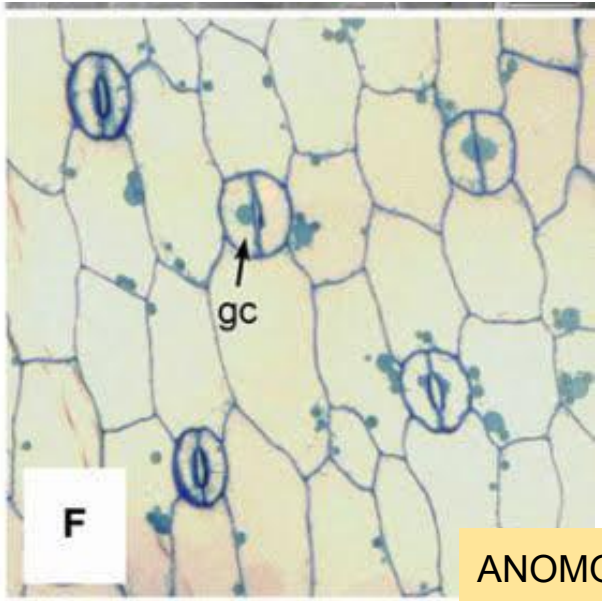
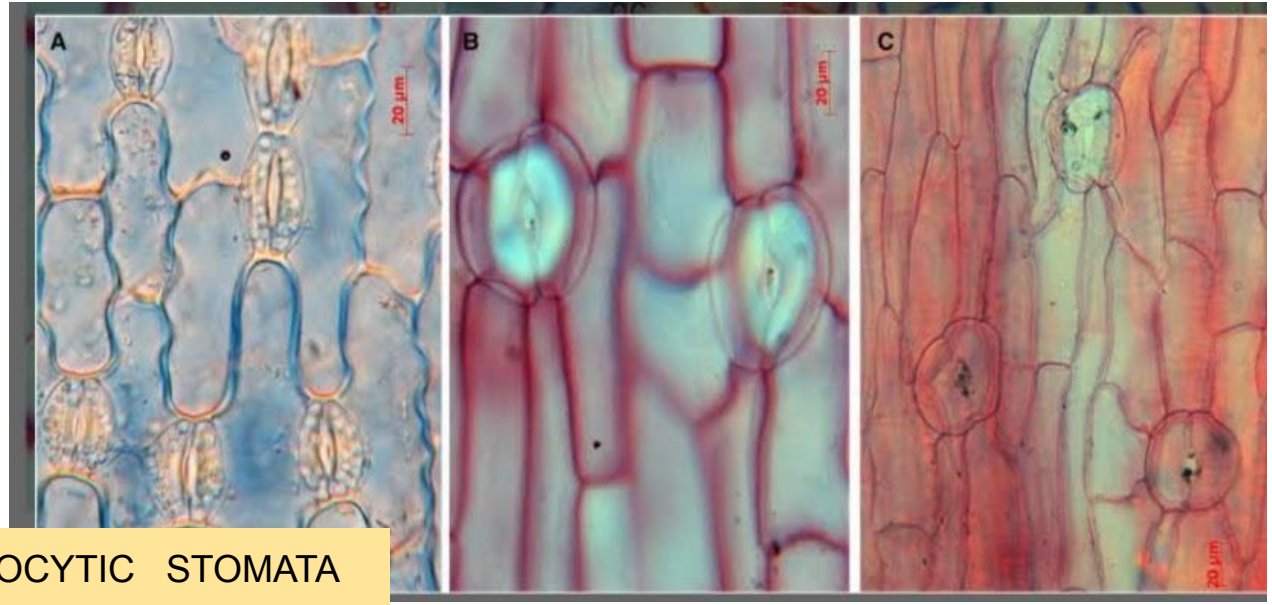
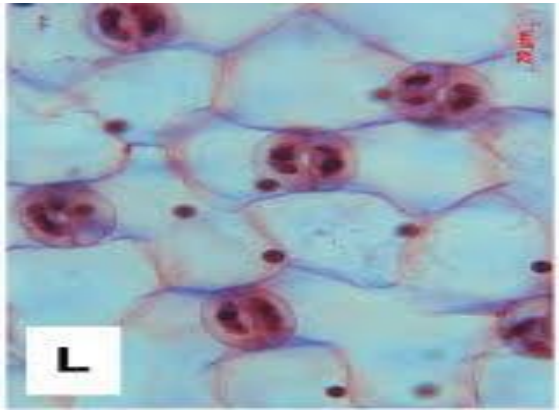
PLANT ANATOMY
PRACTICAL Sem 2; CC3

1) Types of Stomata, Sclerides ,Raphides (Colocasia), Cystolith(Ficus) leaf, Starch grains, Aleurone grains, Laticiferous Ducts; Oil Glands…….. (Part 1). .
2) Study of anatomical details through permanent slides ;- Monocot & Dicot Roots; Monocot & Dicot Stem; Monocot & Dicot Leaf……..……..(Part 2).
3) Study of Anomalous Secondary Structures in Stem of Boerhaavia; Bignonia; Tecoma; Dracena; & Root of Tinospora……....(Part 3)
4) Study of Adaptive Anatomical features:- Hydrophytes (Nymphaea petiole); Xerophyte (Nerium leaf)..... .....(Part 3)

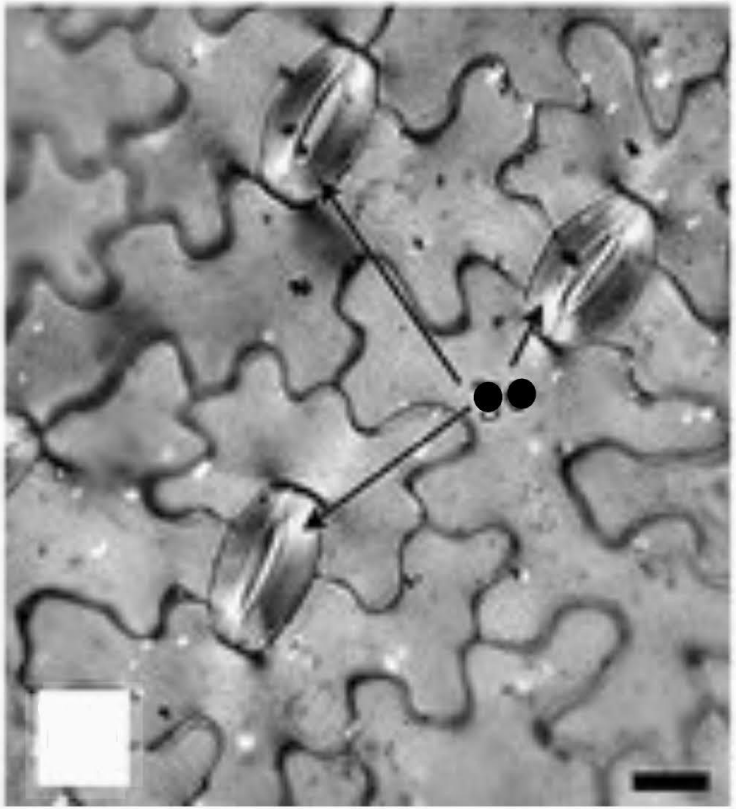


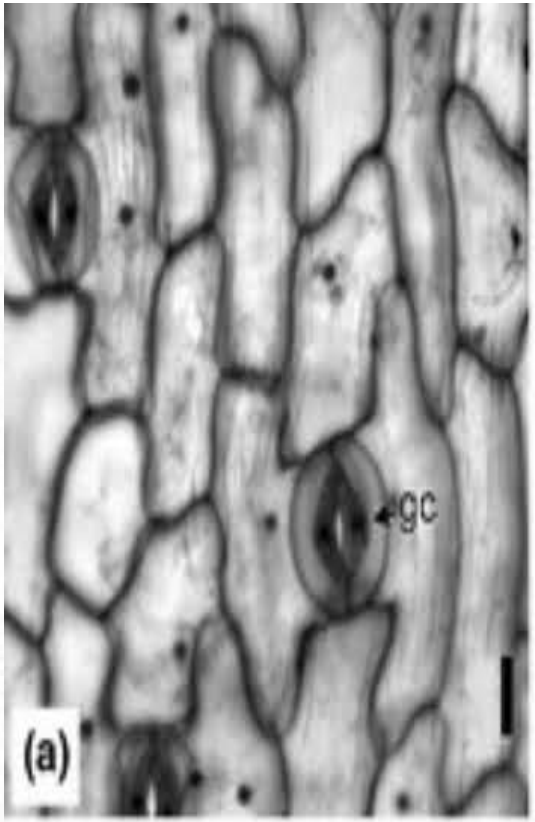


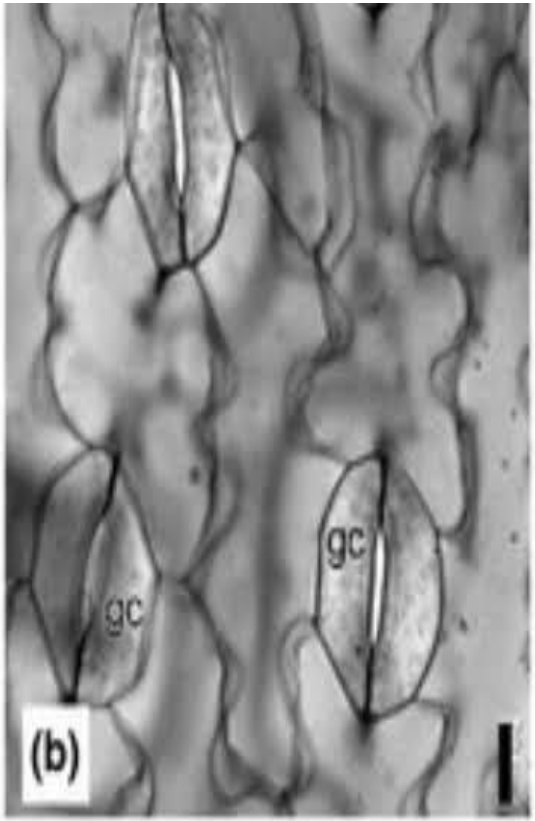
ANOMOCYTIC STOMATA



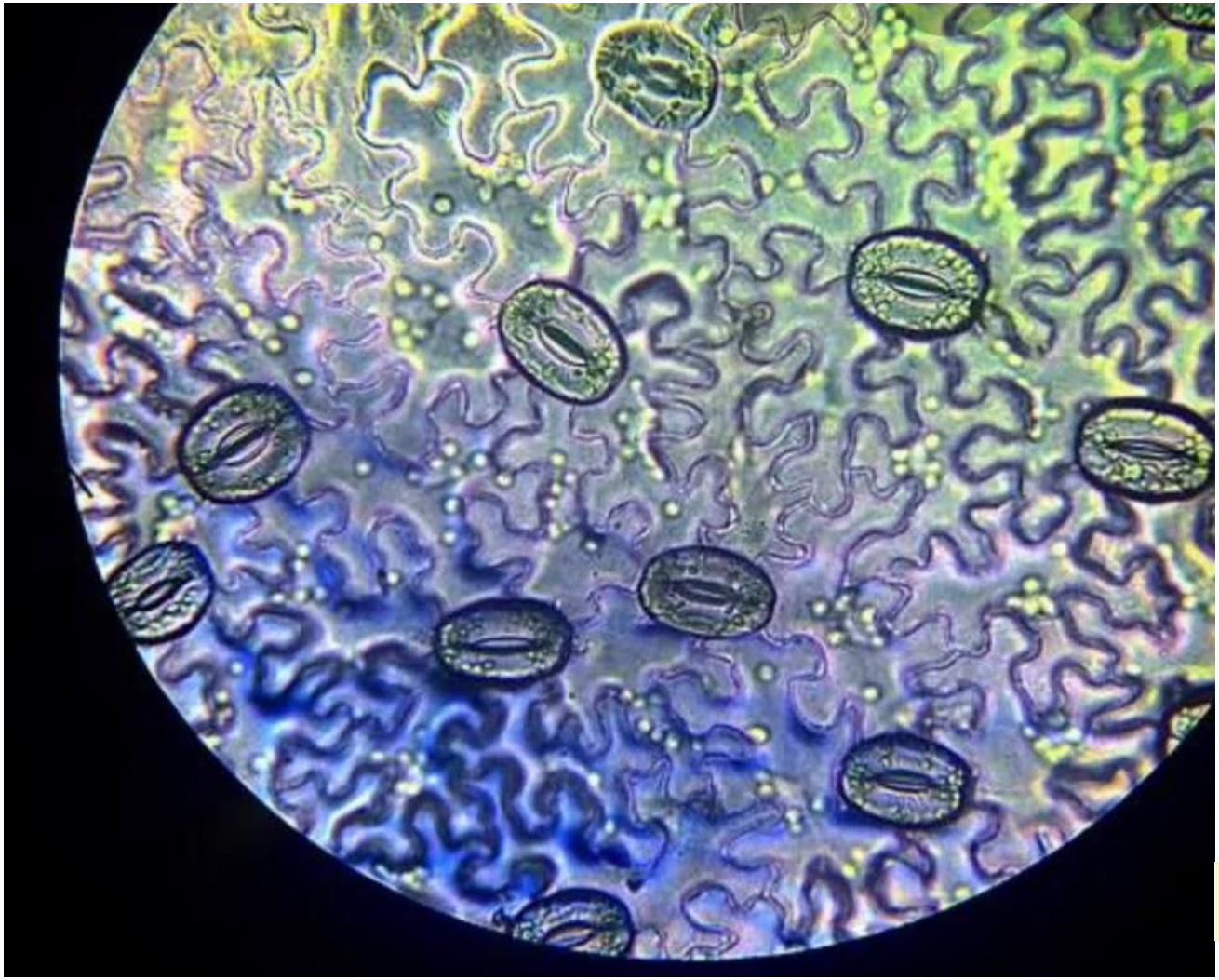
STOMATA

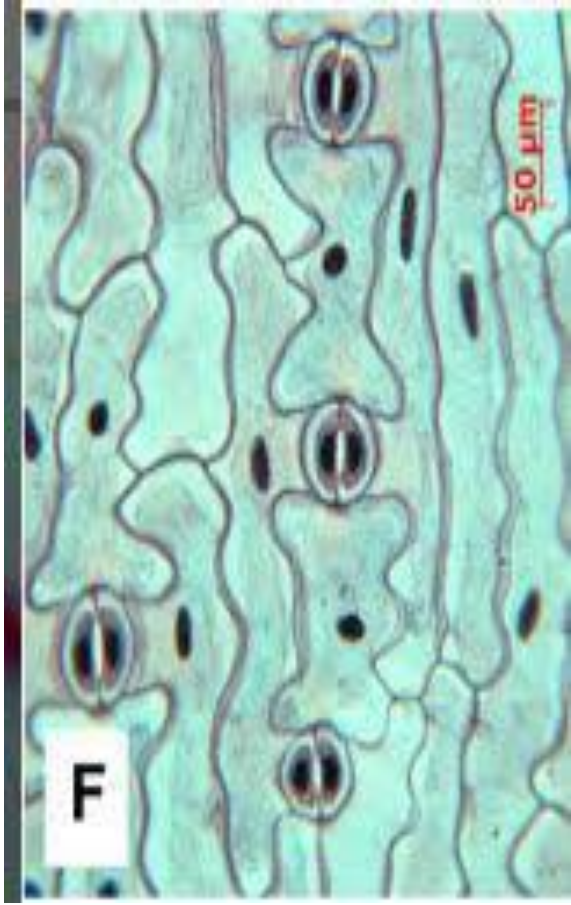






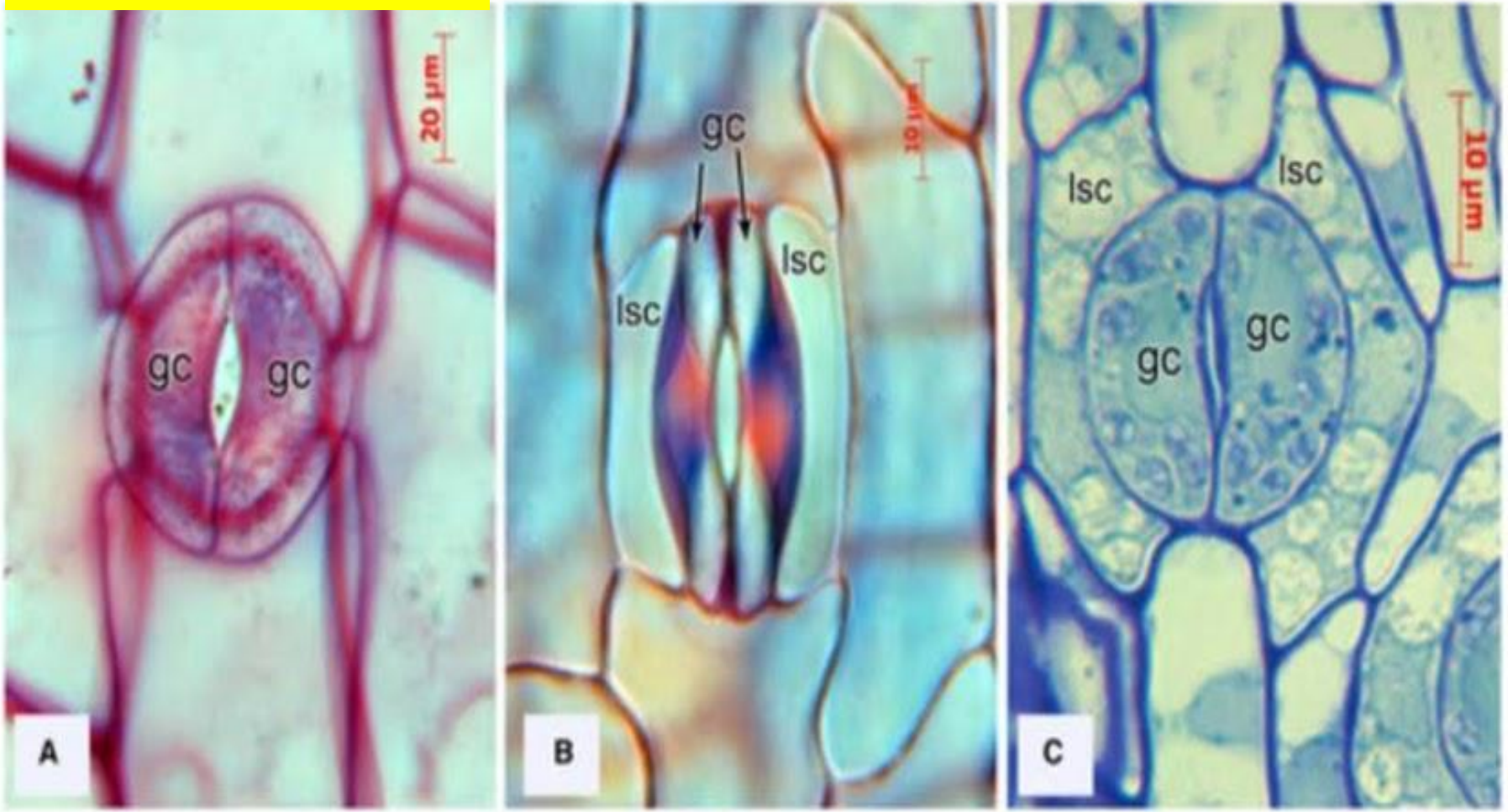
ANOMOCYTIC STOMATA;Subsidiary cells are similar to the rest of the epidermal cells eg. Boraginaceae,Cucurbitaceae,Apocynaceae, Rananculaceae





Anomocytic Stomata

STOMATA IN MONOCOTS

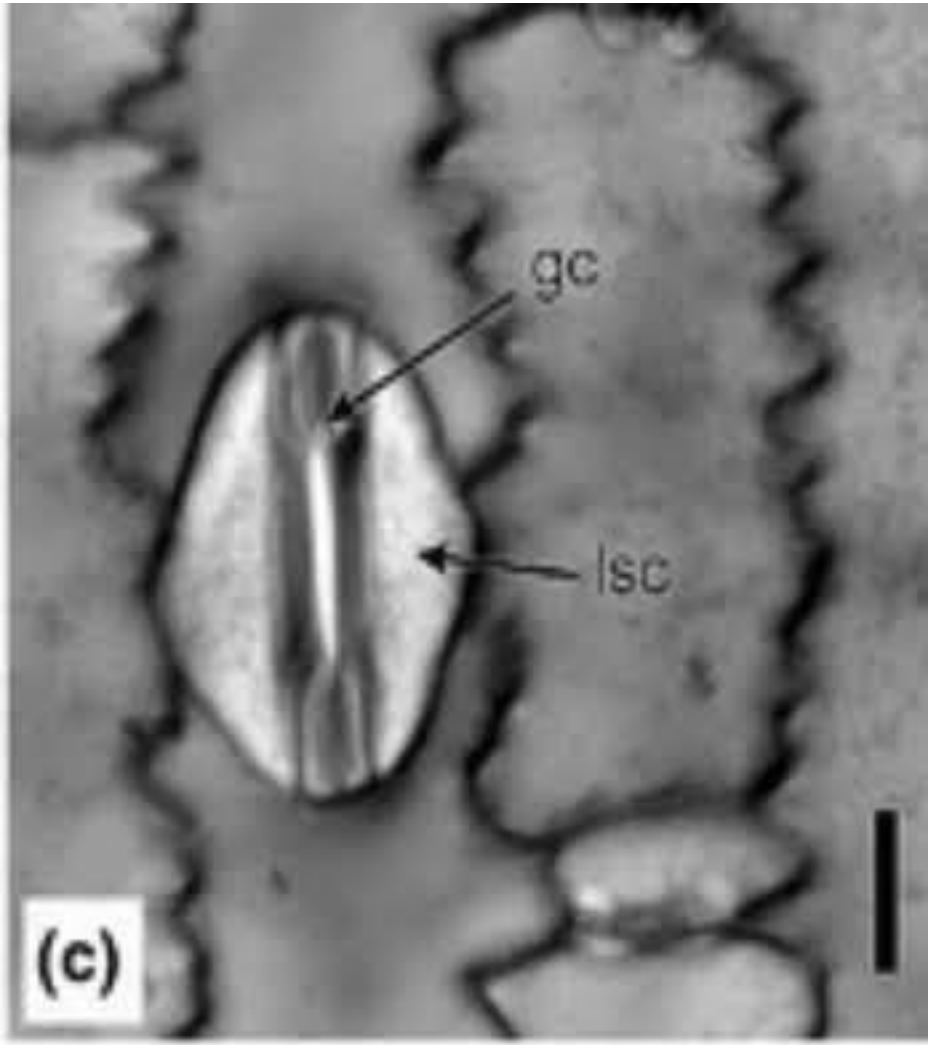


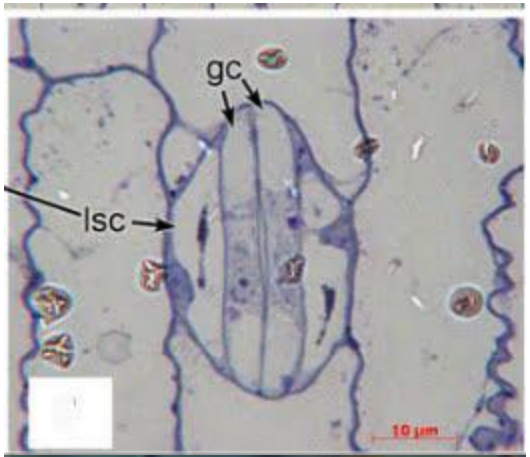
(A) Anomocytic (lacking subsidiary cells) in *Zygadenus venenosus* (Melanthiaceae–Liliales).

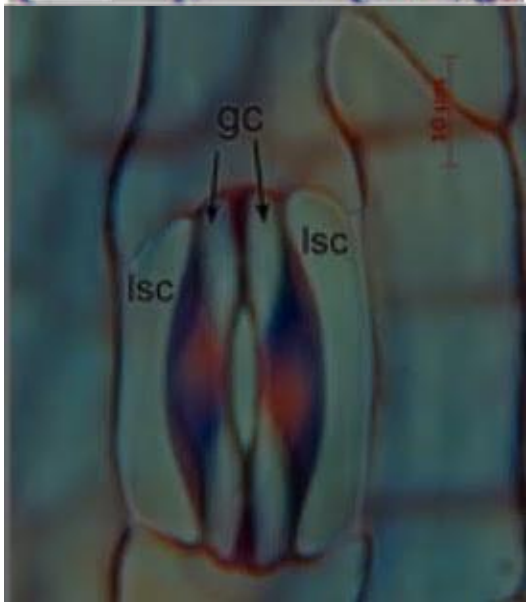
B)

Paracytic with a pair of nonoblique lateral subsidiary cells, in *Flagellaria indica* (Flagellariaceae–Poales). In this "paracytic-nonoblique" type, the lateral subsidiary cells can be markedly smaller than adjacent pavement cells and similar in size to the guard cells, as here.

