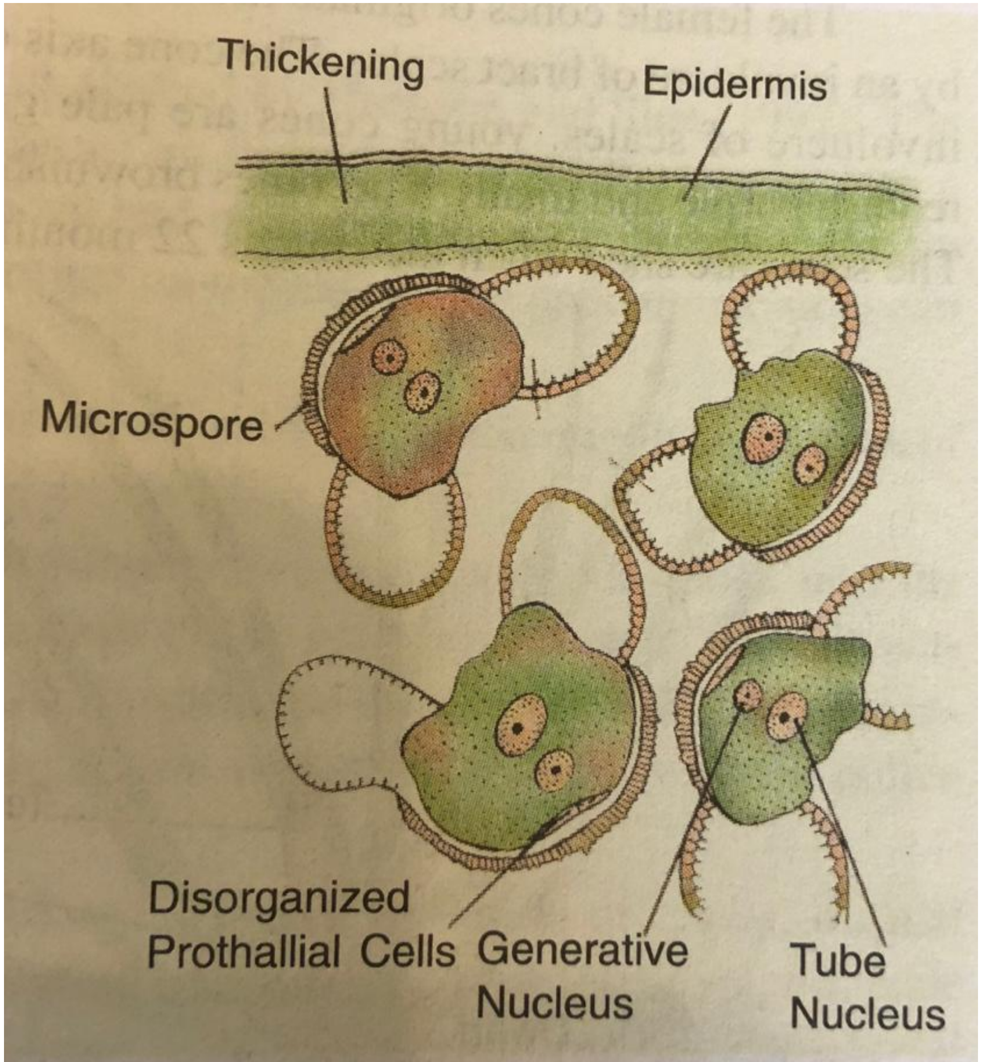

Fig. 13.21. Pinus wallichiana. part of mature microsporangium.