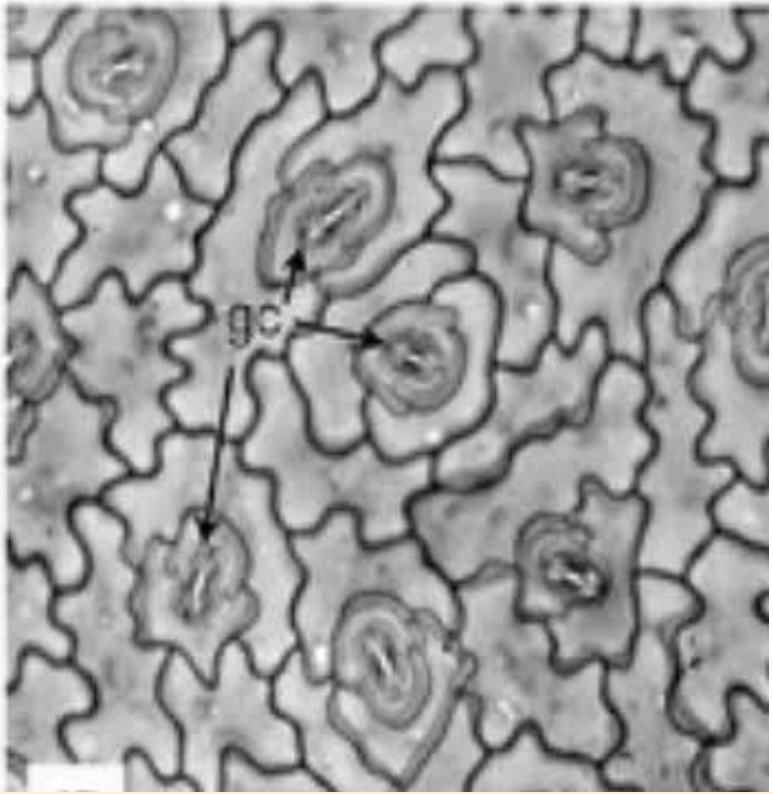
the guard cells, as here. (C) Paracytic stoma with a pair of lateral subsidiary cells, often with oblique cell walls, in *Acorus gramineus* (Acoraceae–Acorales). In this "paracytic-oblique" type, the lateral subsidiary cells are only slightly smaller than pavement cells







GRAMINACEOUS STOMATA



DIACYTIC STOMATA: Subsidiary cells at right angle to the Guard cells
eg.ACANTHACEAE & Caryophyllaceae;
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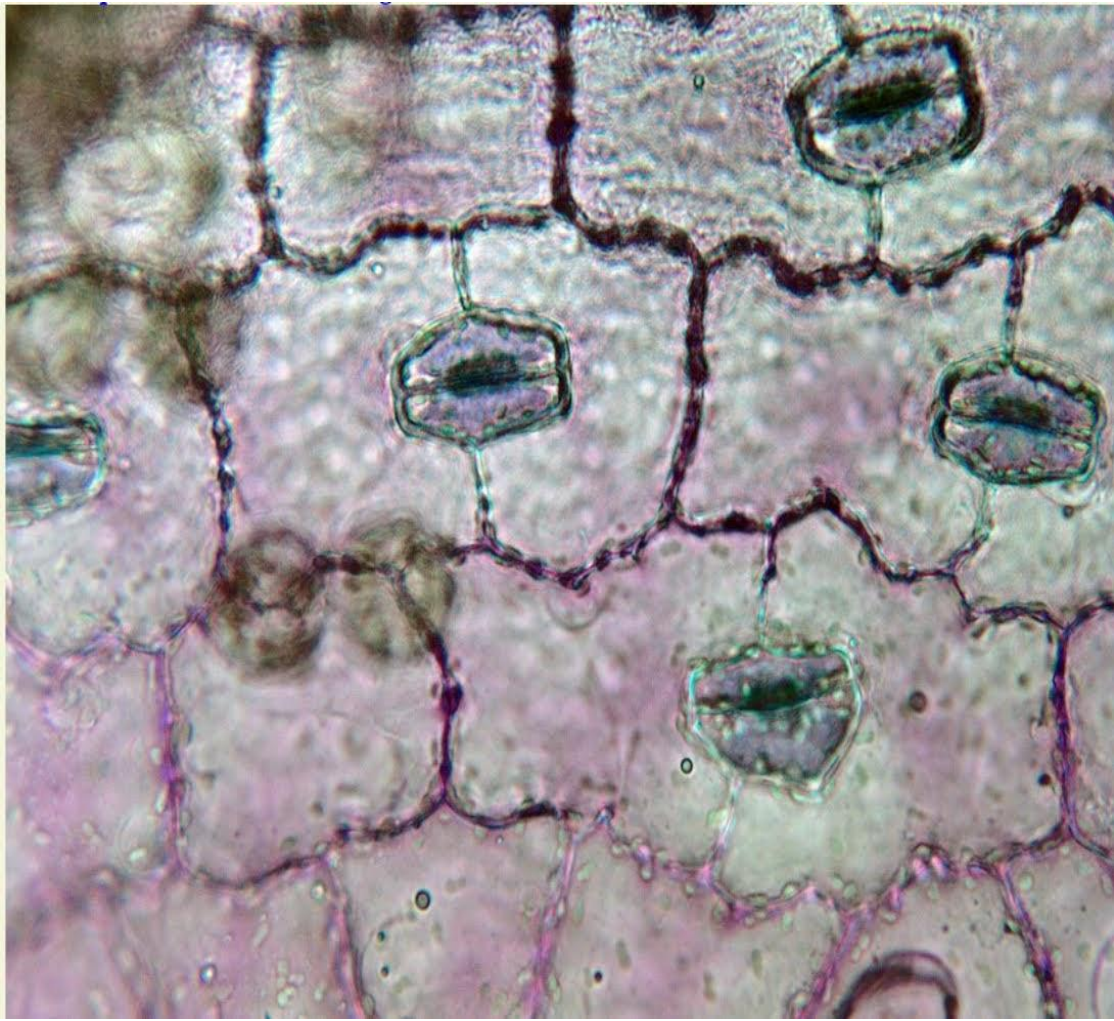
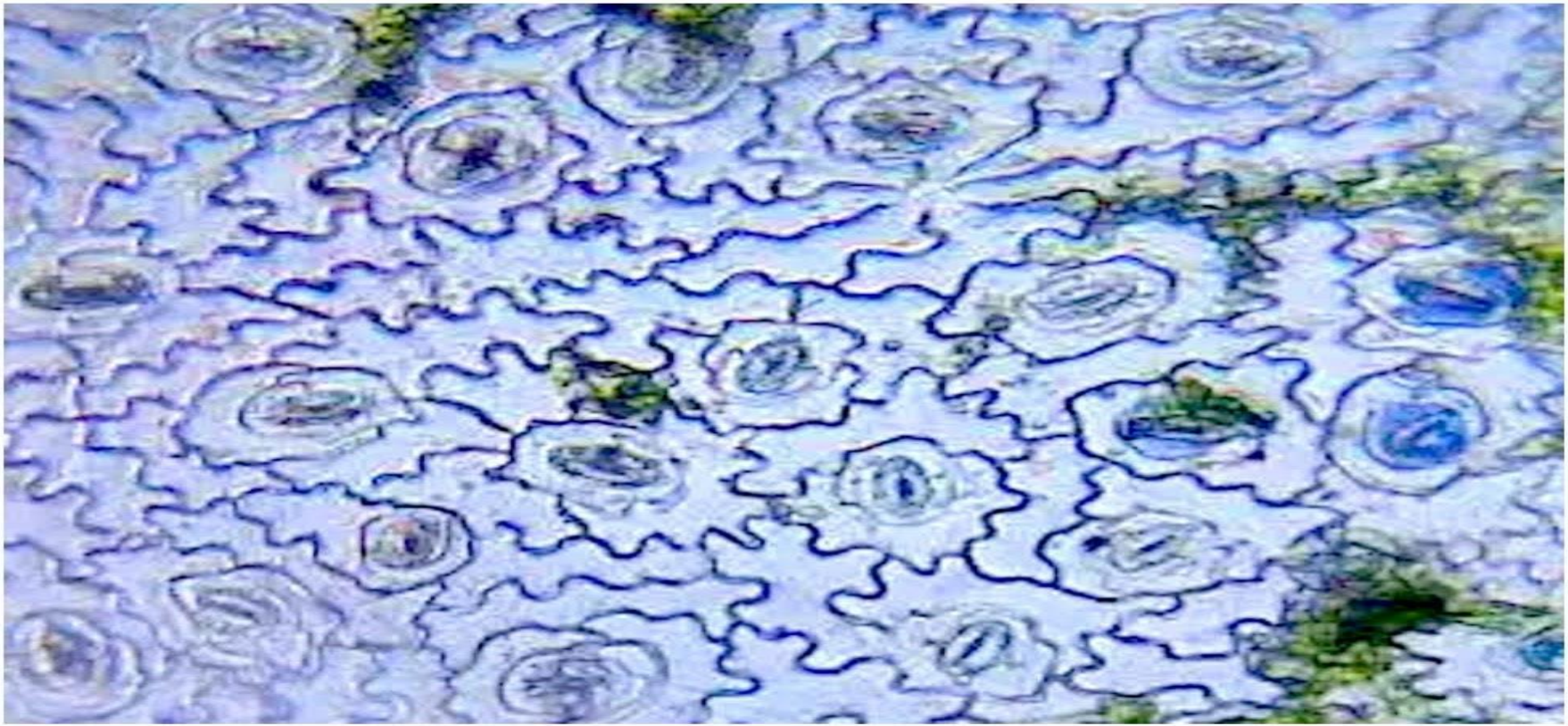
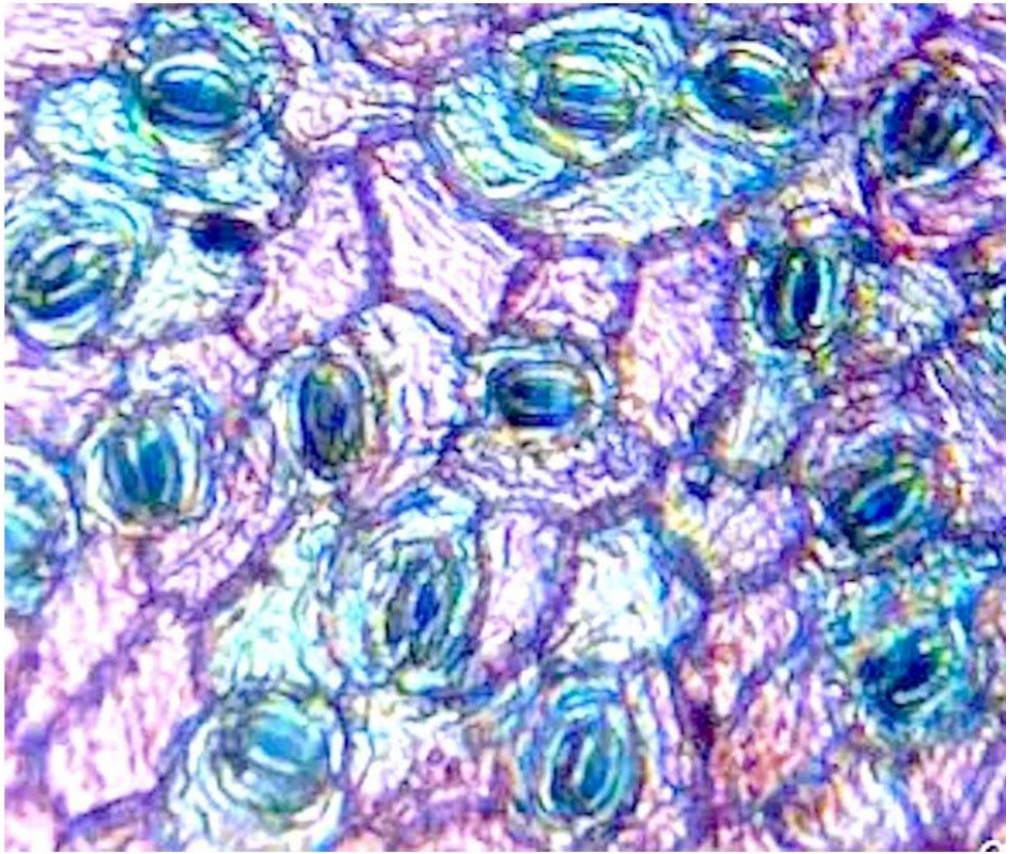
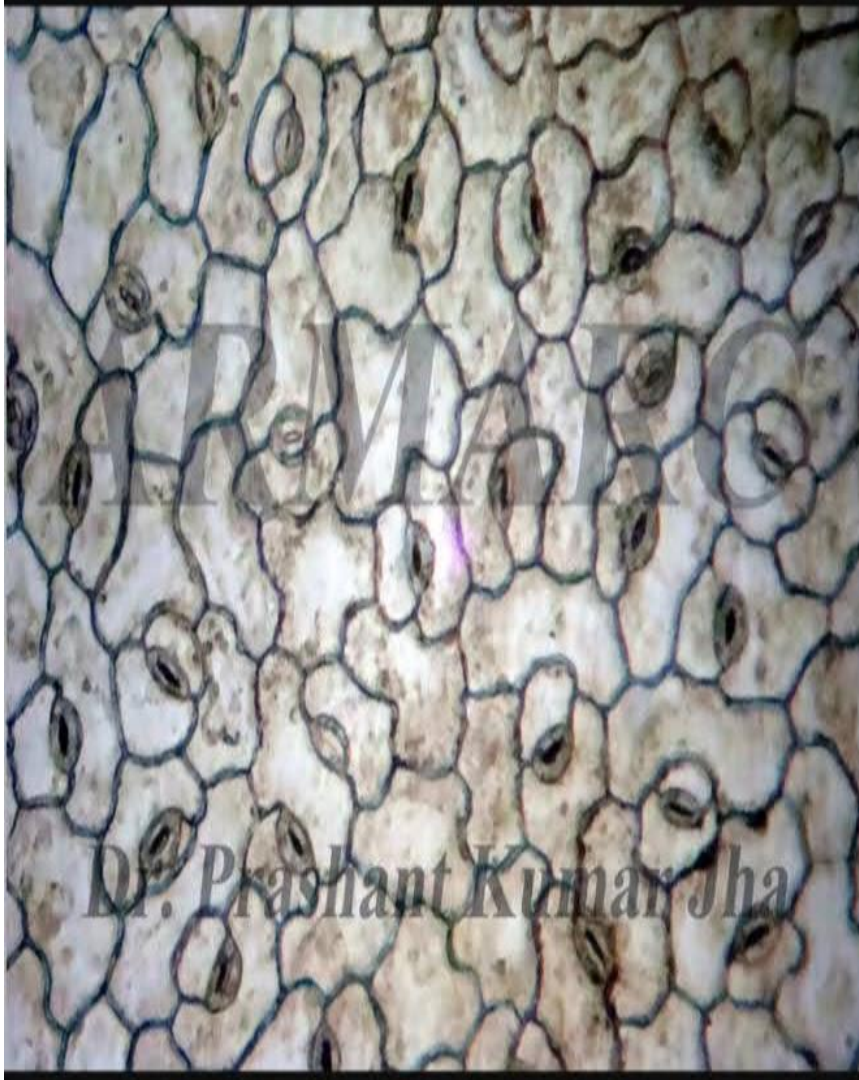


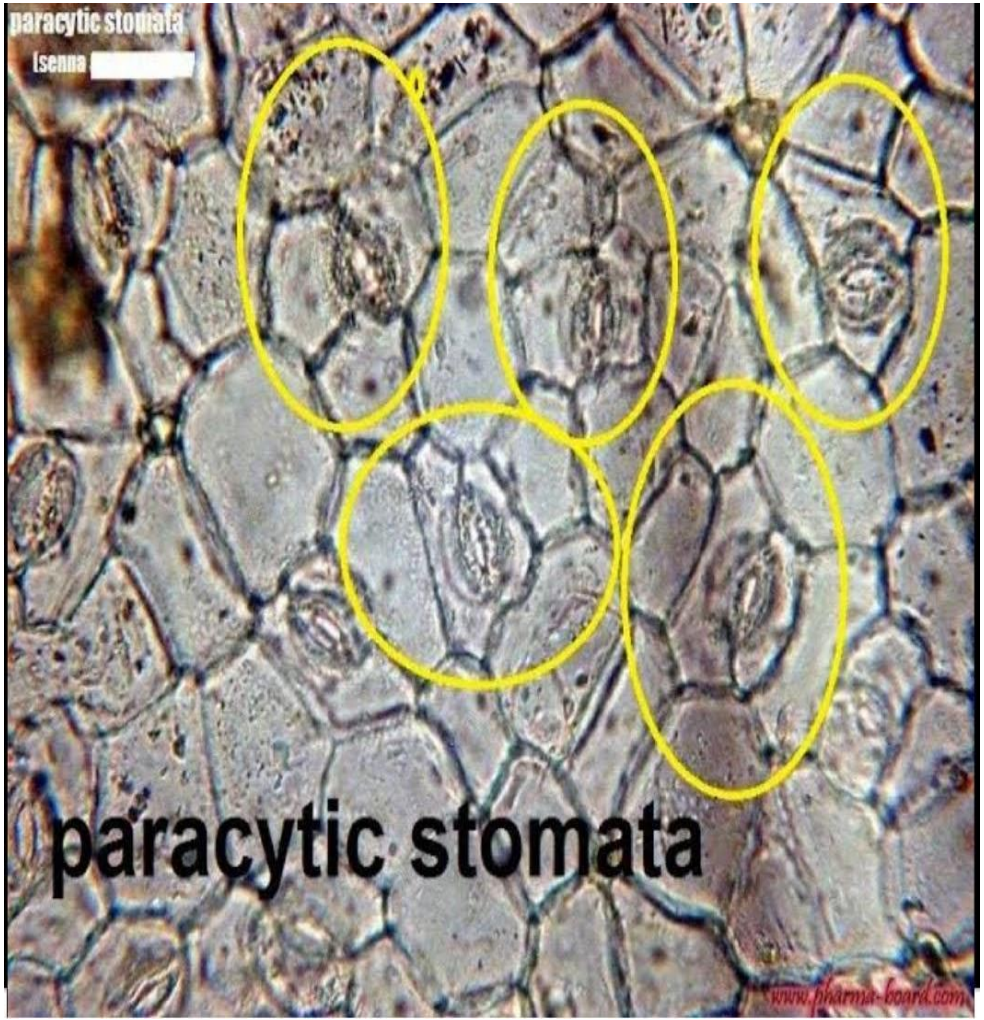


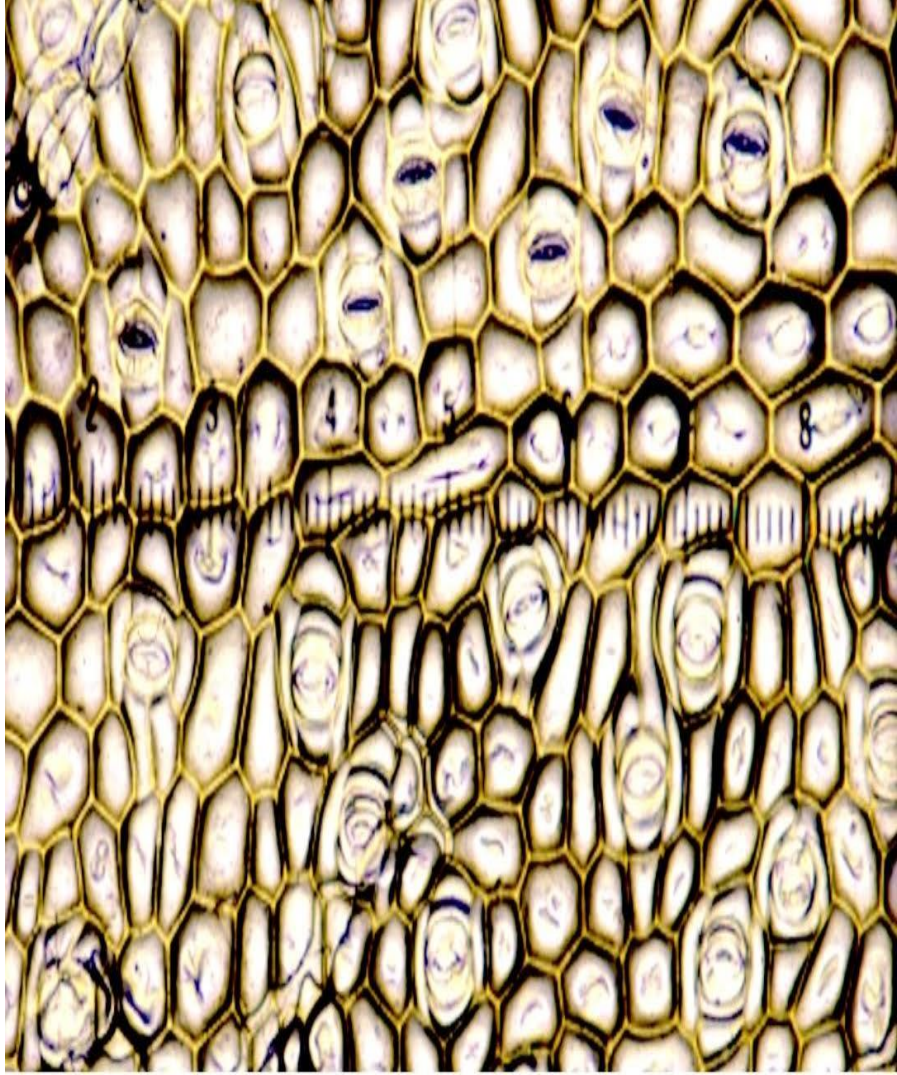
Diacytic stomata in *Adathoda vasica* Nees

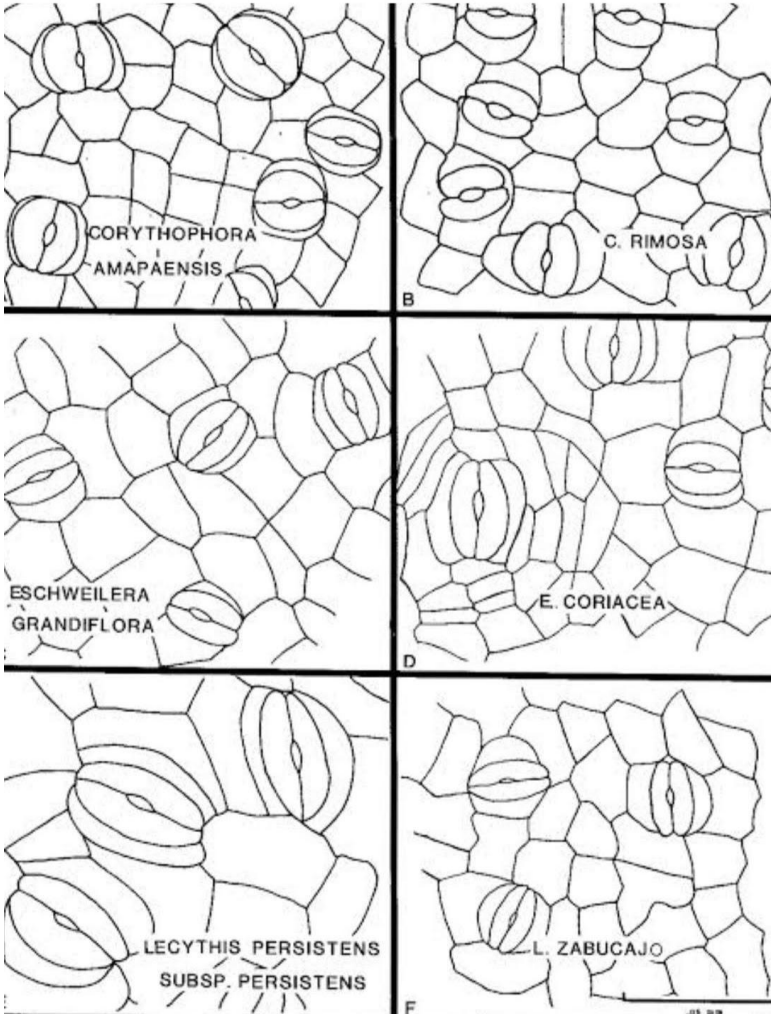


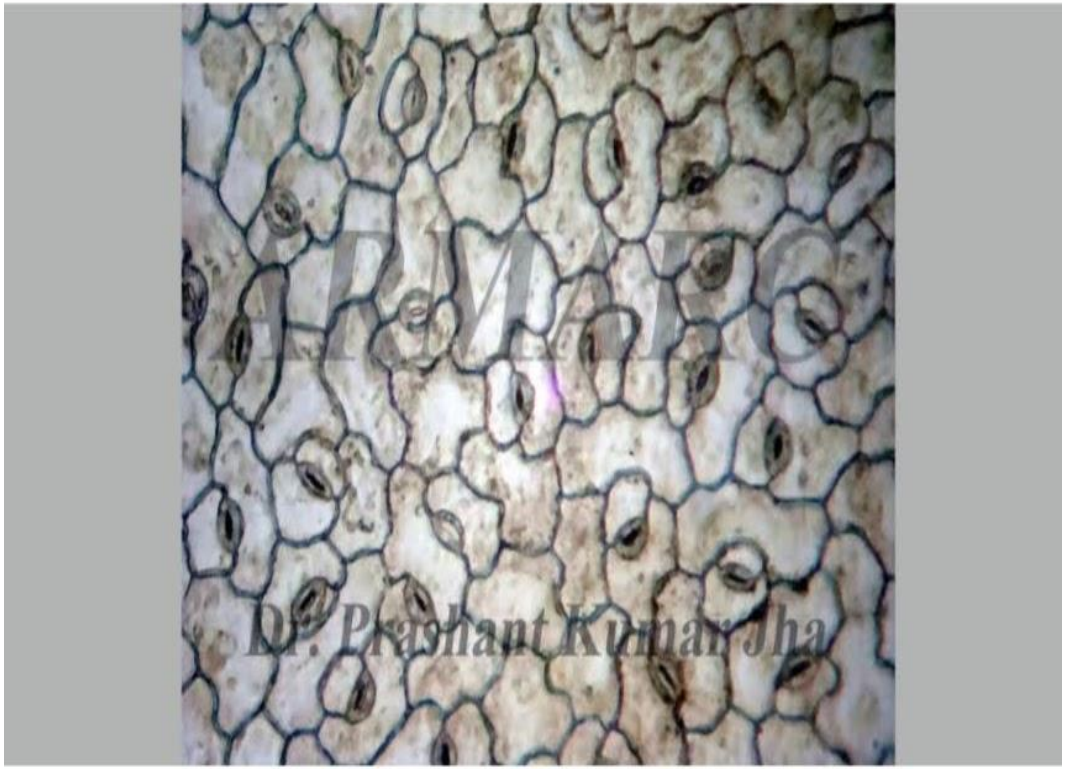
Paracytic stomata in *Ixora coccinea* L.




paracytic stomata
Isenna
paracytic stomata
www.pharma-board.com

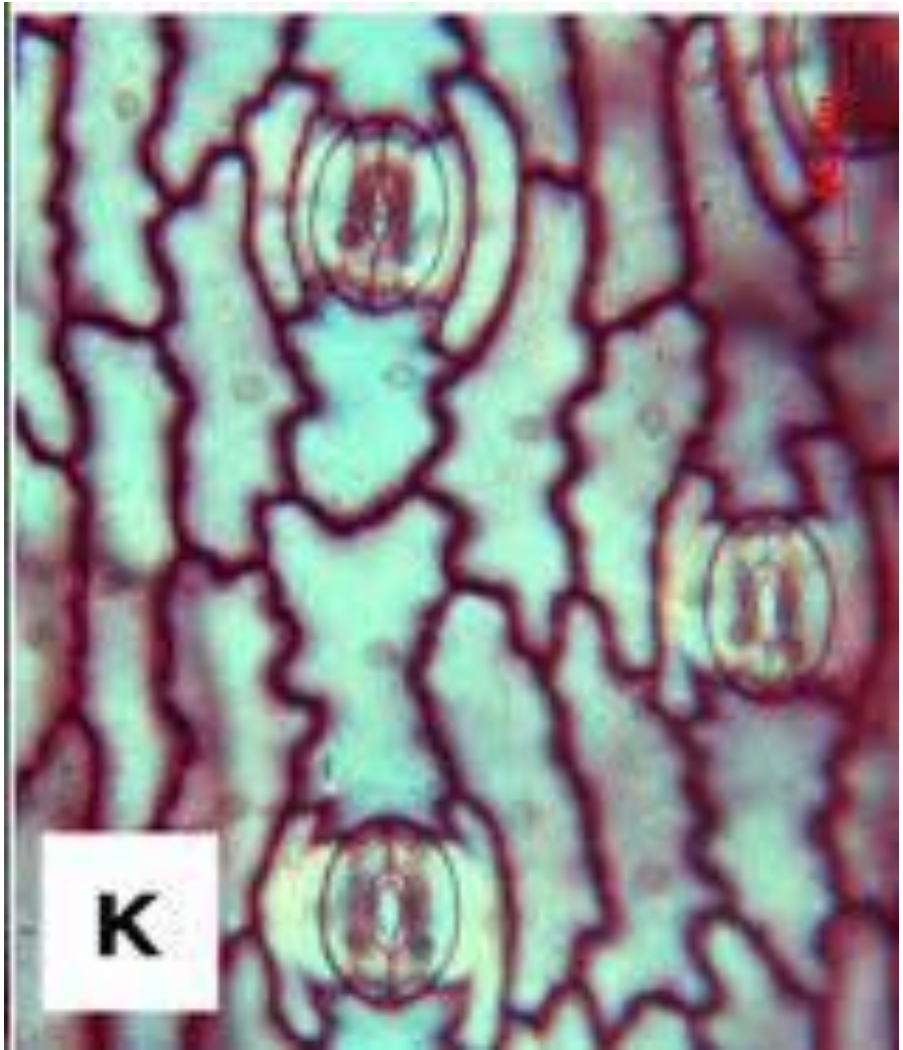


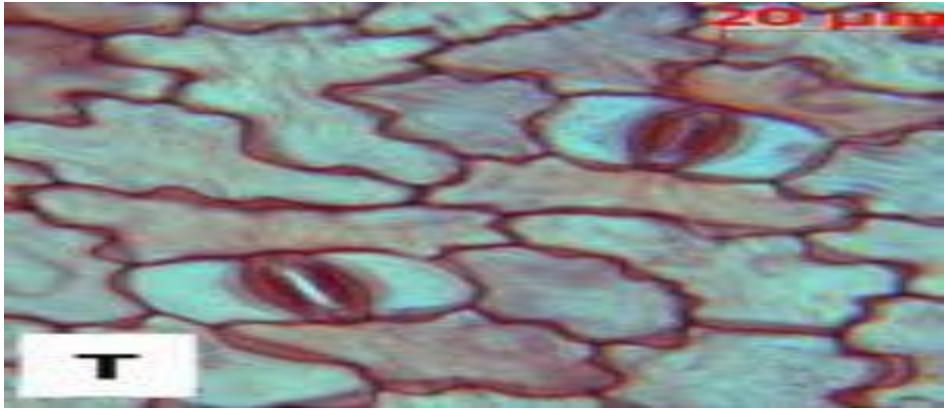


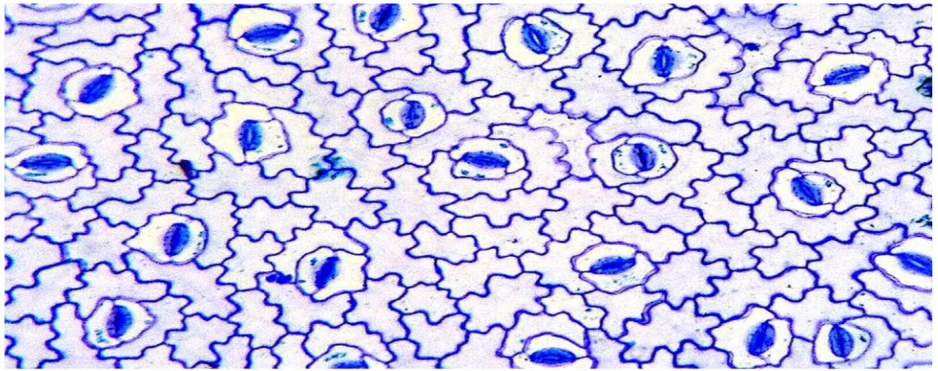


Paracytic

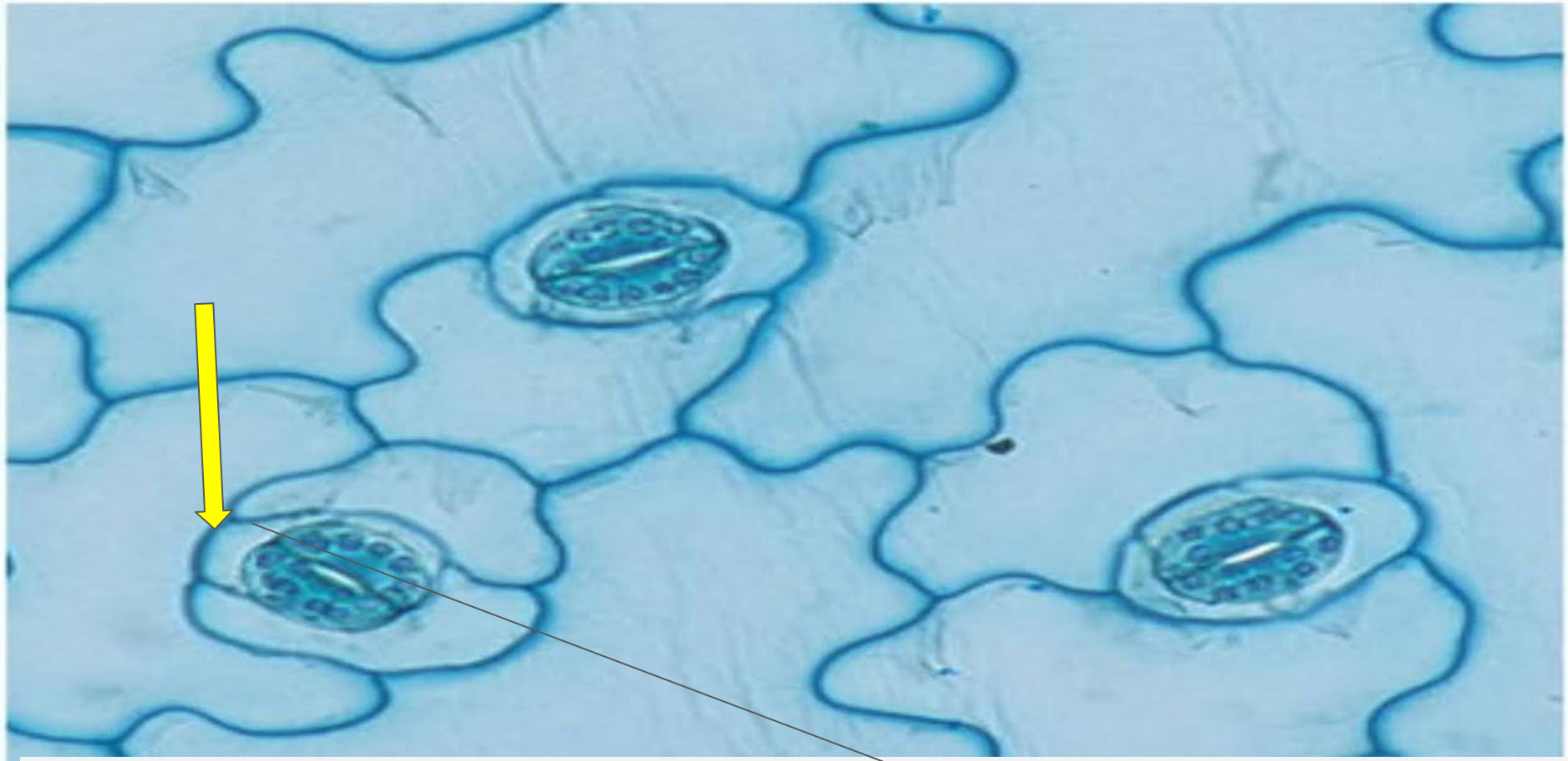
stomata, Cassia tora



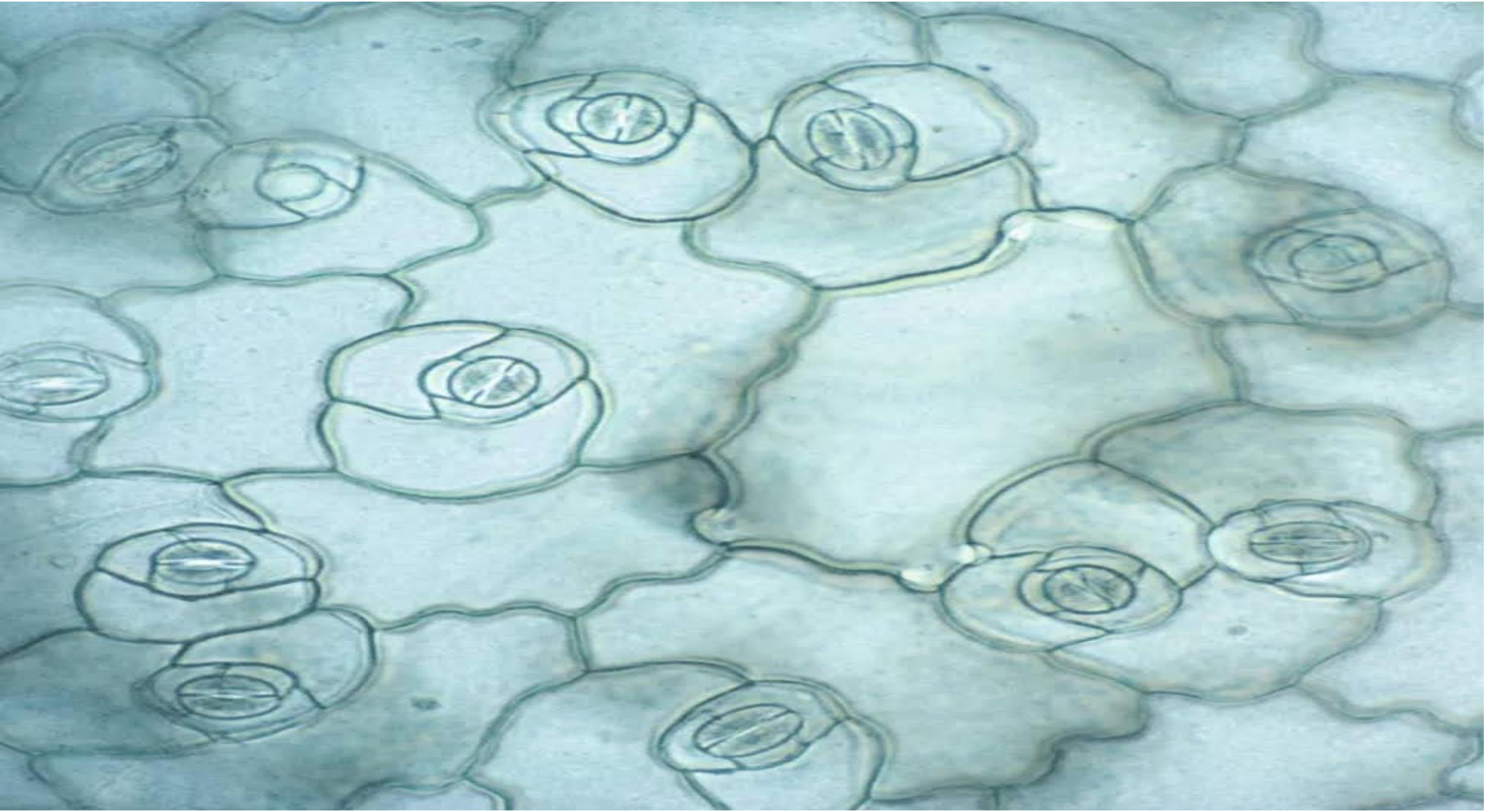


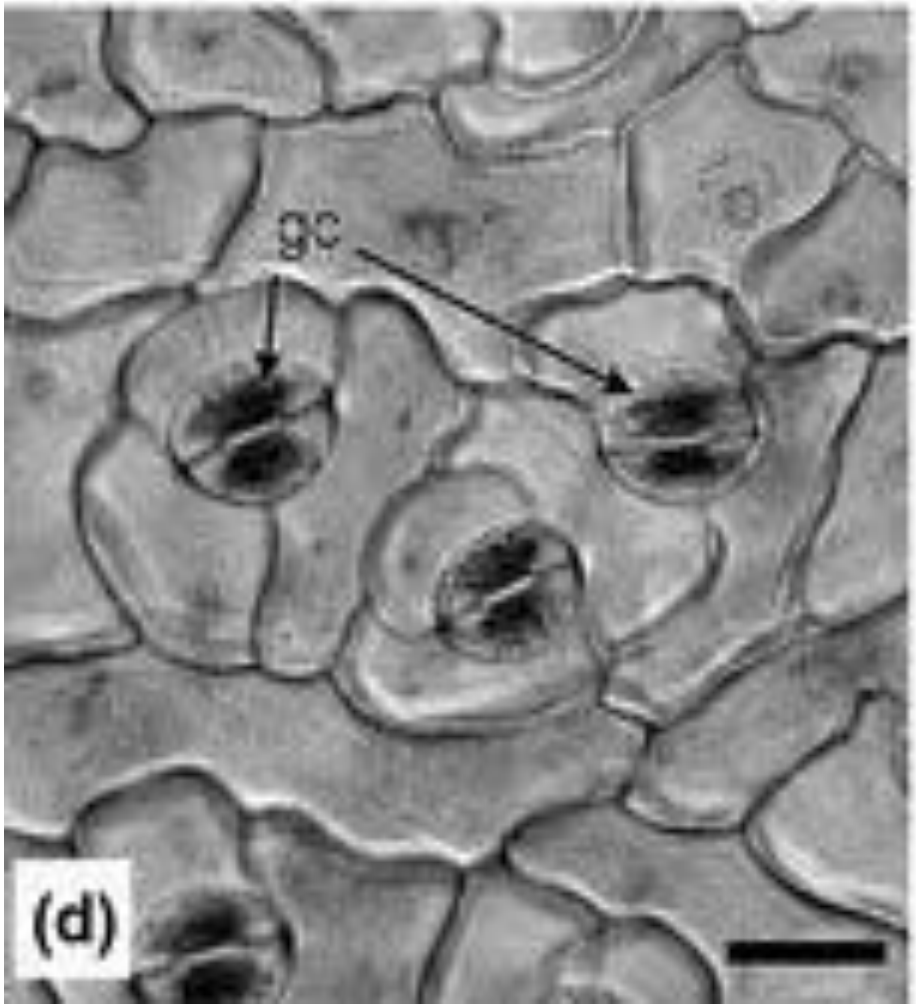


PARACYTIC STOMATA ;
SUBSIDIARY CELLS PARALLAL TO THE GUARD CELLS.



ANISOCYTIC STOMOTA ,of the three SUBSIDIARY cells, one is distinctly smaller than the other two.

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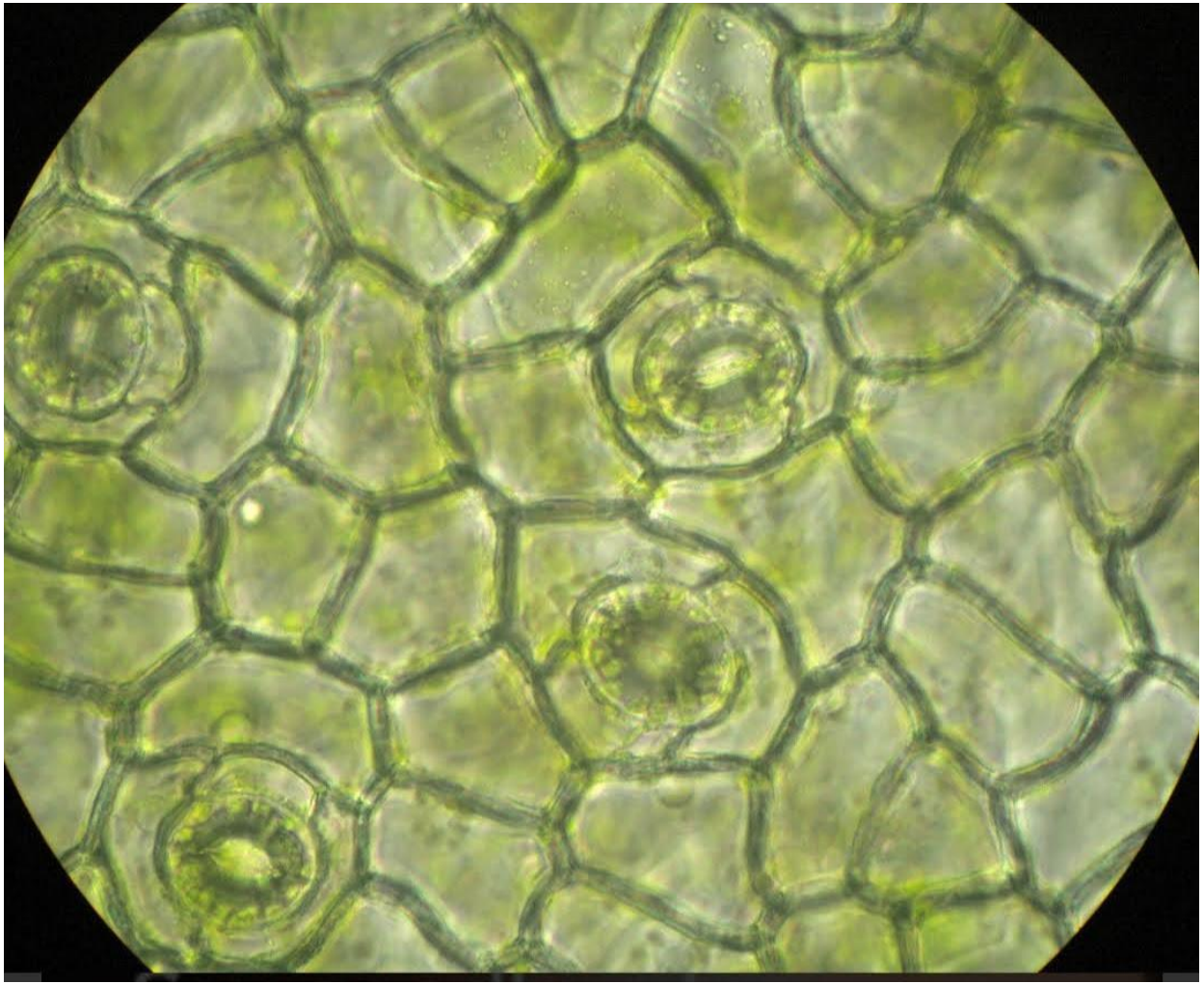
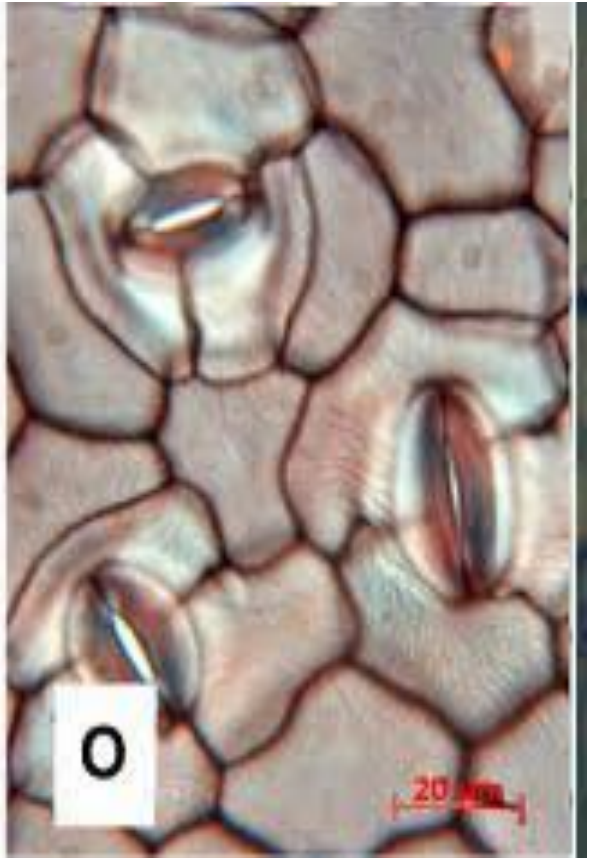
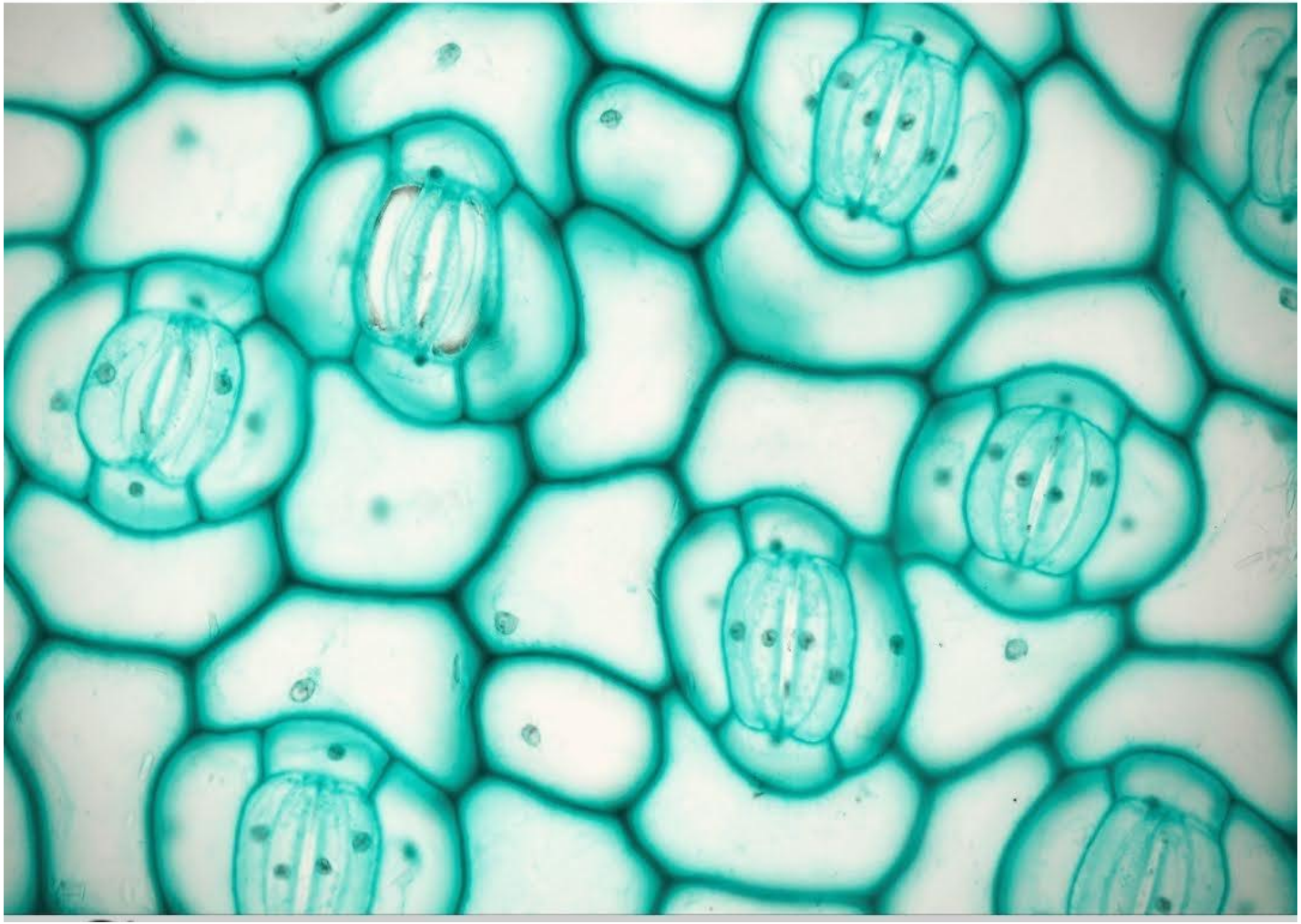




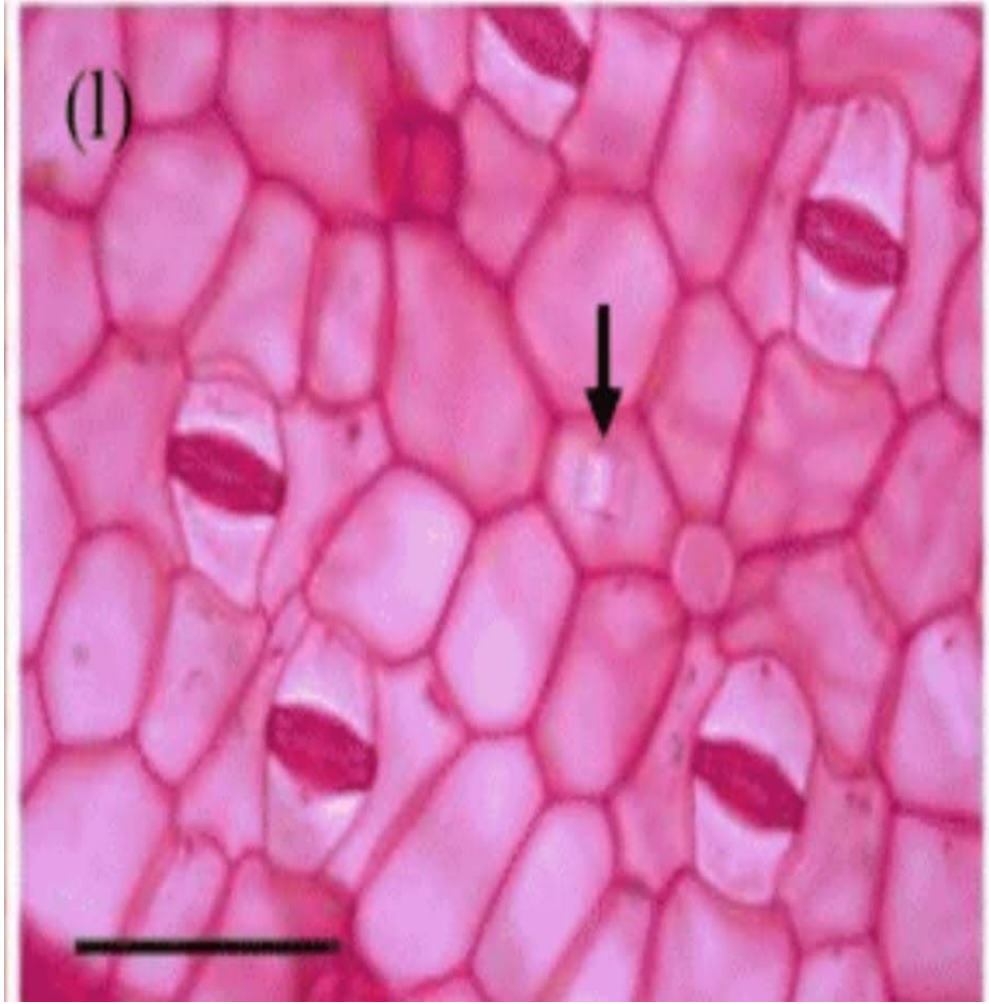
ANISOCYTIC STOMATA.