Embrogeny

- Polyembryony

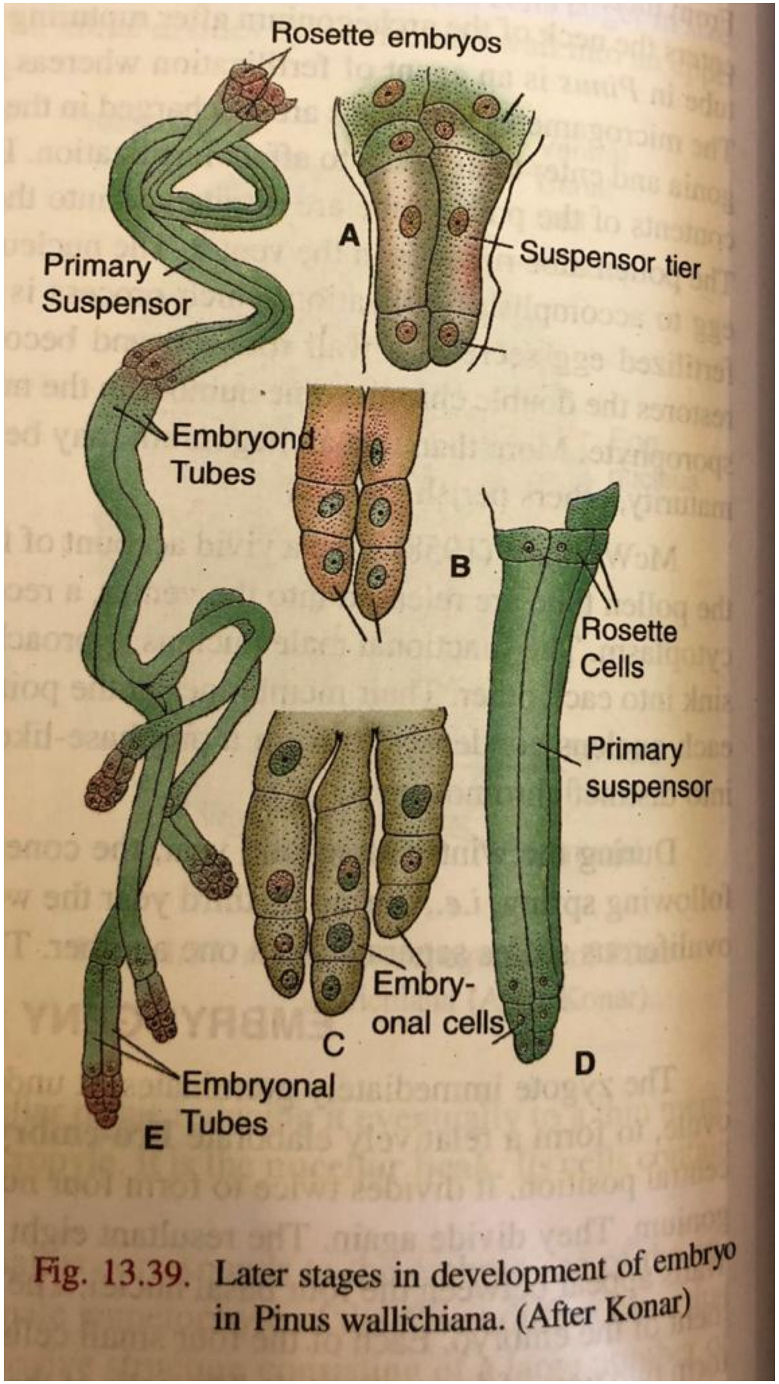

Fig. 13.39. Later stages in development of embryo in Pinus wallichiana. (After Konar)

Seed

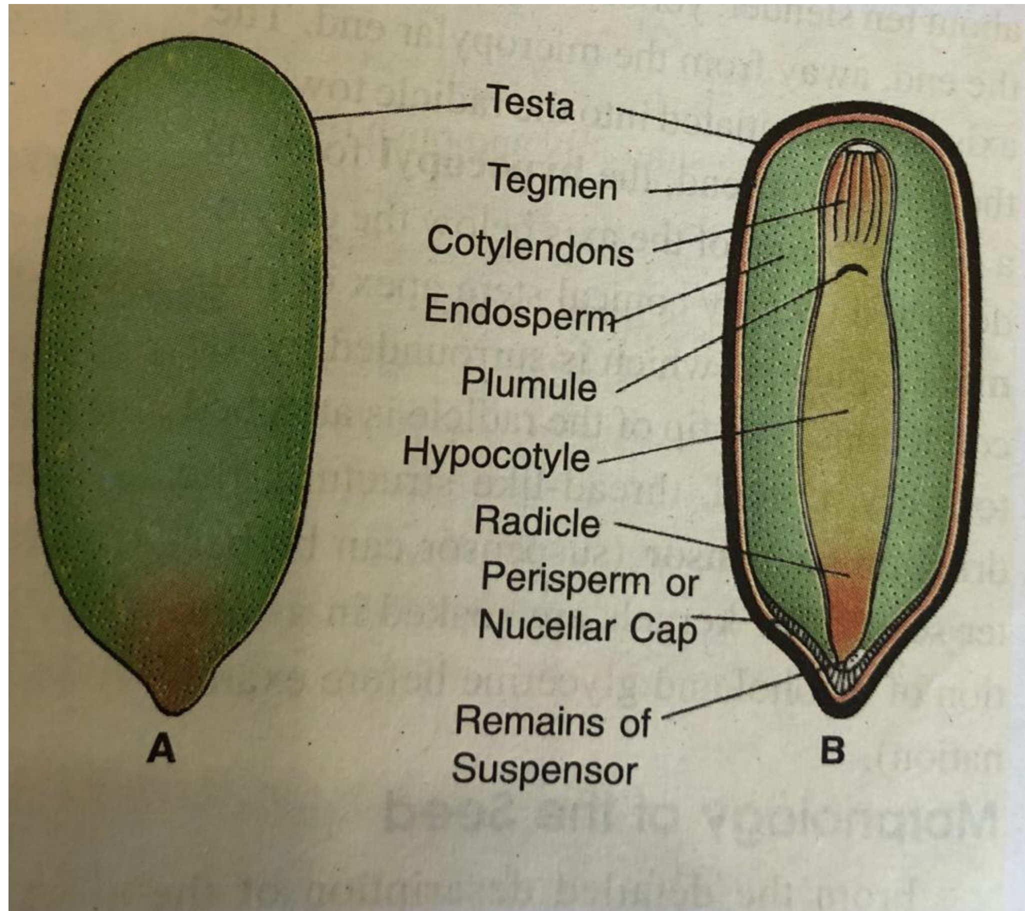

Fig. 13.41. (A – B). A. Seed of P. gerardian. B. L.S. of seed.

END