TETRACYTIC STOMATA

In addition to gramineous stoma Metcalfe (1961) described a new stomatal type in monocotyledons. It is termed tetracytic where the guard cells are surrounded by four subsidiary cells —two laterals and two polar, each being present on the four sides. The two laterals lie parallel to guard cell. The two polar subsidiary cells are often smaller.

Tetracytic stoma characterizes numerous monocotyledonous families. It is also reported from dicotyledons, e.g. Tilia and some members of Asclepiadaceae. The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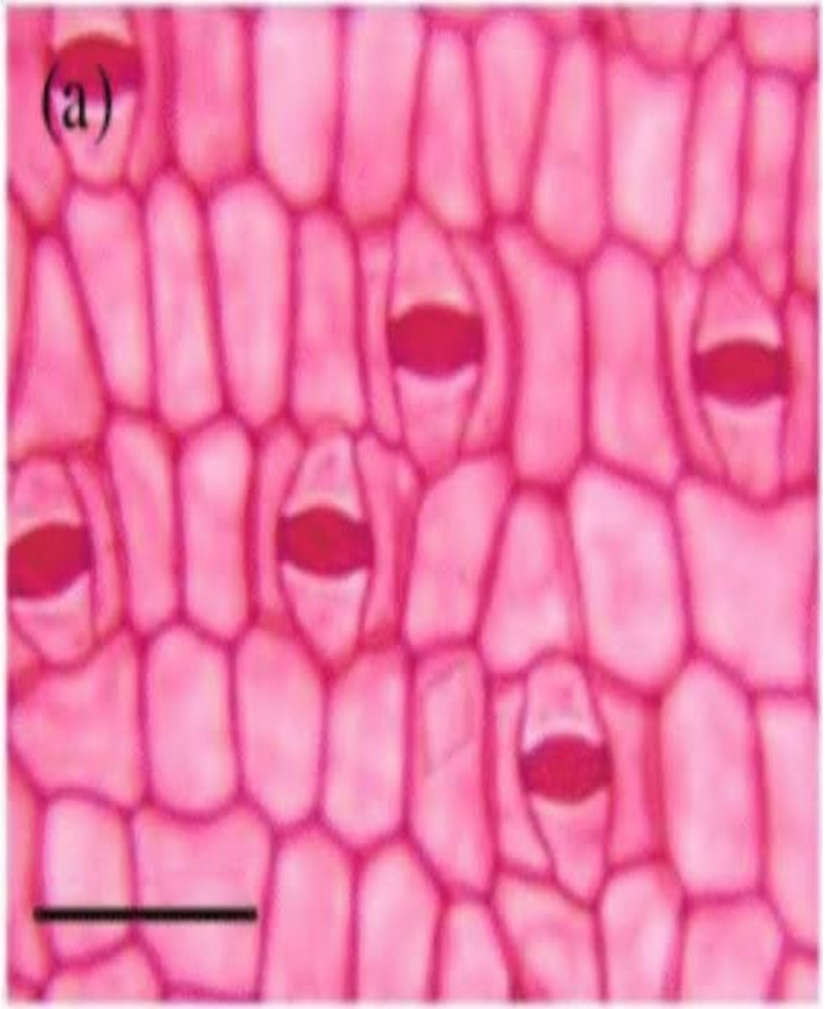
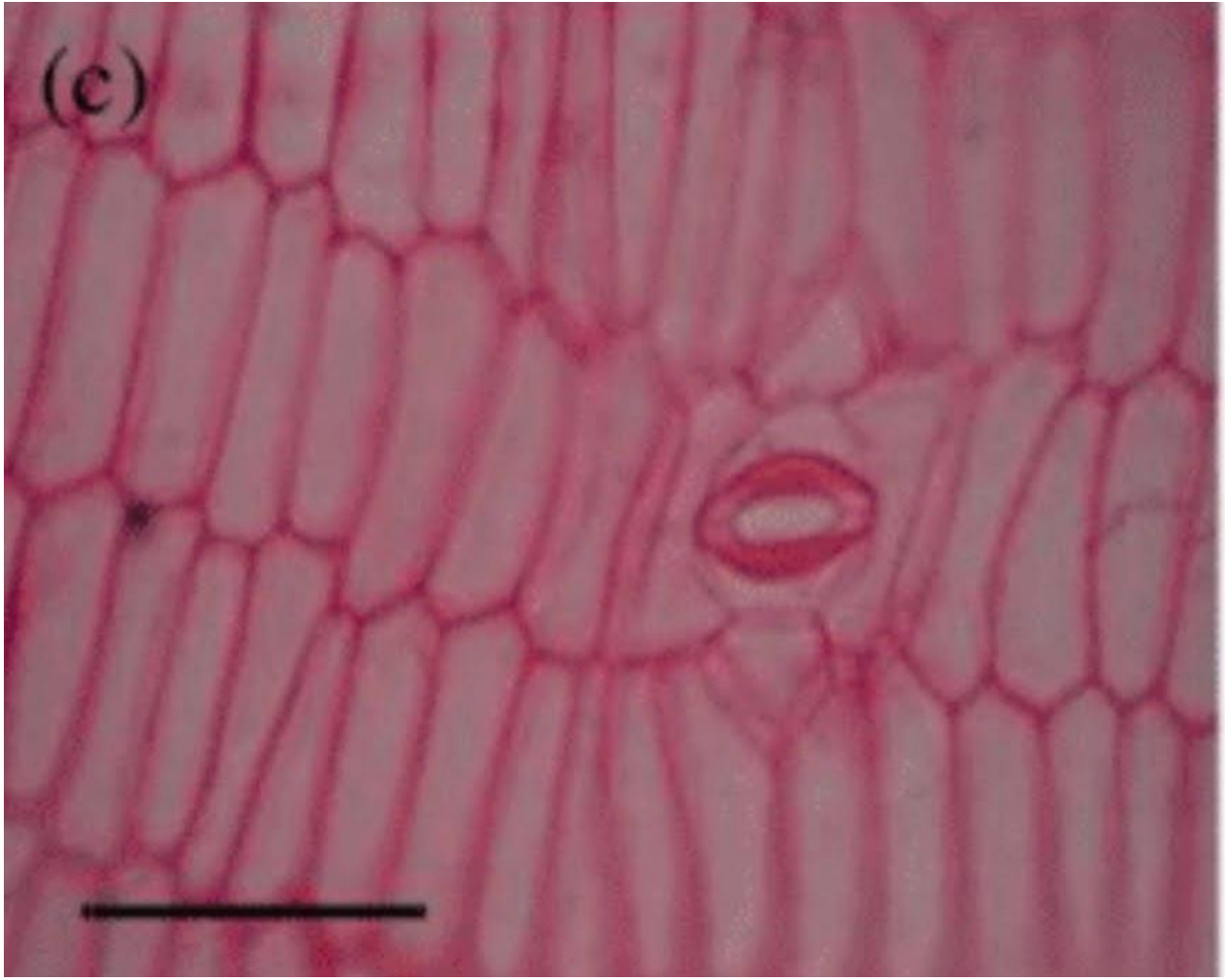

(a)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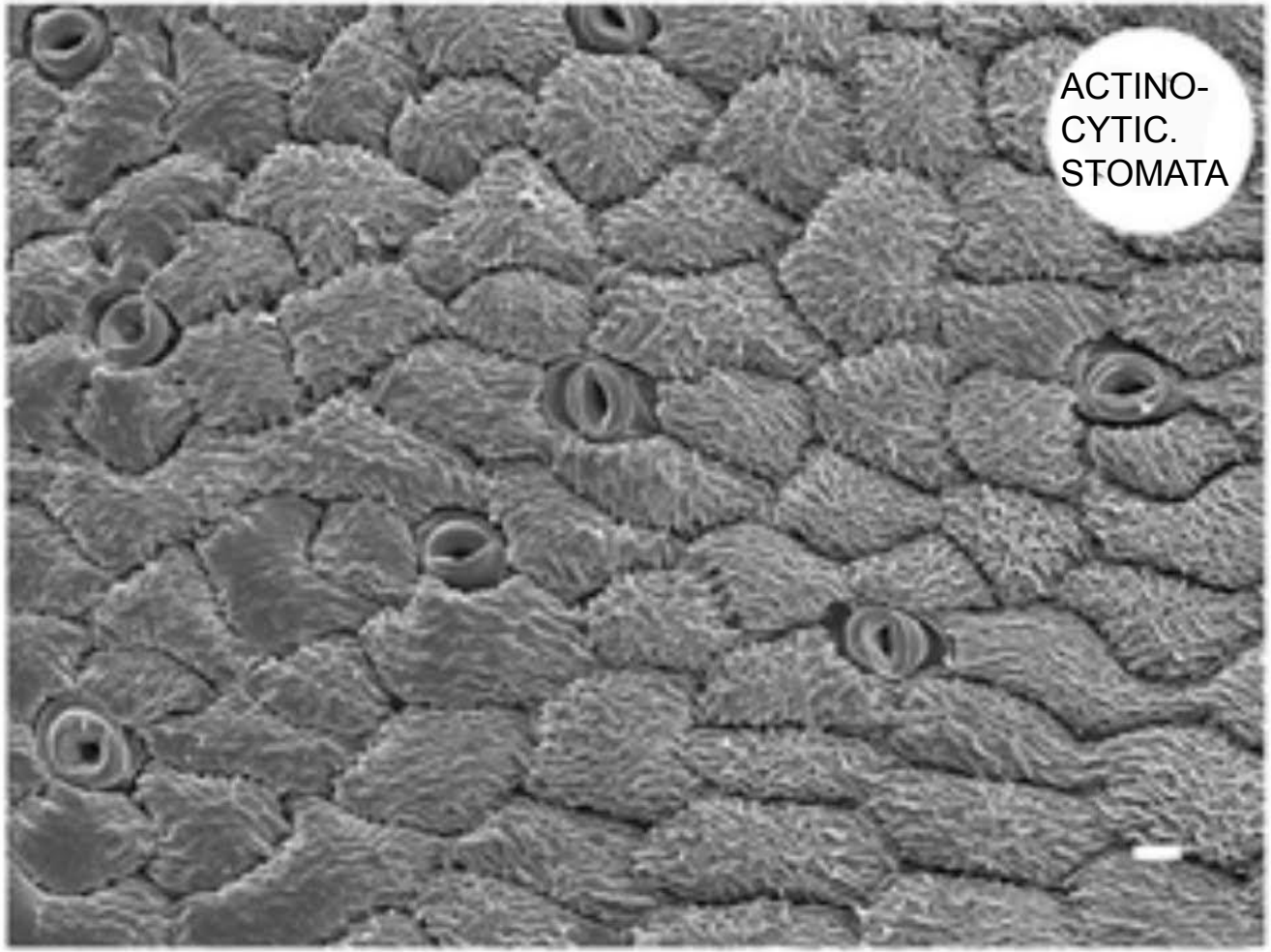
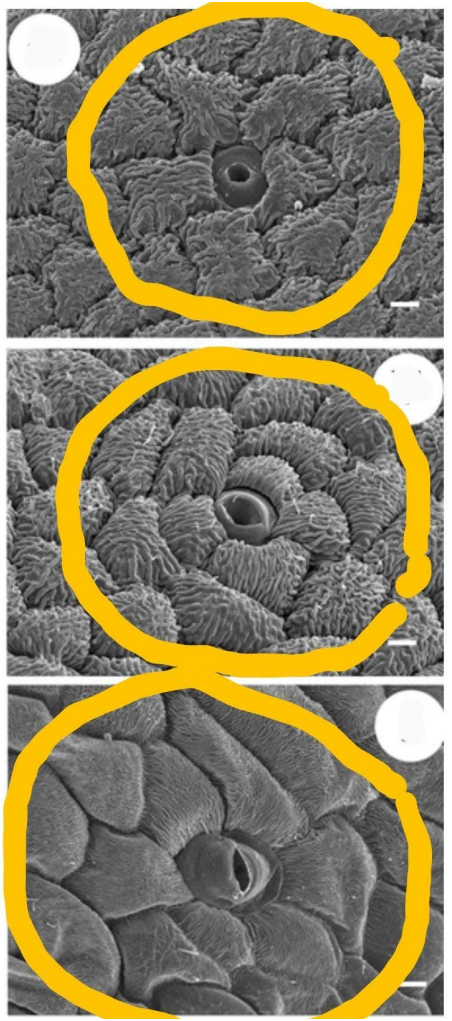
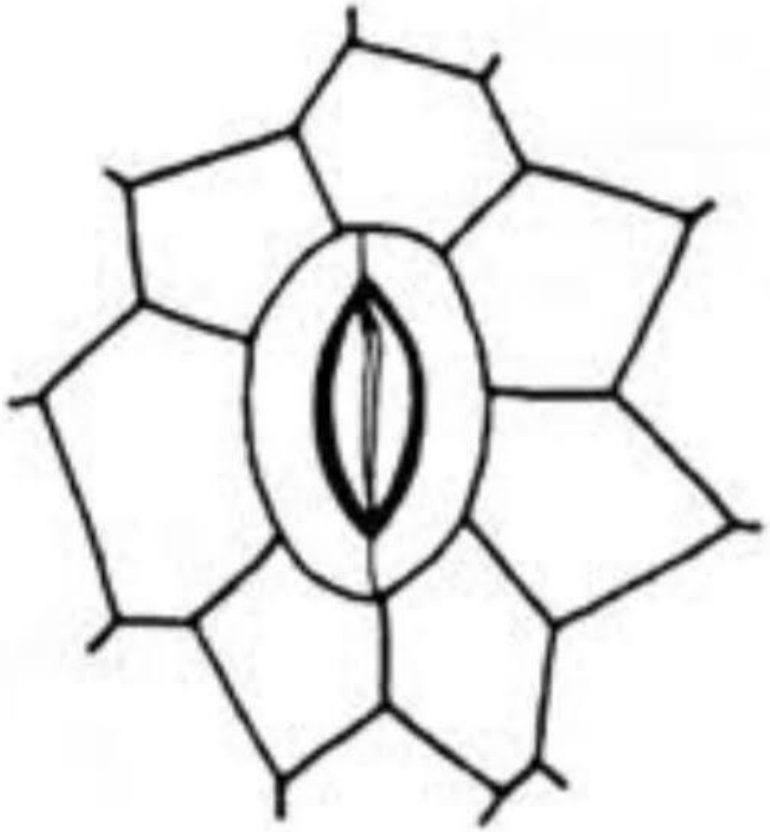

ACTINO-
CYTIC.
STOMATA

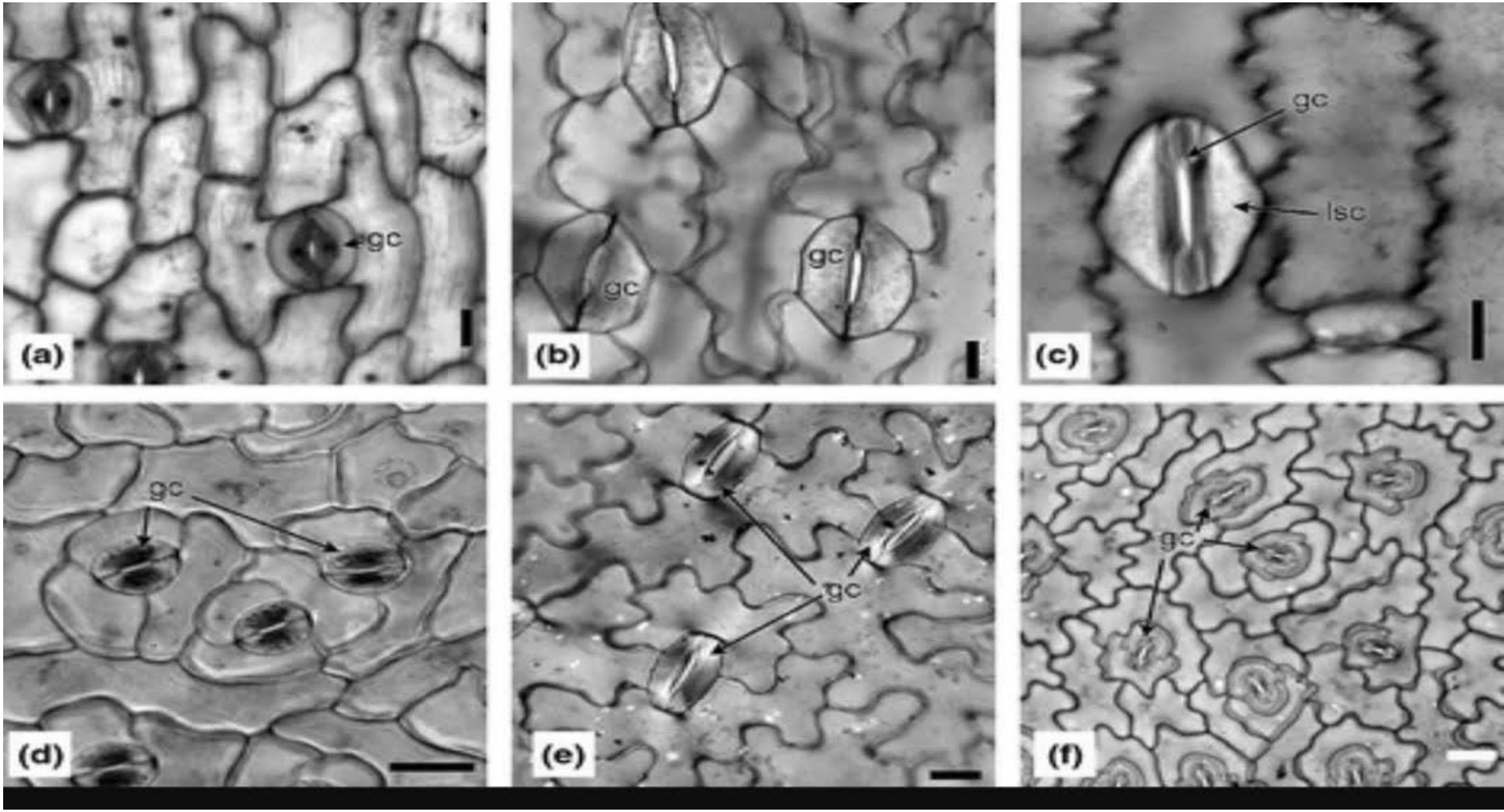




Lannea – actinocytic

5. Actinocytic: These stomata are surrounded by four or more subsidiary cells, elongated radially to the stomata.

Example: Araceae, Musaceae, Commelinaceae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(a)
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1. Anomocytic (irregular celled) or Ranunculaceous: In this type, the stomata remains surrounded by limited number of subsidiary cells which are quite alike the remaining epidermal cells.

Example: Ranunculaceae, Malvaceae, Papaveraceae

2. Anisocytic (Unequal celled) or Cruciferous: In this stomata remains surrounded by three subsidiary cells of which one is distinctly smaller than the other two.

Example: *Cruciferacea, Solanum, Nicotiana* etc.

3. Paracytic (Parallel celled) or Rubiaceous: In this type, the stomata surrounded by two subsidiary cells which are parallel to the longitudinal axis of pore and guard cells.

4. Diacytic (Cross celled) or Caryophyllaceous: In this type, the stomata remains surrounded by a pair of subsidiary cells whose common wall is at right angles to the guard cells.

Example: Acanthacea, Caryophyllaceae

5. Actinocytic: These stomata are surrounded by four or more subsidiary cells, elongated radially to the stomata.
Example: Araceae, Musaceae, Commelinaceae

6. Cyclocytic: The stomata are surrounded by four or more subsidiary cells arranged in a narrow ring around the stoma
Example: Palmae, Pandanus, Cyclanthaceae

7. Graminaceous type: The stomatal guard cells are dumb bell shaped. They are surrounded by subsidiary cells which are lying parallel to the long axis of the pore.
Example: In the members of Poaceae and cyperaceae

In addition to gramineous stoma Metcalfe (1961) described a new stomatal type in monocotyledons. It is termed tetracytic where the guard cells are surrounded by four subsidiary cells —two laterals and two polar, each being present on the four sides. The two laterals lie parallel to guard cell. The two polar subsidiary cells are often smaller.

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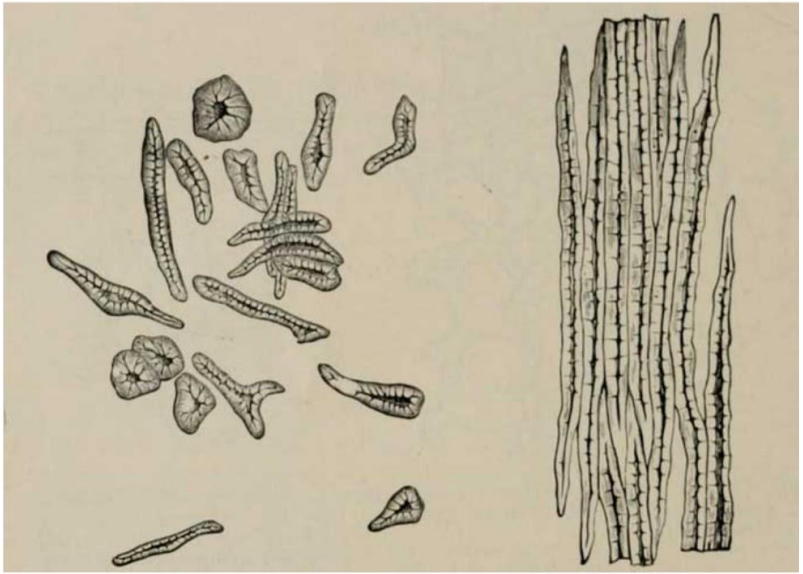
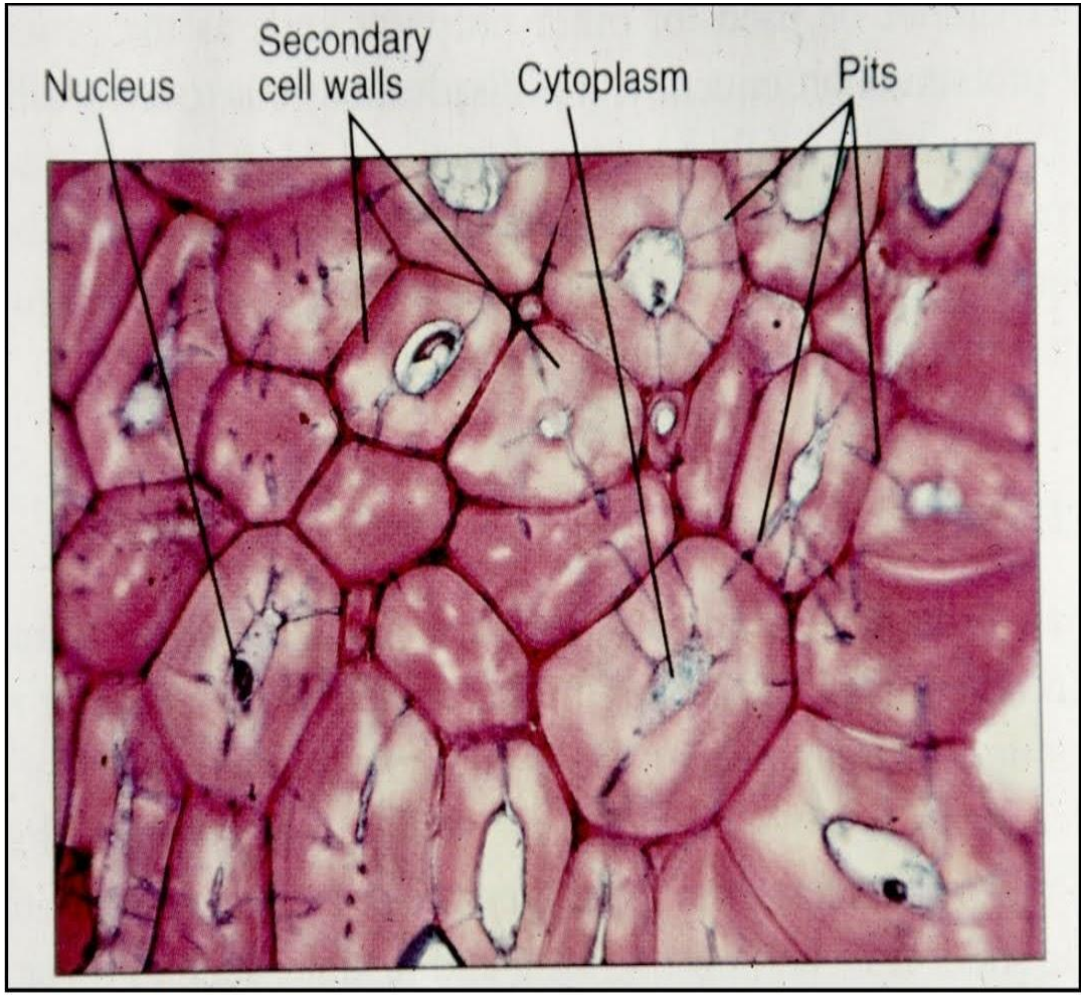
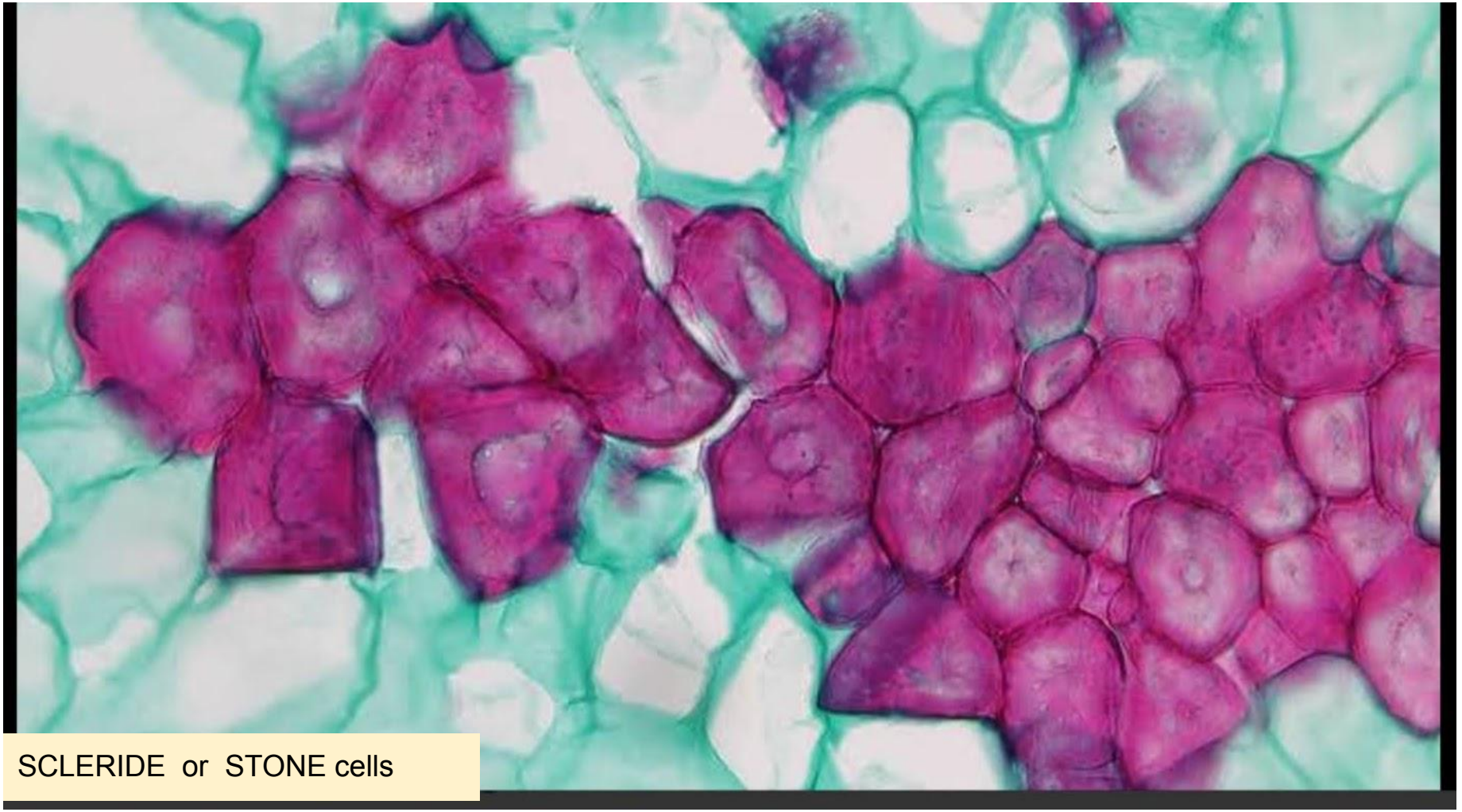


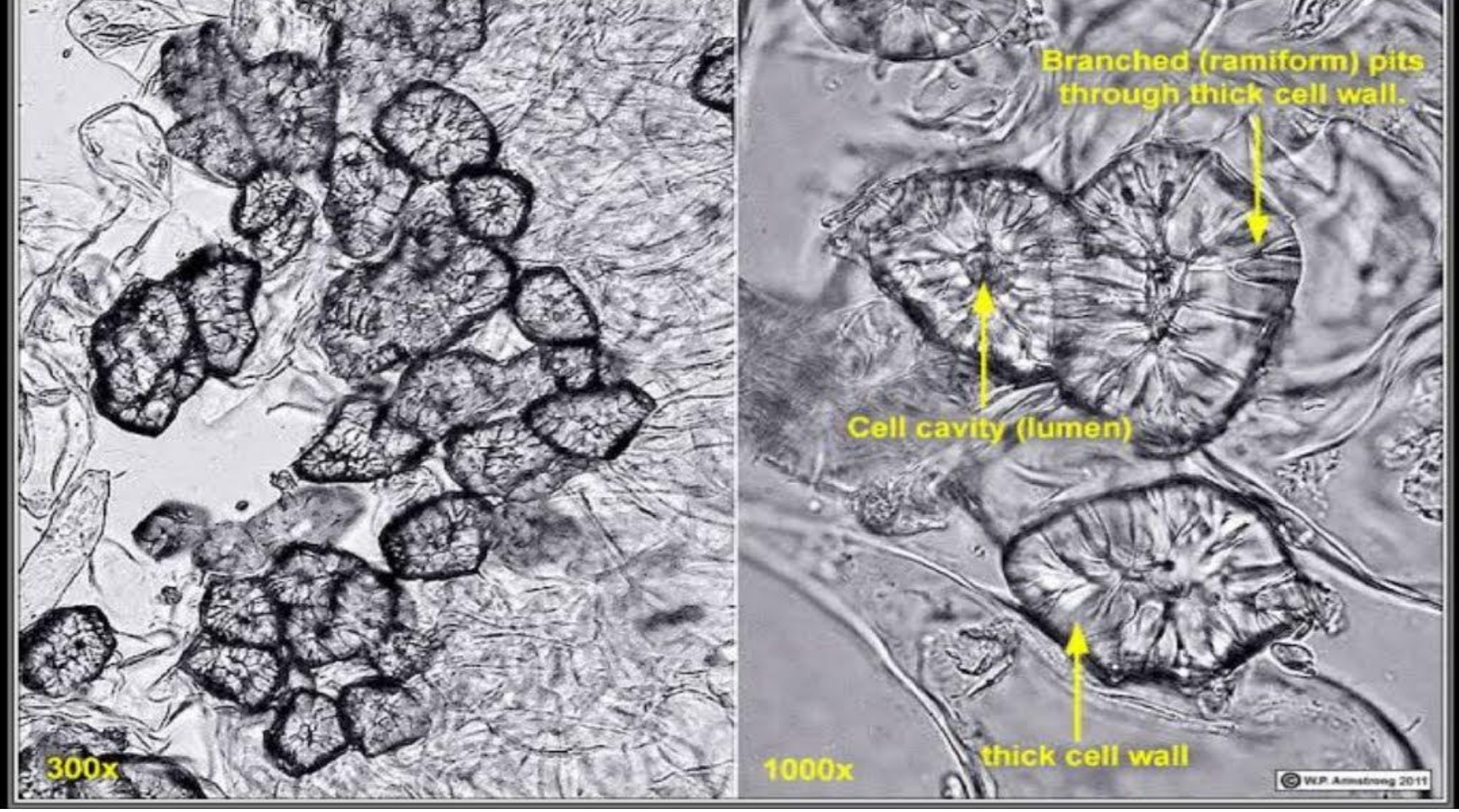
Figure 2.7. Drawings of stone cells from the coconut shell and fiber cells from the bark of *Sambucus nigra*. The microscopy of vegetable foods, with special reference to the detection of adulteration and the diagnosis of mixtures.

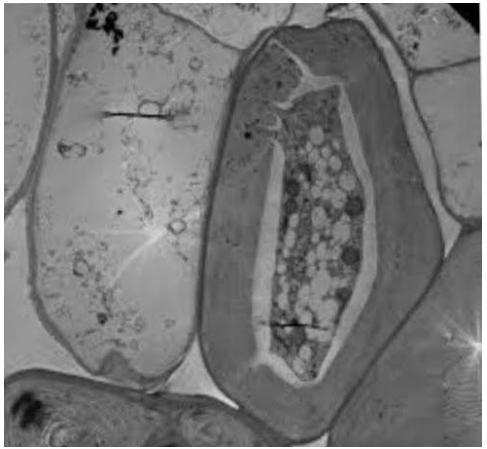


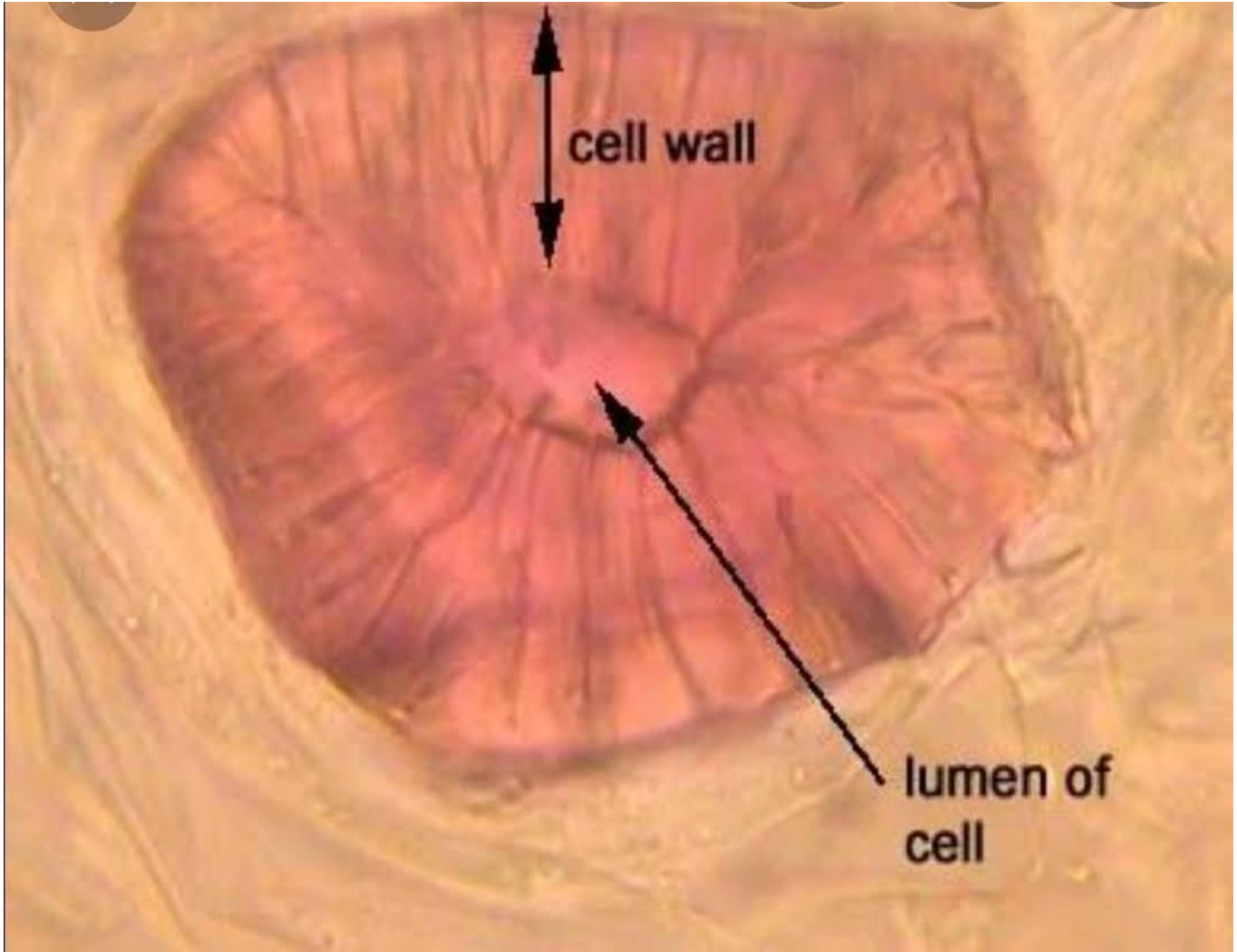
Despite their thick walls, these sclereids remain living and they are intreconnected by pits.



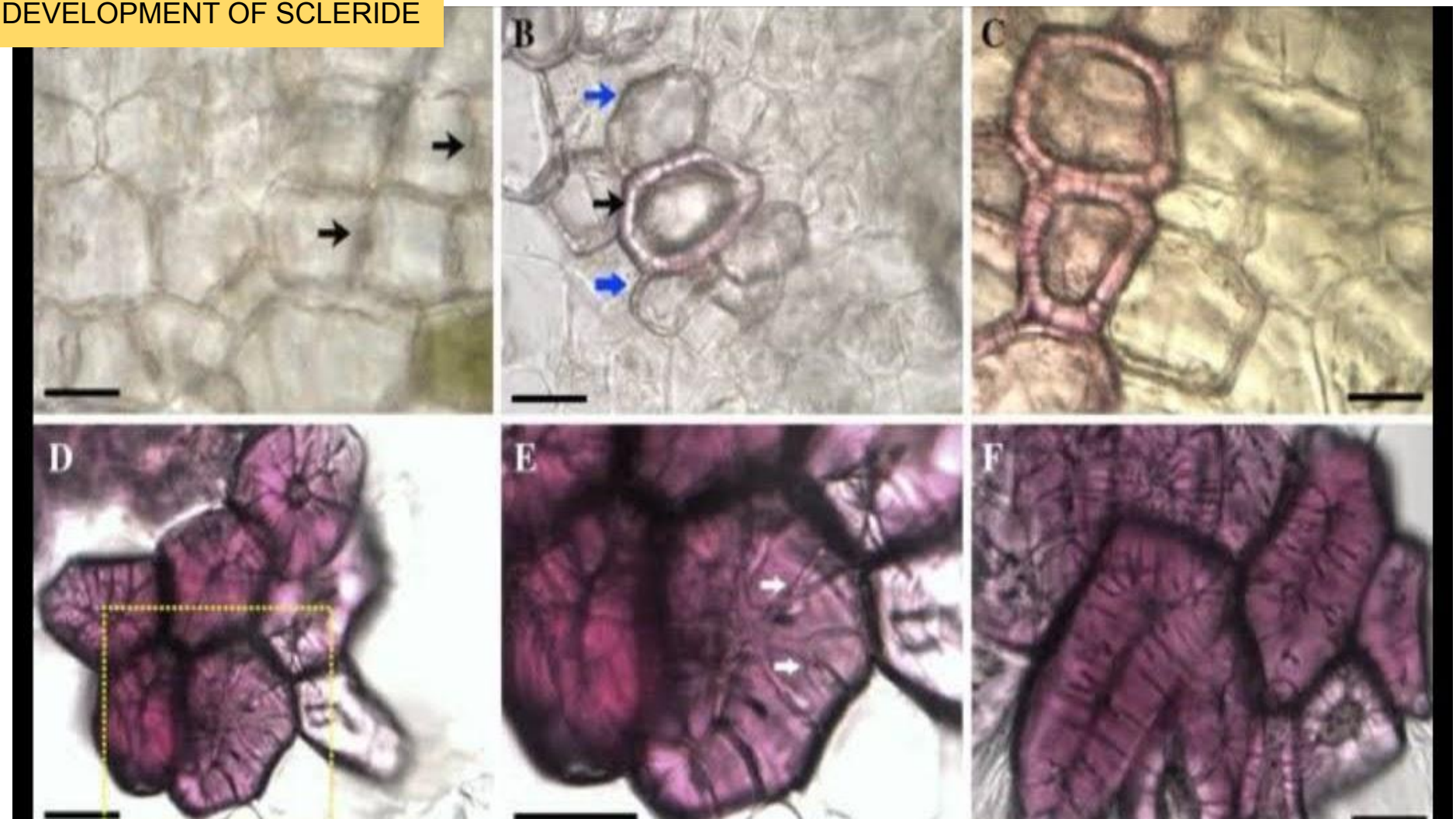
SCLERIDE or STONE cells

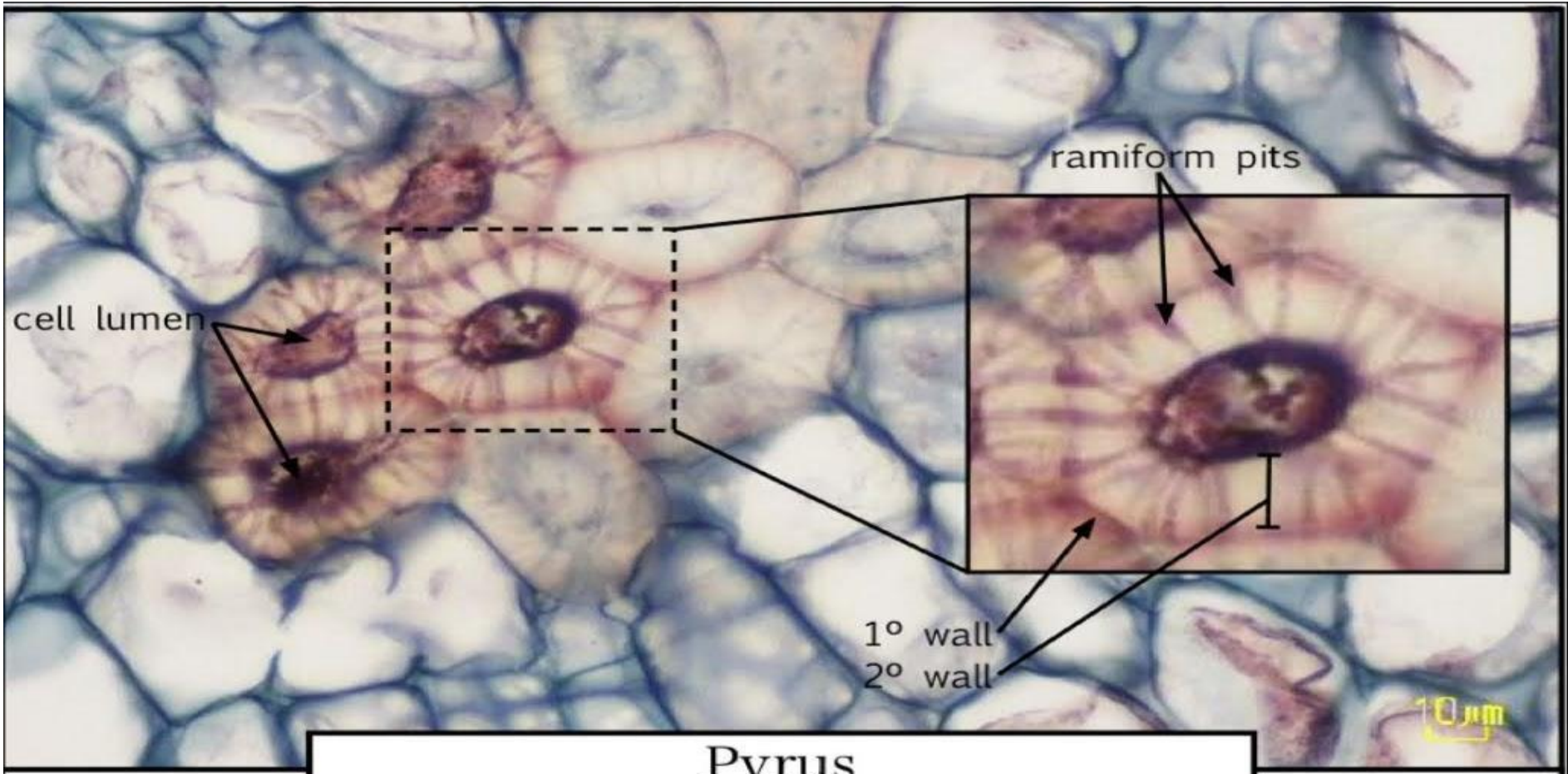

300x
Branched (ramiform) pits through thick cell wall.
Cell cavity (lumen)
thick cell wall
1000x
© W.P. Armstrong 2011




cell wall
lumen of cell

DEVELOPMENT OF SCLERIDE





Pyrus

Dicot | Rosaceae | fruit xs

Sclereids


SCLERIDES

5. Sclerides (stone cells)

Preparation and staining—Either scrapping of the ripe fruits like Guave *(Psidium* sp.) or Pear *(Pyrus* sp.) is made or a thin section of green fruit is cut. It is then mounted in a drop of Aniline sulphate soln.

Comment—(i) The cells are elongated. (ii) The cells are either isodiametric or irregular, thick walled and lignified. (iii) The cell wall shows ramified pits. (iv) The lumen is much reduced. (v) The cells occurring in groups and patches.

Identenfication—*Sclerides.*

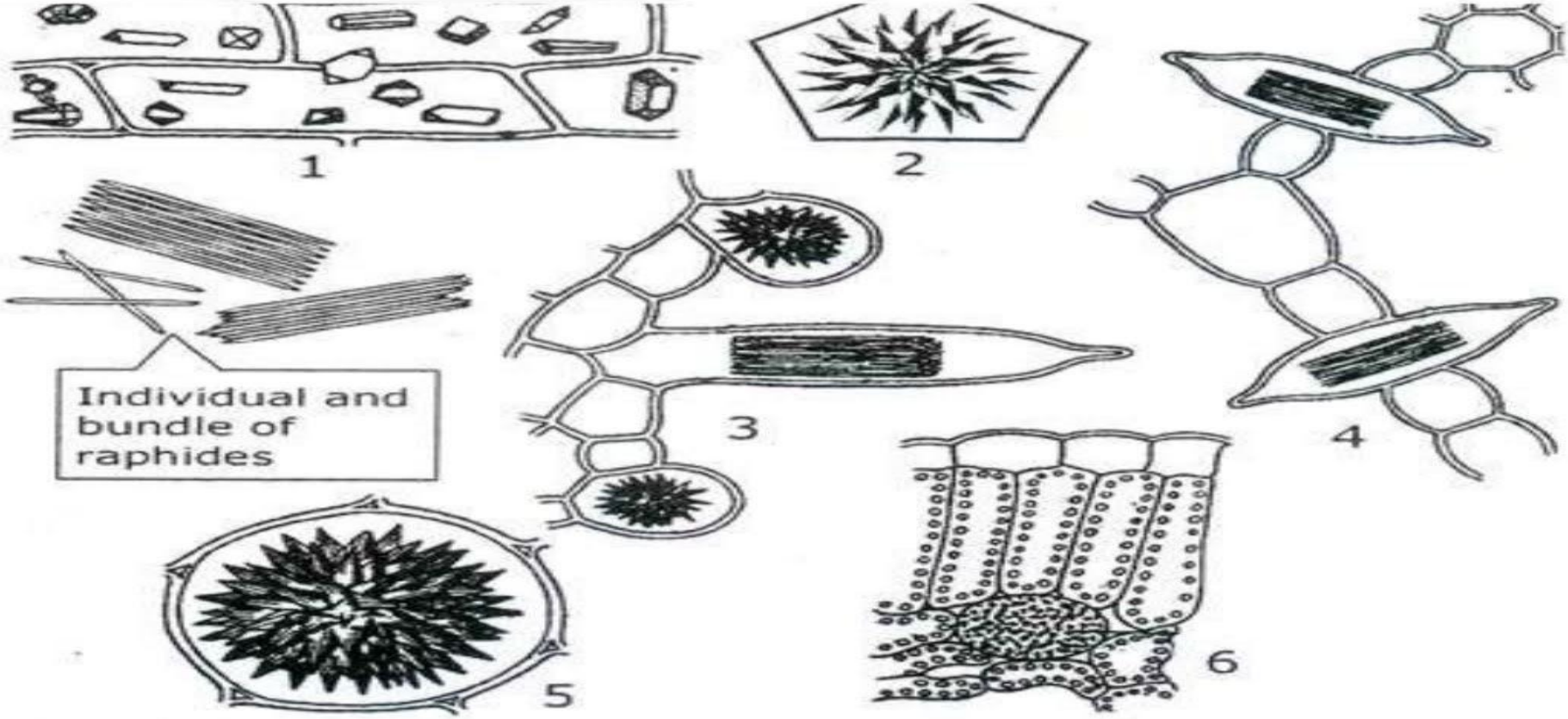
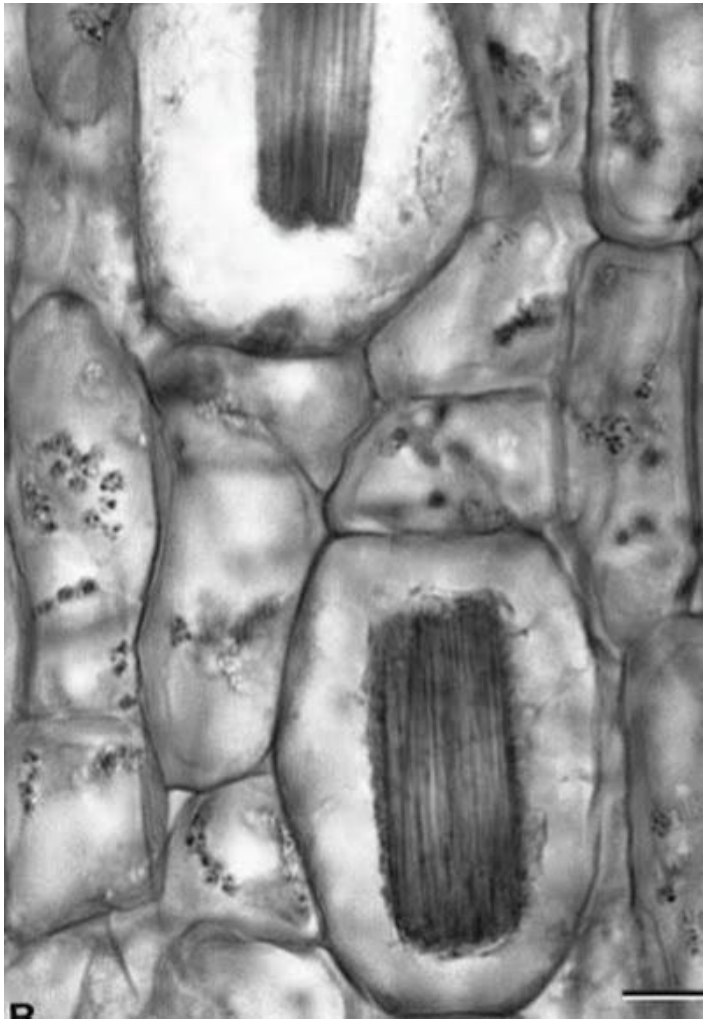
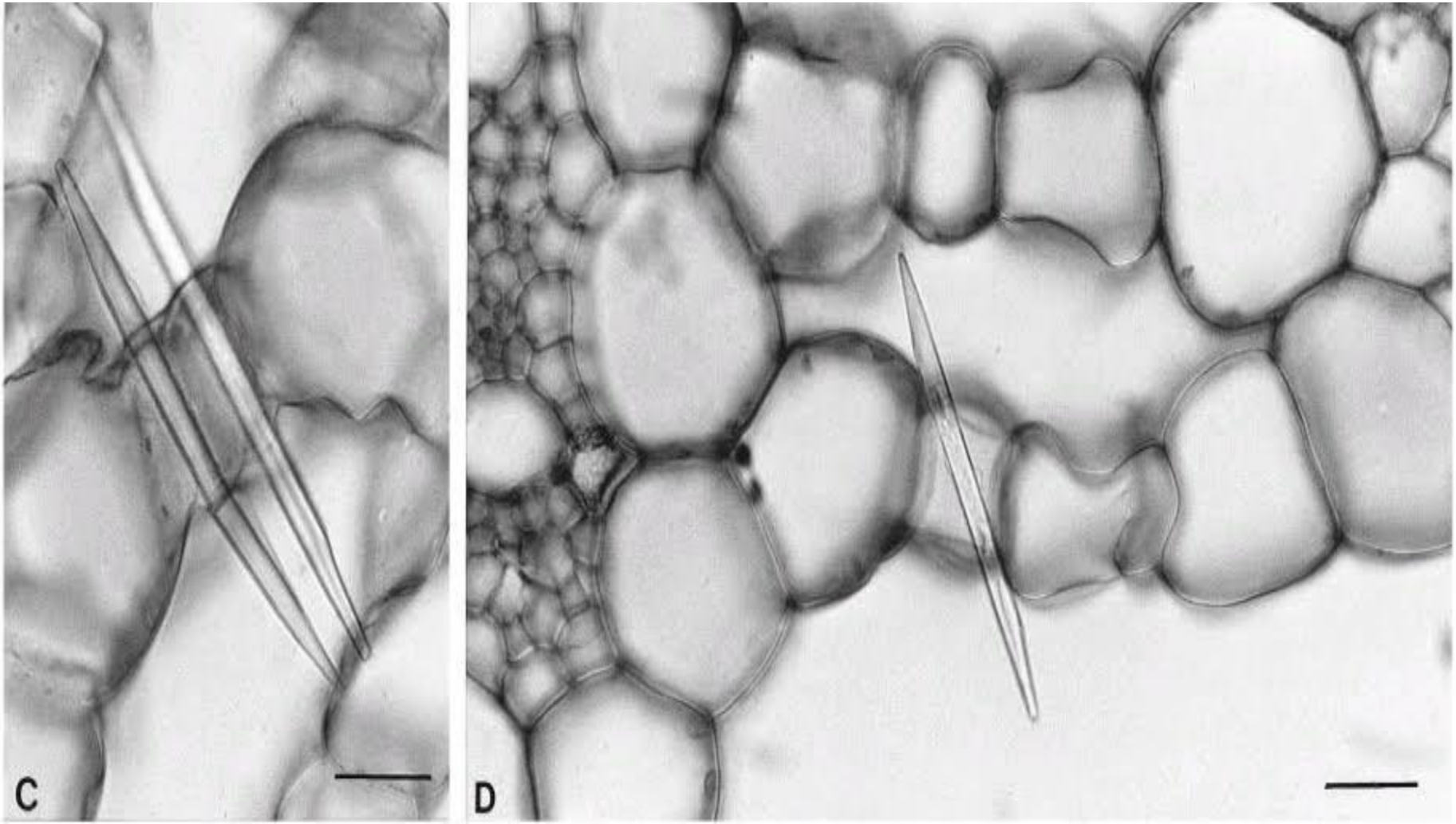


Figure 1.10

Calcium oxalate crystals. 1. Solitary crystals in the tunic of *Allium*. 2. Sphaeraphides in *Nerium* leaf. 3. Raphides and sphaeraphides in the leaf of *Pistia*. 4. Raphides in the petiole of *Eichhornia*. 5. Sphaeraphides in the petiole of *Carica*. 6. Crystal sand in the leaf of *Atropa belladonna*.

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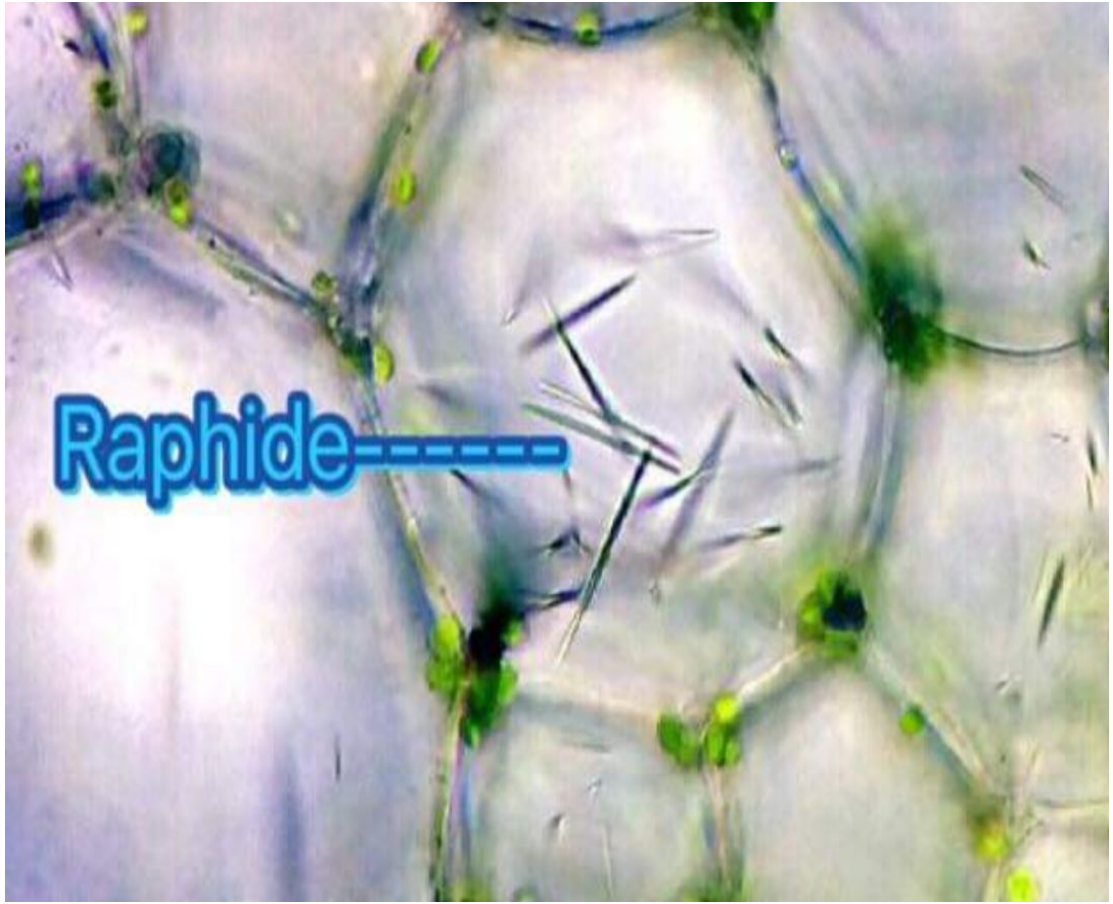
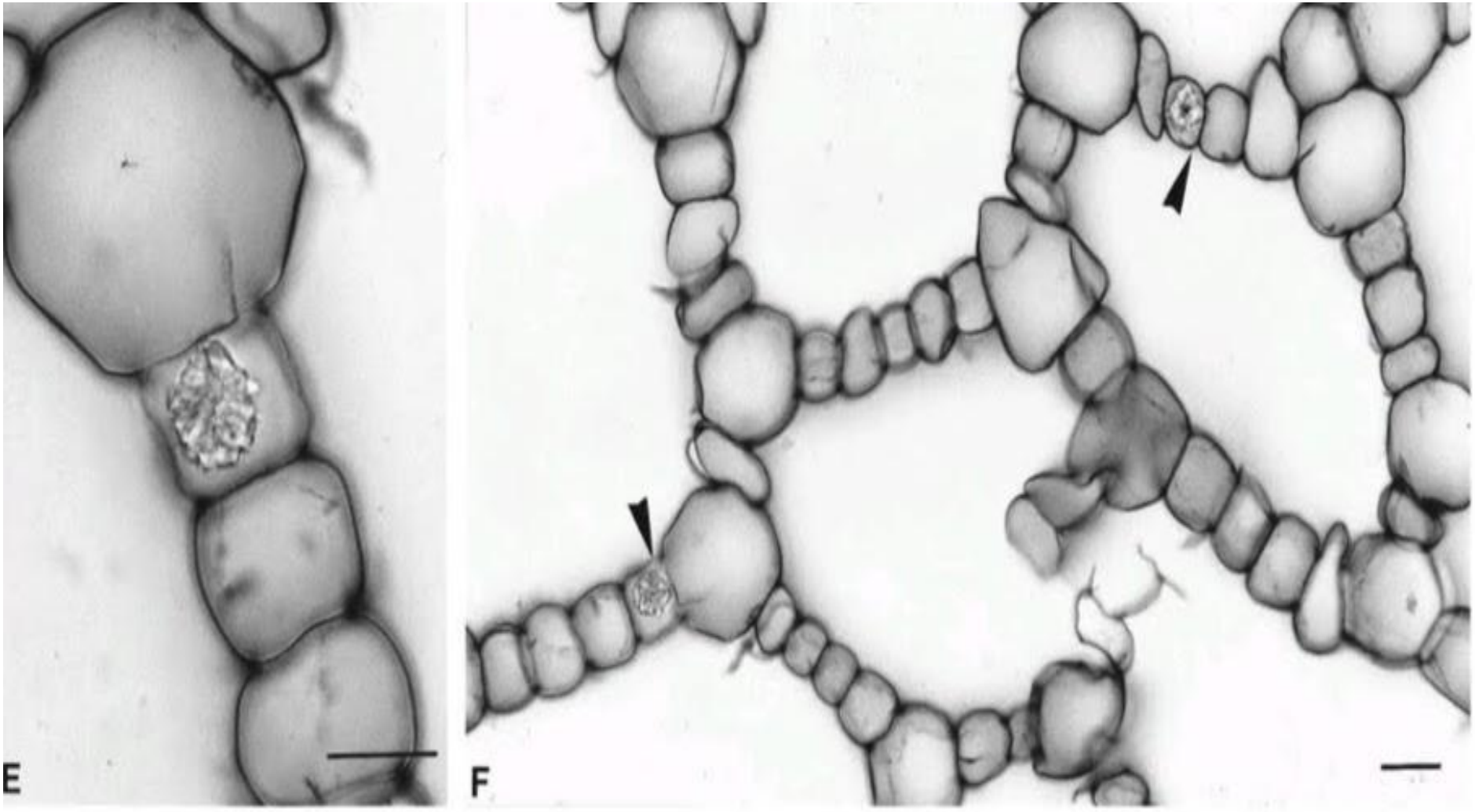
D


Raphide------

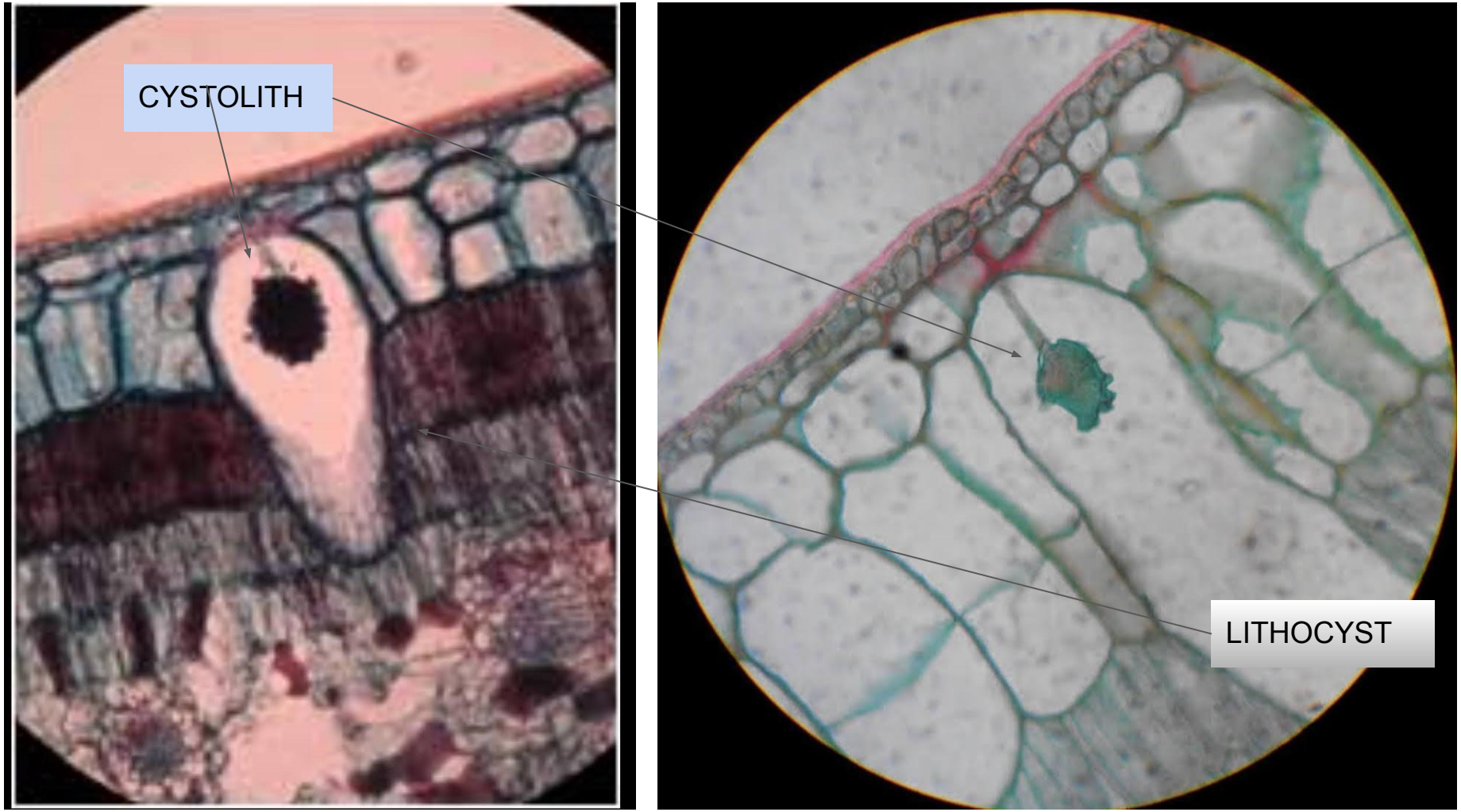

E
F

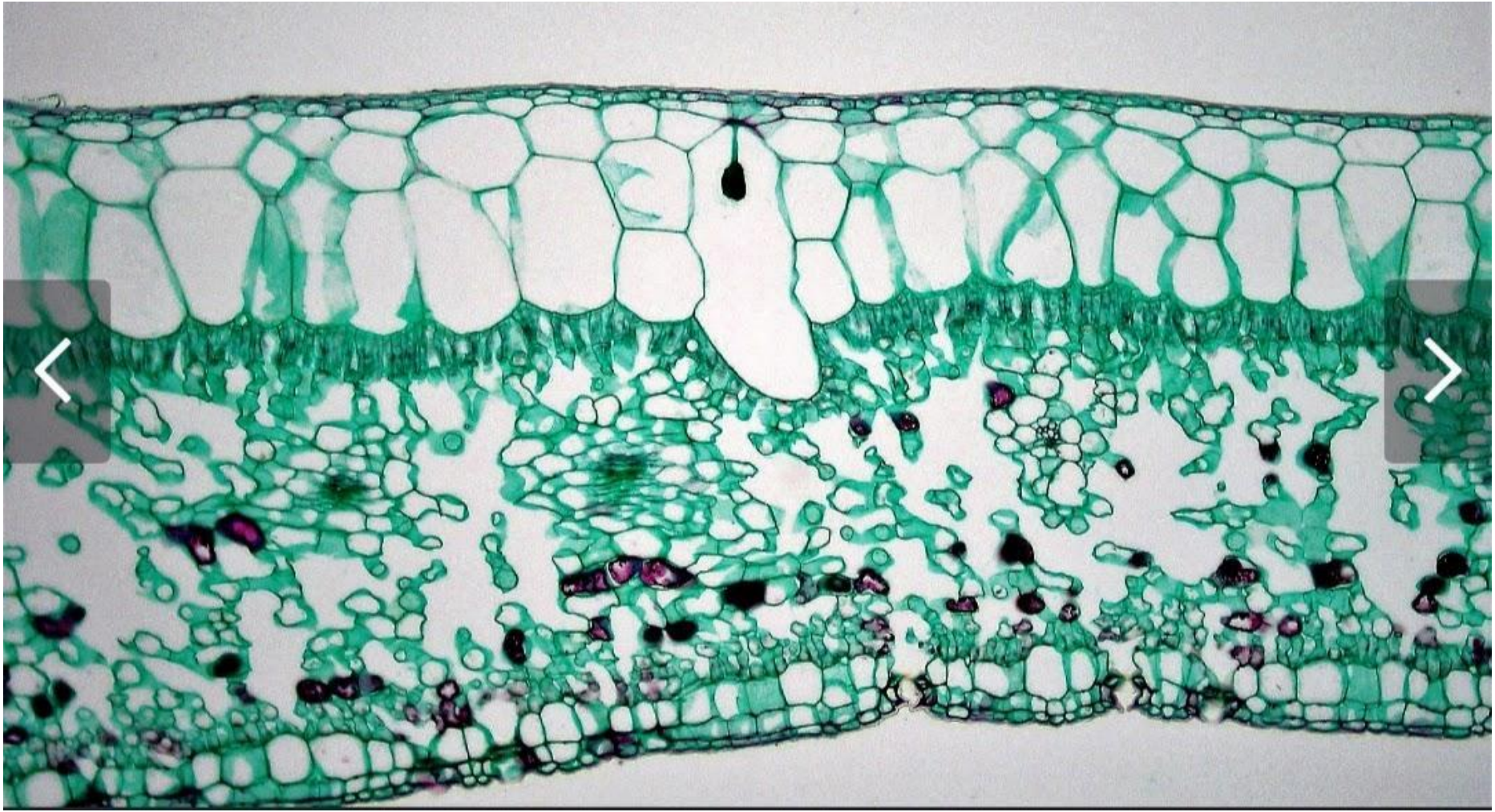
2. Raphides and Sphaeraphides

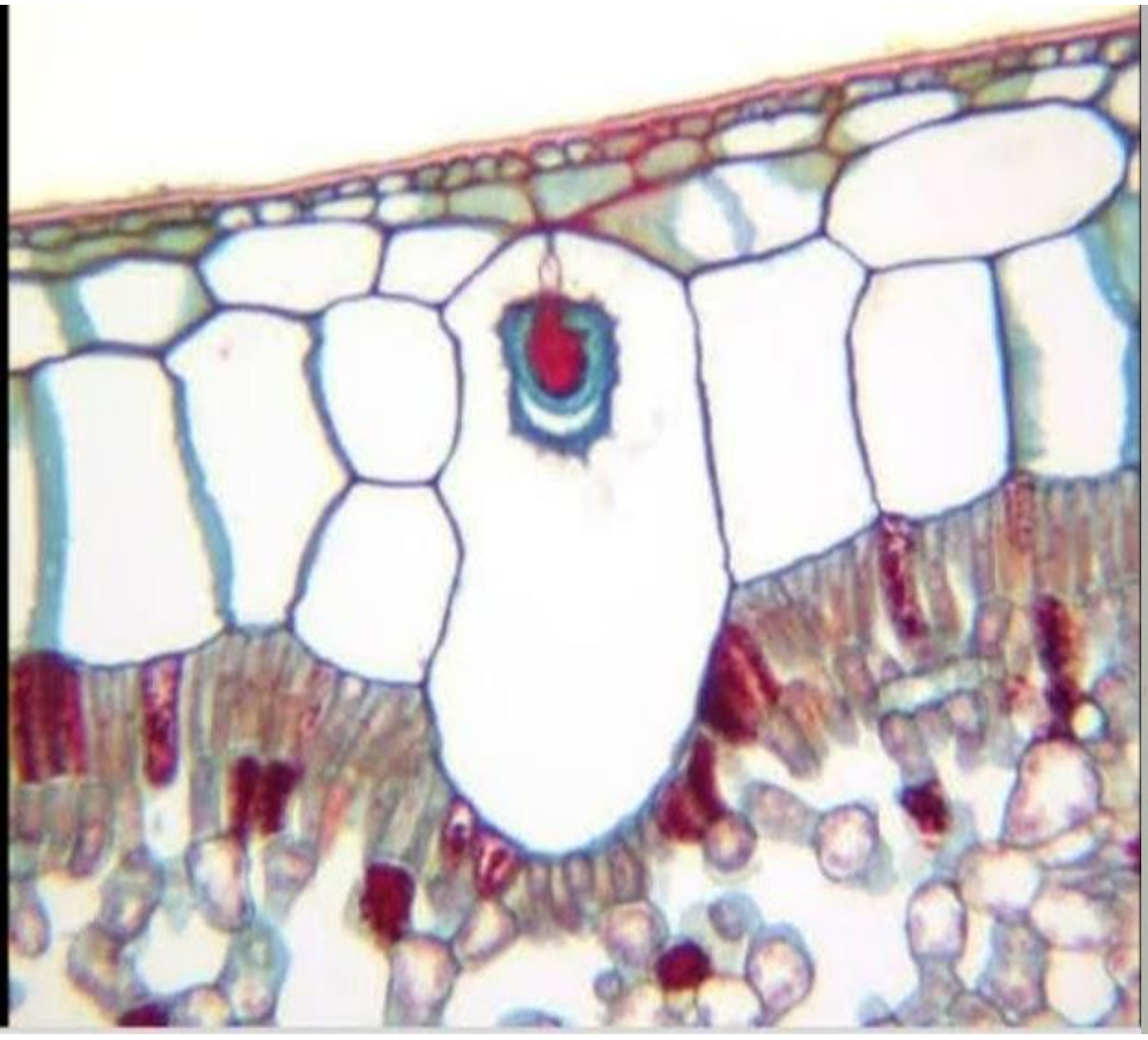
Preparation and staining—A thin T. S. of either Arum (*Colocasia* sp.) petiole or *Pistia* sp. is cut and properly stained with Bismark Brown. The section is then mounted either in glycerine or Canada Balsam.

Comment—(i) It shows a few enlarged cells either boat-shaped or globose. (ii) Boat shaped cells contain calcium oxalate crystals, raphides looking like a bunch of needles. (iii) Globose cells contain star-shaped calcium oxalate crystals, sphaeraphides.

Identification : ***Raphides and sphaeraphides.***


CYSTOLITH
LITHOCYST



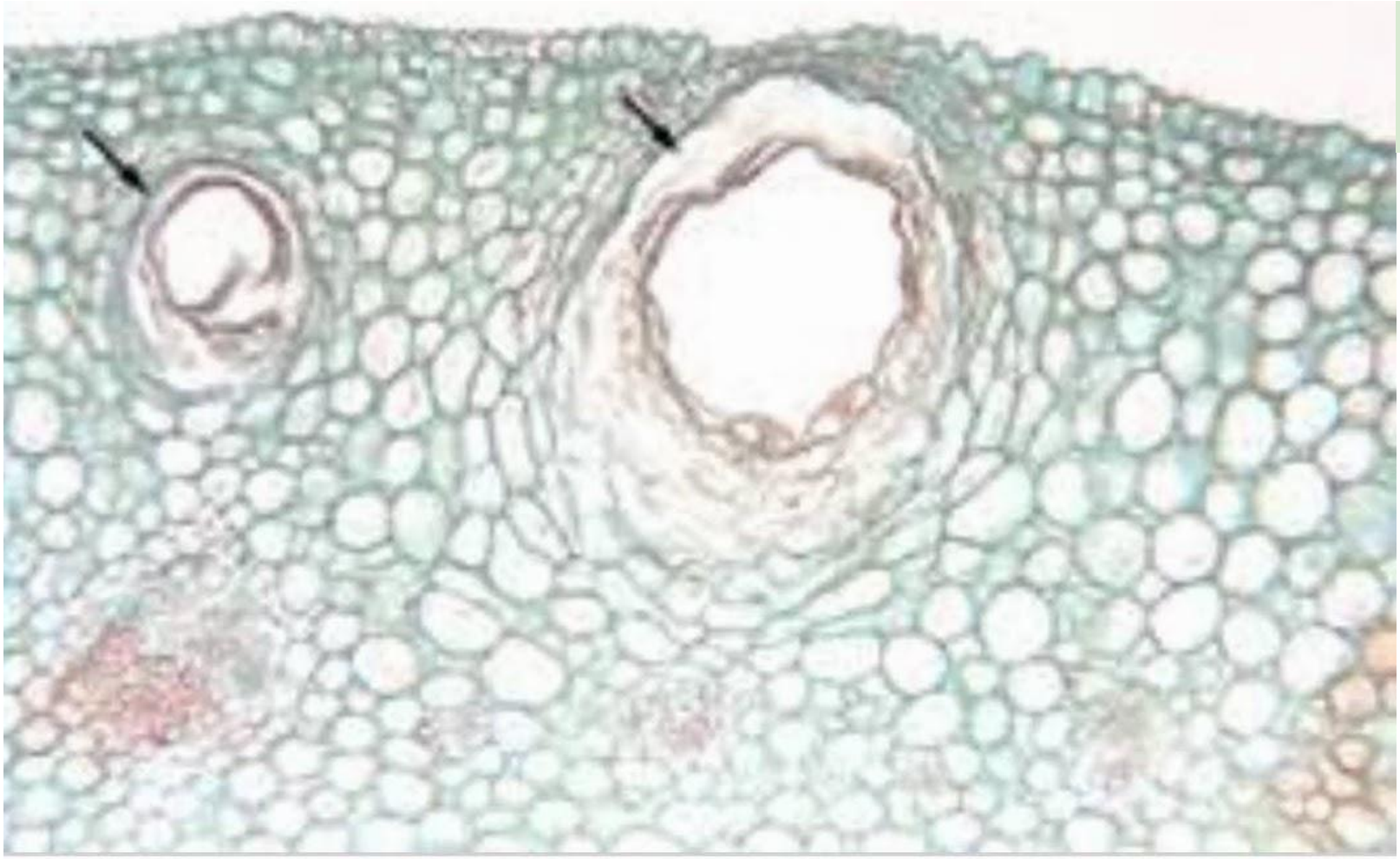


1. Cystolith

Preparation and staining—A thin T. S. of Banyan leaf *(Ficus bengalensis)* is cut and properly stained with Bismark Brown. It is then mounted either in glycerine (for temporary preparation) or Canada Balsam (for permanent preparation).

Comment—(i) The upper epidermis is multiseriate. (ii) Some cells of the innermost layer of upper epidermis are enlarged. (iii) Within the enlarged cells crystals like a bunch of grapes are found hanging from the peg-like projections of the cell wall.

Identification : *Cystolith.*



OIL GLANDS
From
Citrus Rind

7. Oil gland

Preparation—A thin T.S. of rind of Orange (*Citrus sp.*) is cut and mounted in a drop of water.

Comment—(i) The glands are spherical in shape. (ii) The structure has a peripheral layer of thin walled secretory cells. (iii) The cavities are filled up with oil drops.

Identification : *Oil glands.*

HILUM

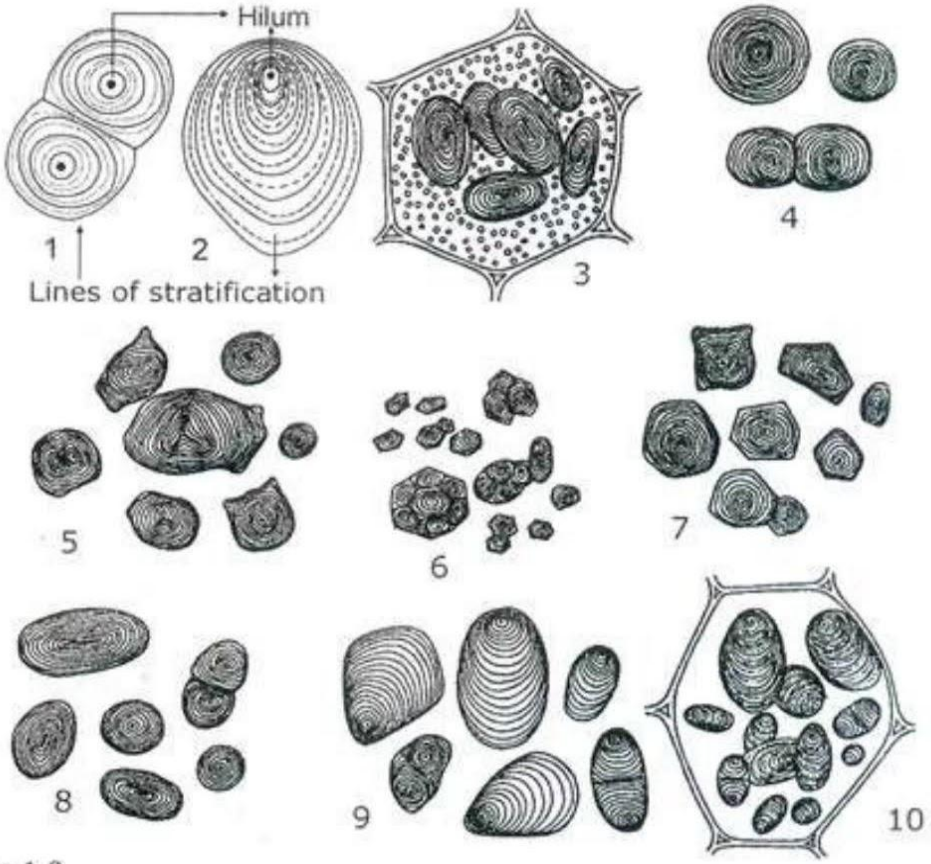
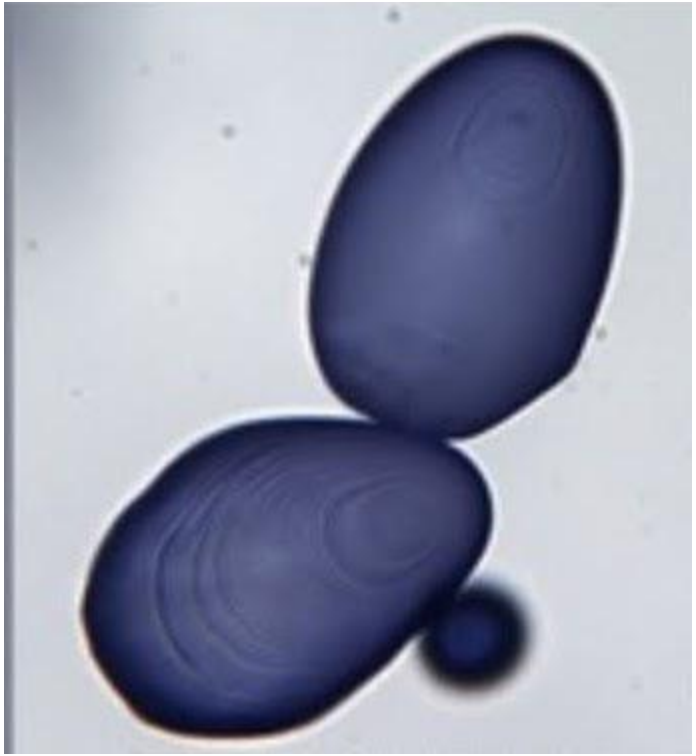
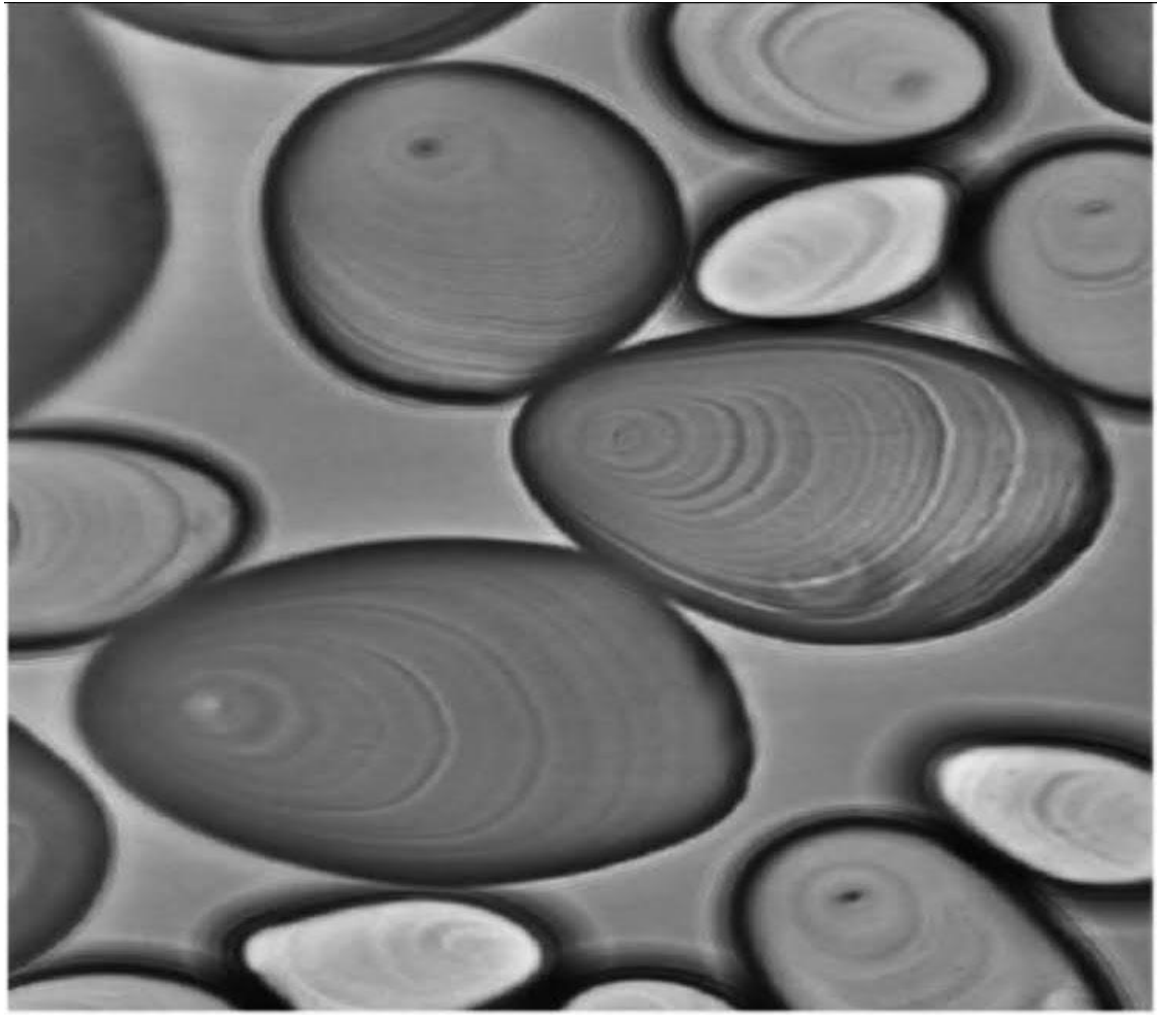


Figure 1.8

Starch grains. 1. Compound starch grain. 2. Simple starch grain. 3. From cotyledon of *Pisum* seed. 4. From flesh of *Musa*. 5. From tuberous root of *Ipomoea batatas*. 6. From endosperm of *Oryza* grain. 7. From endosperm of *Zea* grain. 8. From cotyledon of *Cicer* seed. 9. From tuber of *Solanum tuberosum*. 10. Same in situ.

GROWTH RING/STRIATIONS/ LAMELLAE





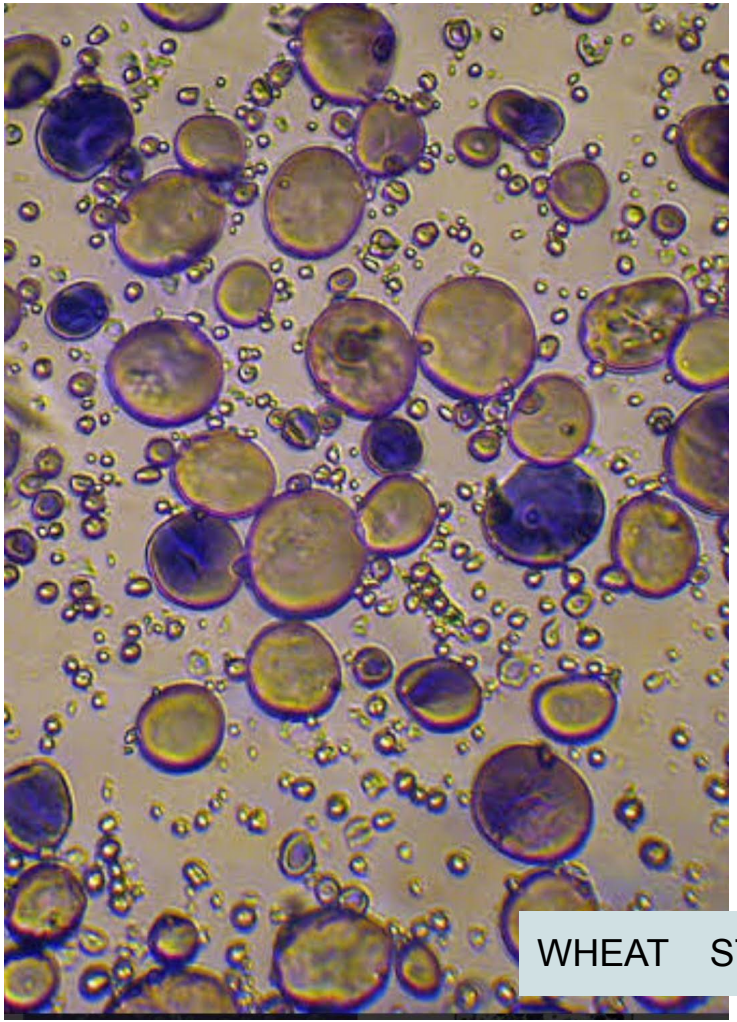
POTATO STARCH GRAIN

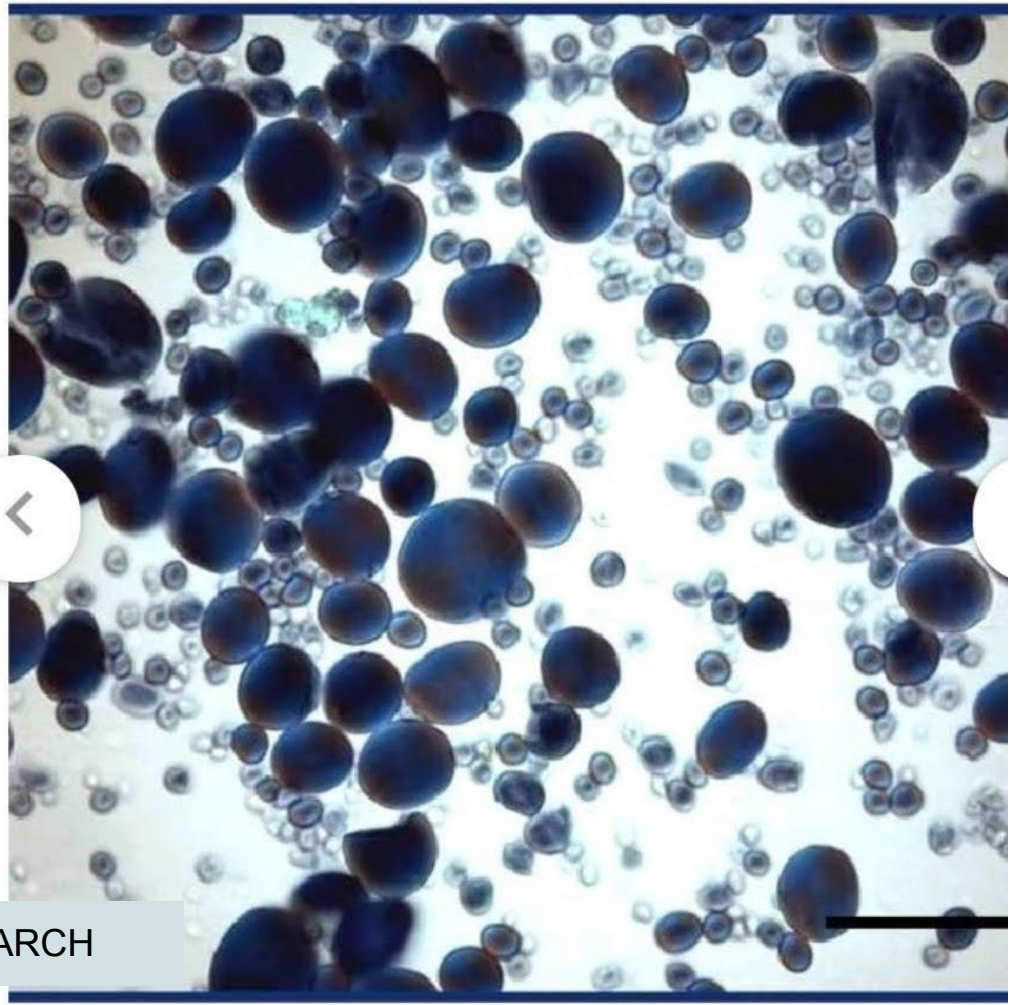
3. Starch grains

Preparation and staining—Freshly cut Potato tuber is scrapped and then the scrapings mounted in a drop of dilute iodine solution.

Comment—(i) Numerous simple, compound or semi-compound eccetric grains with hilum. (ii) Presence of lines of stratification. (iii) Blue coloured grains.

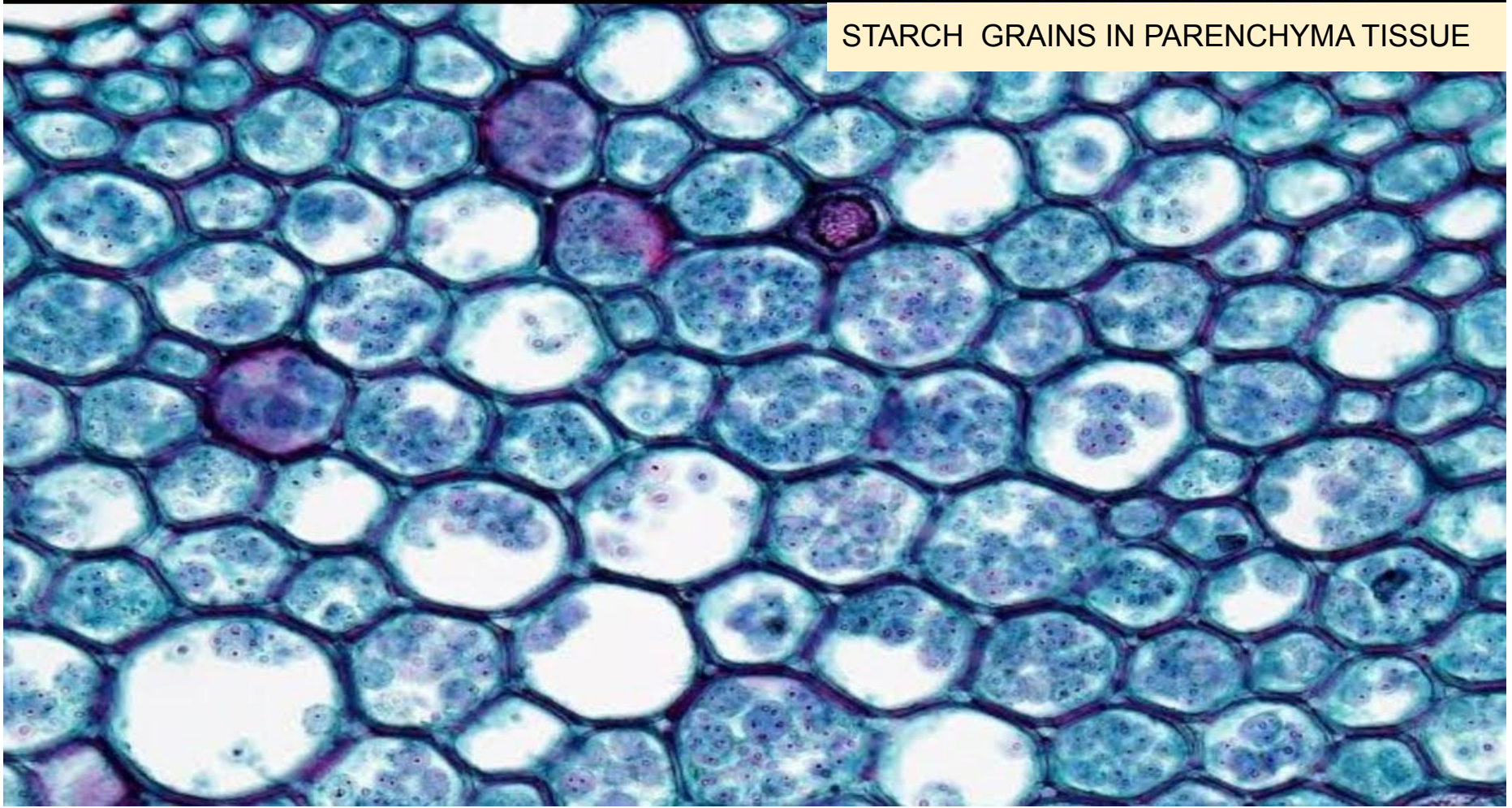
Identification : *Starch grains.*





WHEAT STARCH

STARCH GRAINS IN PARENCHYMA TISSUE



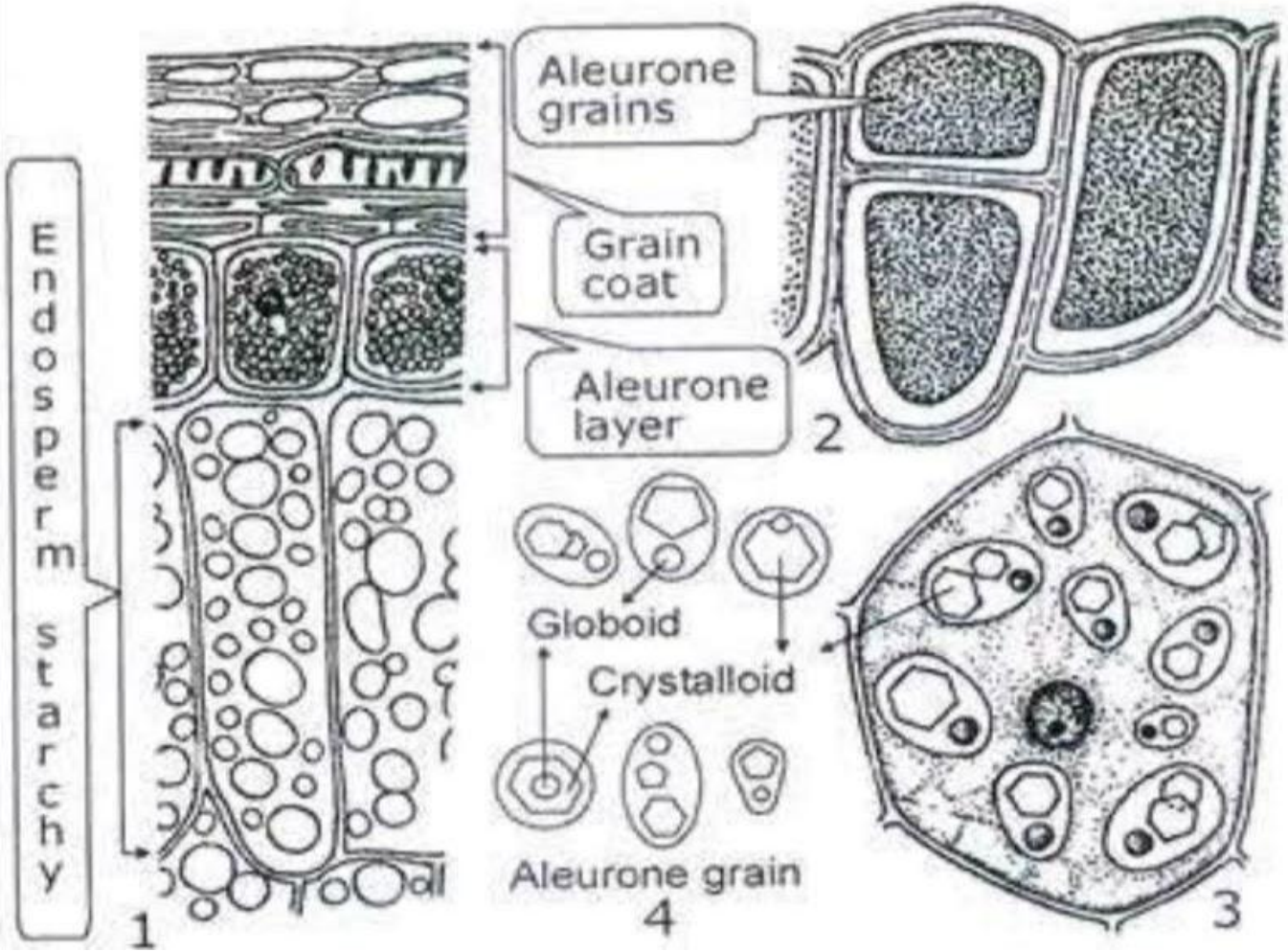


Figure 1.9

Aleurone grains.
1. In *Triticum*.
2. In *Zea*.
3. In *Ricinus*.
4. Diagrams of a few aleurone grains.

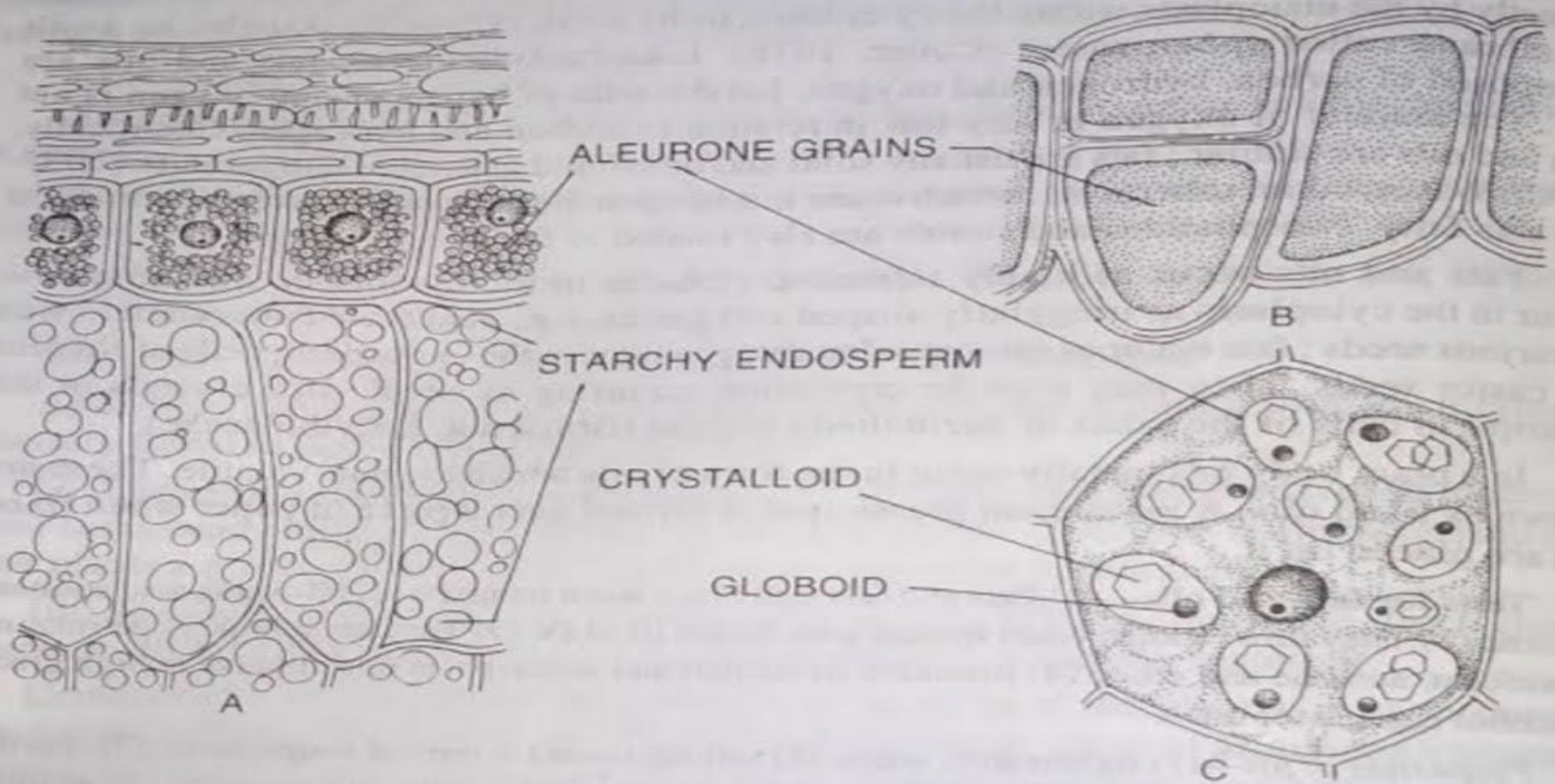
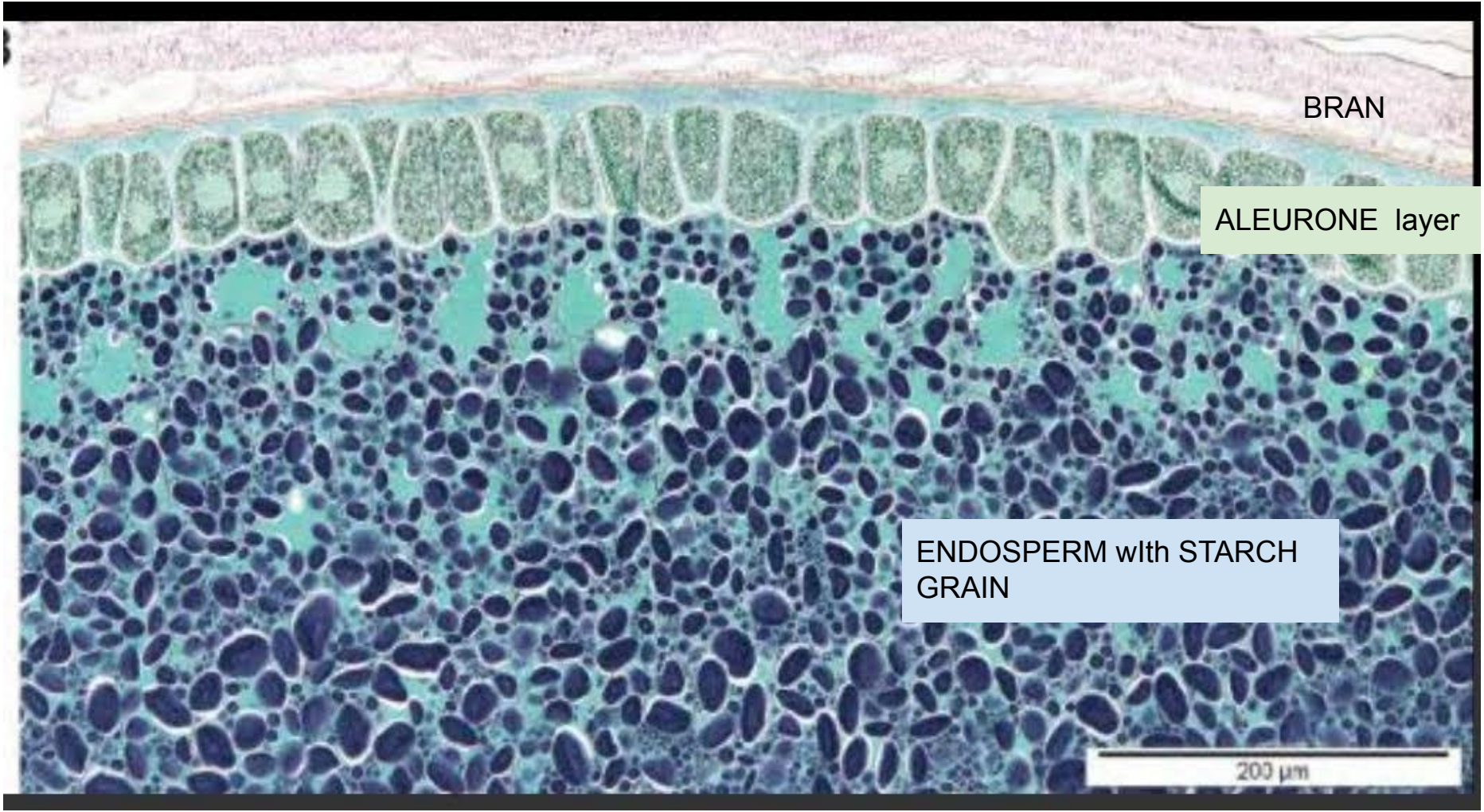
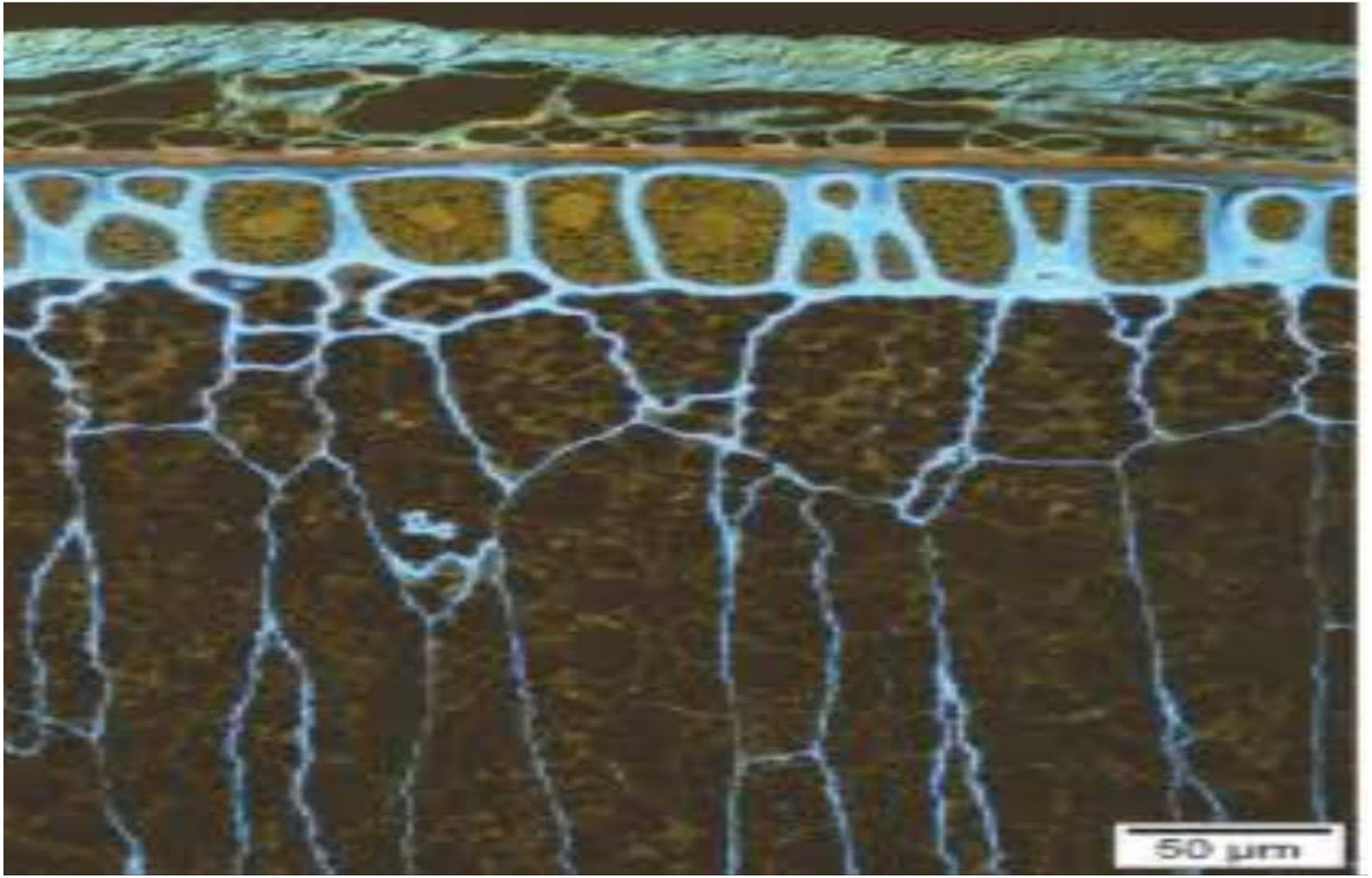


Fig. 2.18—Structures of aleurone grains. A—In wheat (*Triticum* sp.) grain. B—In maize (Zea *mays*) grain. C—In endosperm cells of castor (*Ricinus* sp.) seed.


BRAN
ALEURONE layer
ENDOSPERM wIth STARCH GRAIN
200 µm


50 µm

GRAIN COAT
or BRAN

ALEURONE
LAYER

ENDOSPERM
with
STARCH
GRAIN

ALEURONE layer of wheat

4. Aleurone grains

Preparation—A thin T. S. through the water soaked endospern of Castor seed *(Ricinus communis)* is made. The section is treated with alcohol for ten minutes and mounted in a drop of glycerine.

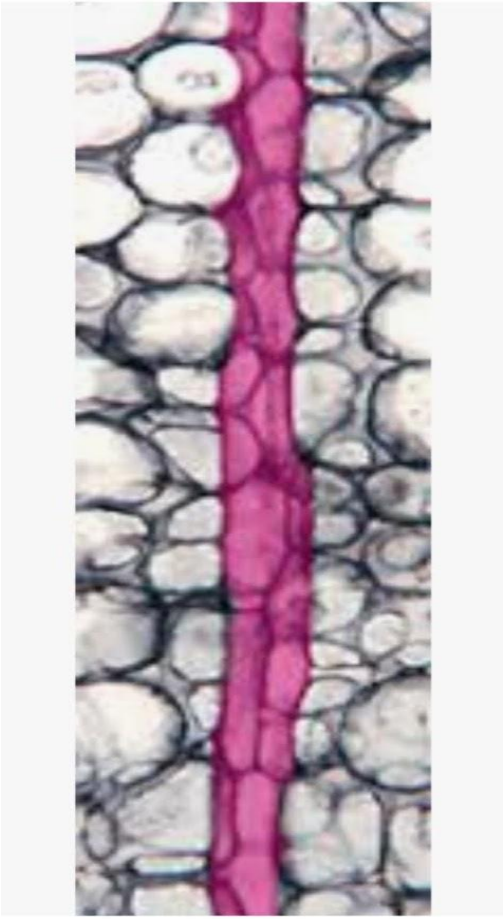
Comment—(i) Large number of oval bodies are found within the cell. (ii) The oval body has a matrix in each of which following two different structures are found : (a) **Crystalloid**—Larg polyangular, nitrogenous crystalline bodies. (b) **Globoids**—Comparatively small, round body formed of double phosphate of magnesium and calcium.

Identification : *Aleurone grains.*

aleurone layer The single layer of large cells under the bran coat and outside the endosperm of cereal grains. About 3% of the weight of the grain, and rich in protein, as well as containing about 20% of the vitamin B1, 30% of the vitamin B2 and 50% of the niacin of the grain. Botanically the aleurone layer is part of the endosperm, but in milling it remains attached to the inner layer of the bran.

aleurone layer A layer of cells below the testa of some seeds (e.g. barley), which contains hydrolytic enzymes (including amylases and proteases) for the digestion of the food stored in the endosperm. The production of enzymes is activated by gibberellins when the seed is soaked in water prior to germination.

aleurone layer The outer layer of living cells of the endosperm of wheat and other grain species. It is a single layer of cells that synthesizes the enzyme α-amylase, which is secreted during germination into the starch-filled endosperm and breaks down the starch into maltose and glucose. Studies on the barley grain have shown that gibberellins control the synthesis of the enzyme by switching on the genes for the synthesis of the specific RNA that codes for the α-amylase protein.



Non-articulated laticifer

A **laticifer** is a type of elongated secretory cell found in the leaves and/or stems of plants that produce latex and rubber as secondary metabolites.

Laticifers may be divided into:

- **Articulated laticifers**, i.e., composed of a series of cells joined together, or
- **Non-articulated laticifers**, consisting of one long coenocytic cell.

- **Non-articulated laticifers**, consisting of one long coenocytic cell.

Non-articulated laticifers begin their growth from the meristematic tissue of the embryo, termed the laticifer initial, and can exhibit continual growth throughout the lifetime of the plant.[1][2] Laticifer tubes have irregularly edged walls and a larger inner diameter than the surrounding parenchyma cells.[3] In the development of the cell, elongation occurs via karyokinesis and no cell plate develops resulting in coenocytic cells which extend throughout the plant.[2] These cells can reach up to tens of centimeters long and can be branched or unbranched. They are thought to have a role in wound healing and as defense against herbivory, as well as pathogen defense, and are often used for taxonomy.

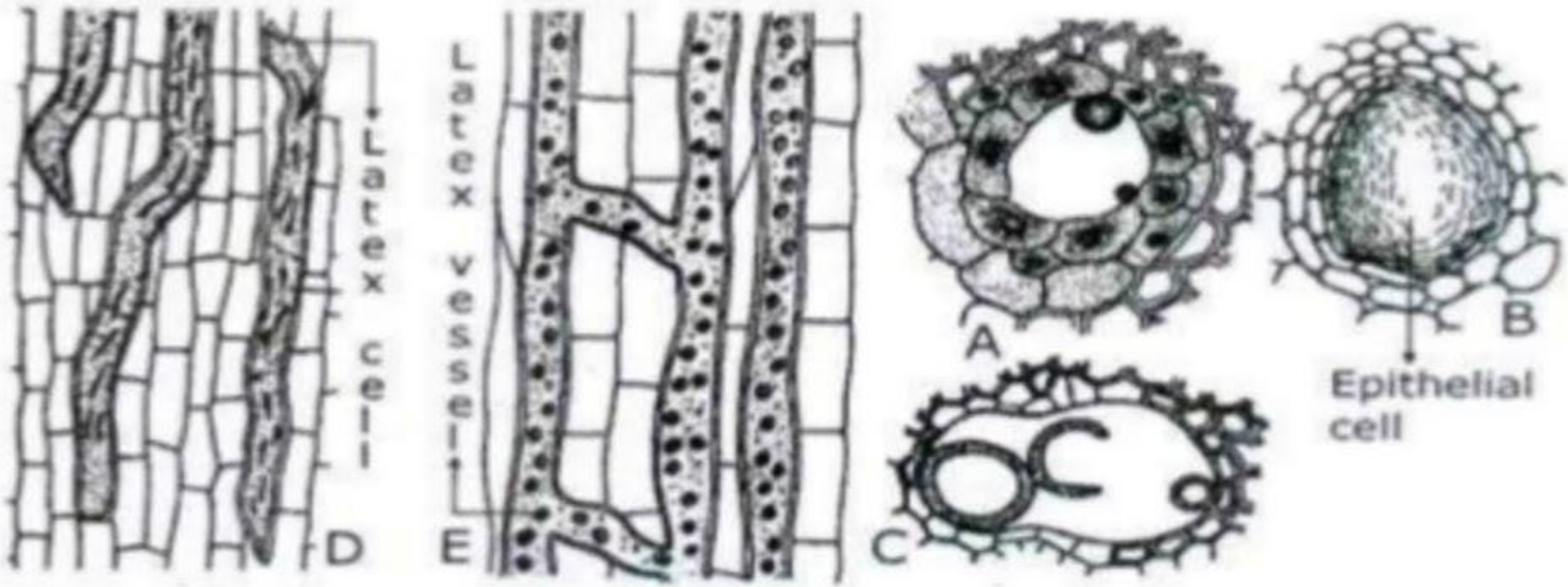


Figure 11.3

Diagrams showing D. latex cell of *Euphorbia pilulifera* (non-articulate), E. latex vessel of *Carica papaya* (articulate) and intercellular spaces : A. Resin duct of *Pinus* (schizogenous), B. oil-cavity of *Citrus* fruit (Lysigenous) and C. Protoxylem lacuna of maize (schizo-lysigenous).

Articulated non-anastomosing:

compound tubes not connected with each other laterally (*Ipomoea,*

Articulated anastomosing:

cell chains connected with each other laterally (*Hevea, Lactuca, Carica papaya, Manihot*)

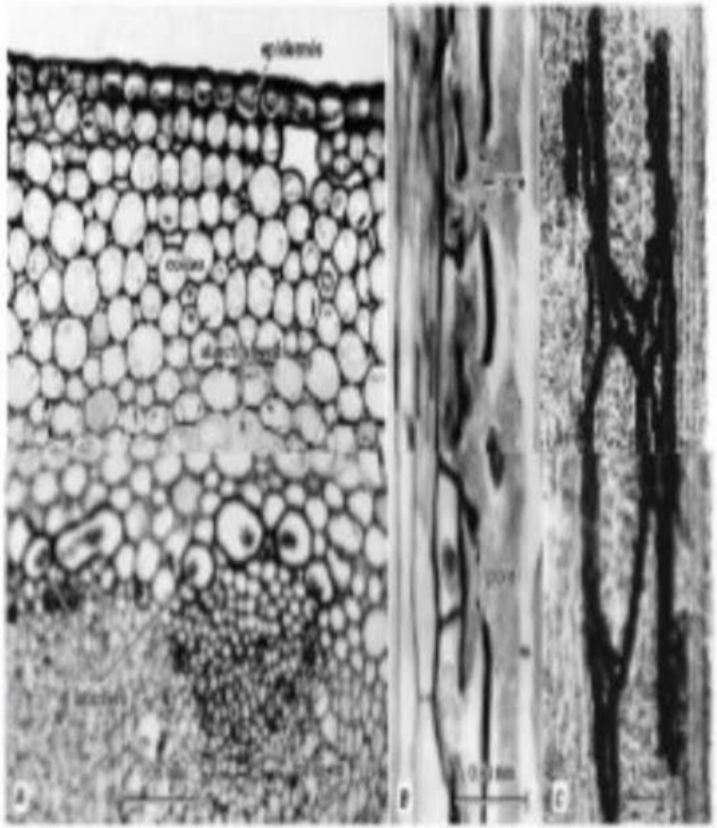
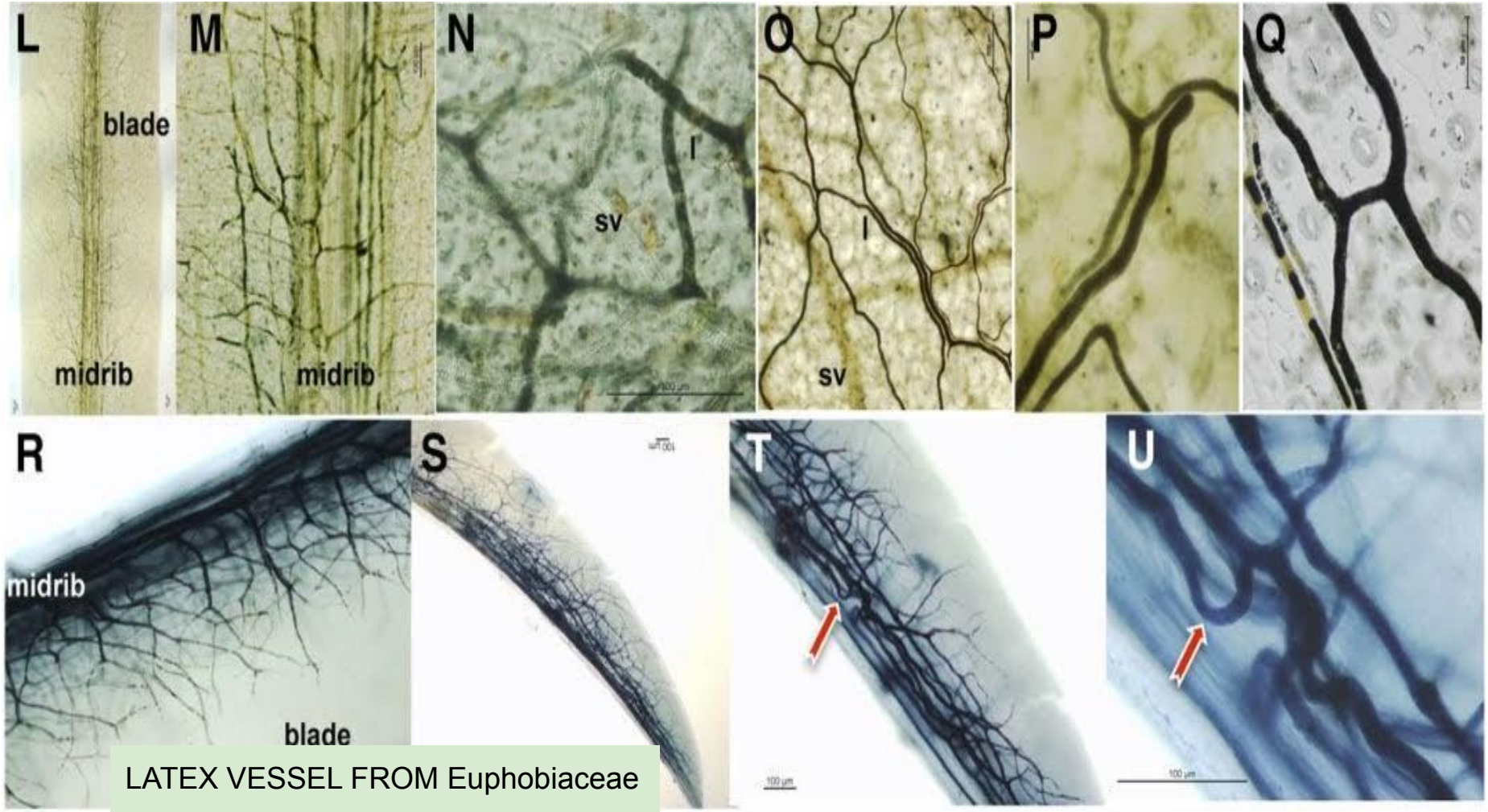
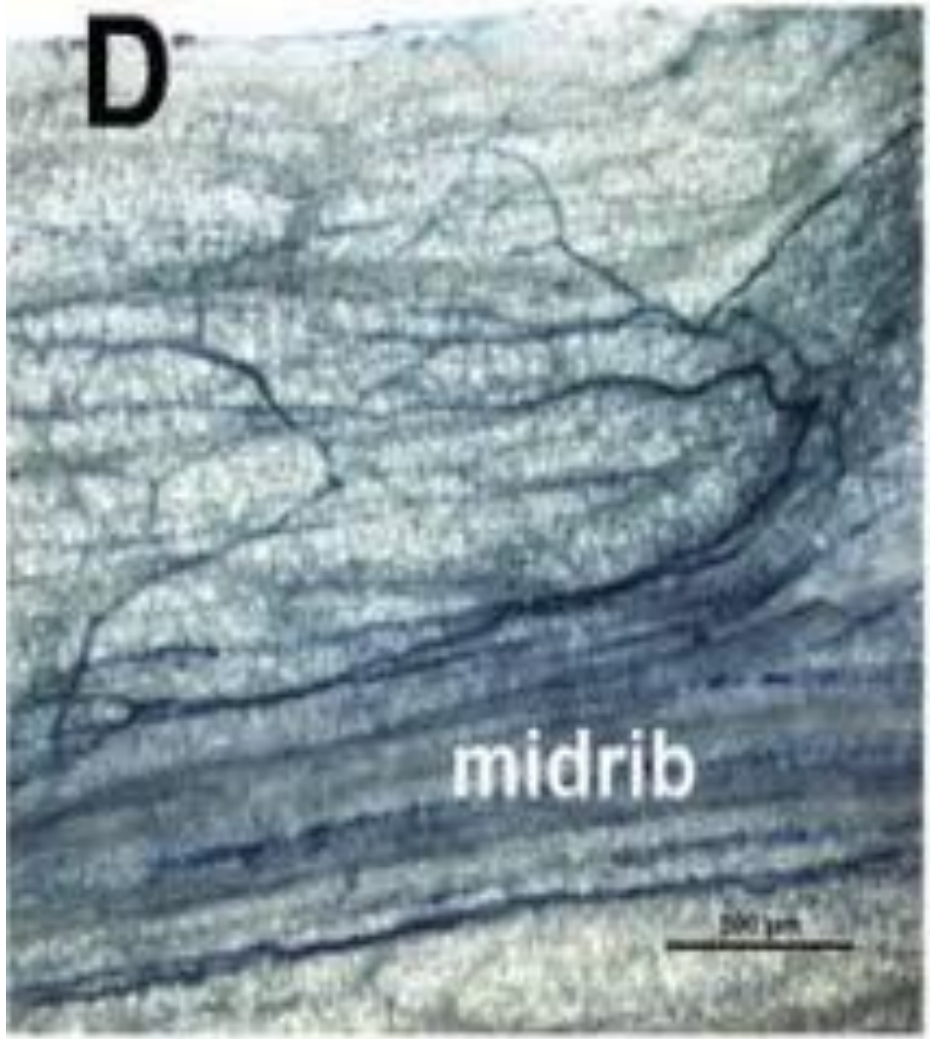


FIGURE 17.14

Articulated anastomosing laticifers in *Lactuca scariola*. A, transverse section of stem. Laticifers are outside the phloem. B, C, longitudinal views of laticifers in partly macerated tissue (B) and section (C) of stem. Perforations can be seen in the walls of the laticifer in B. (C, from Esau, 1977.)



LATEX VESSEL FROM Euphobiaceae


D
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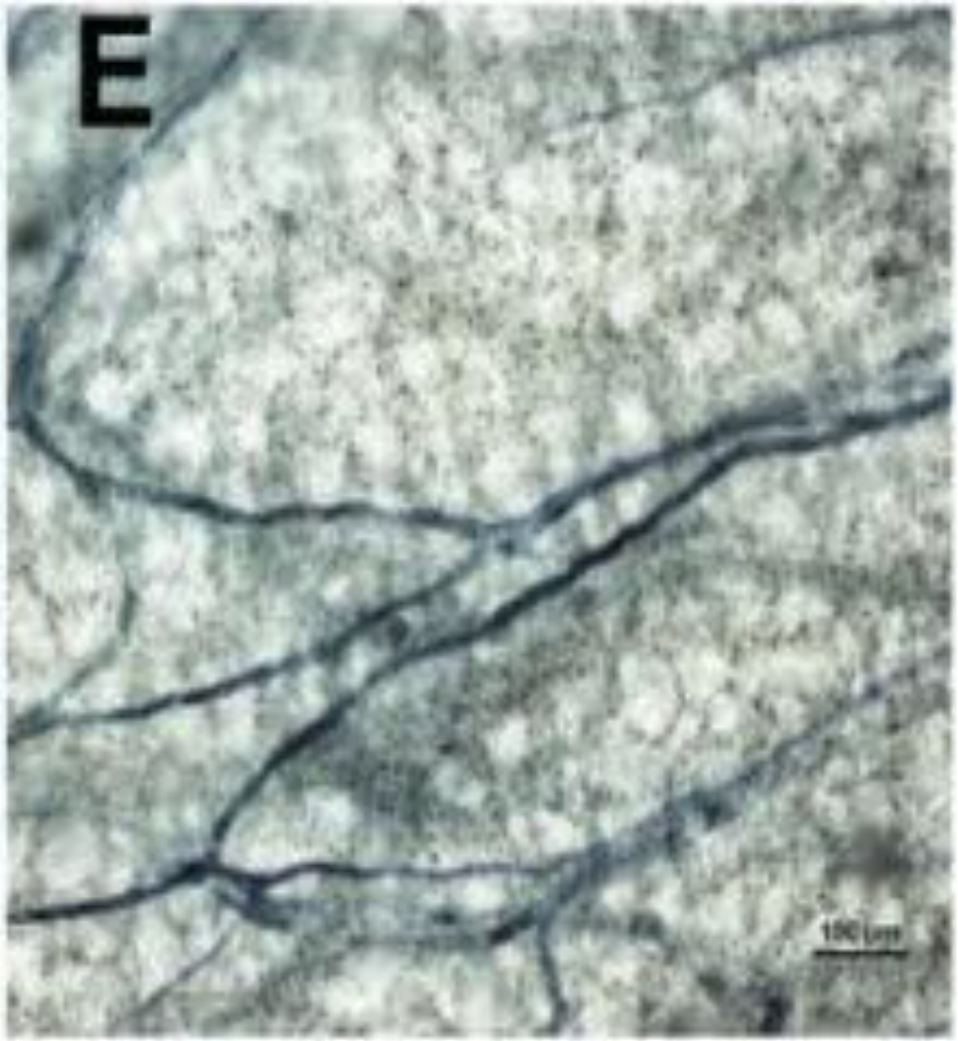
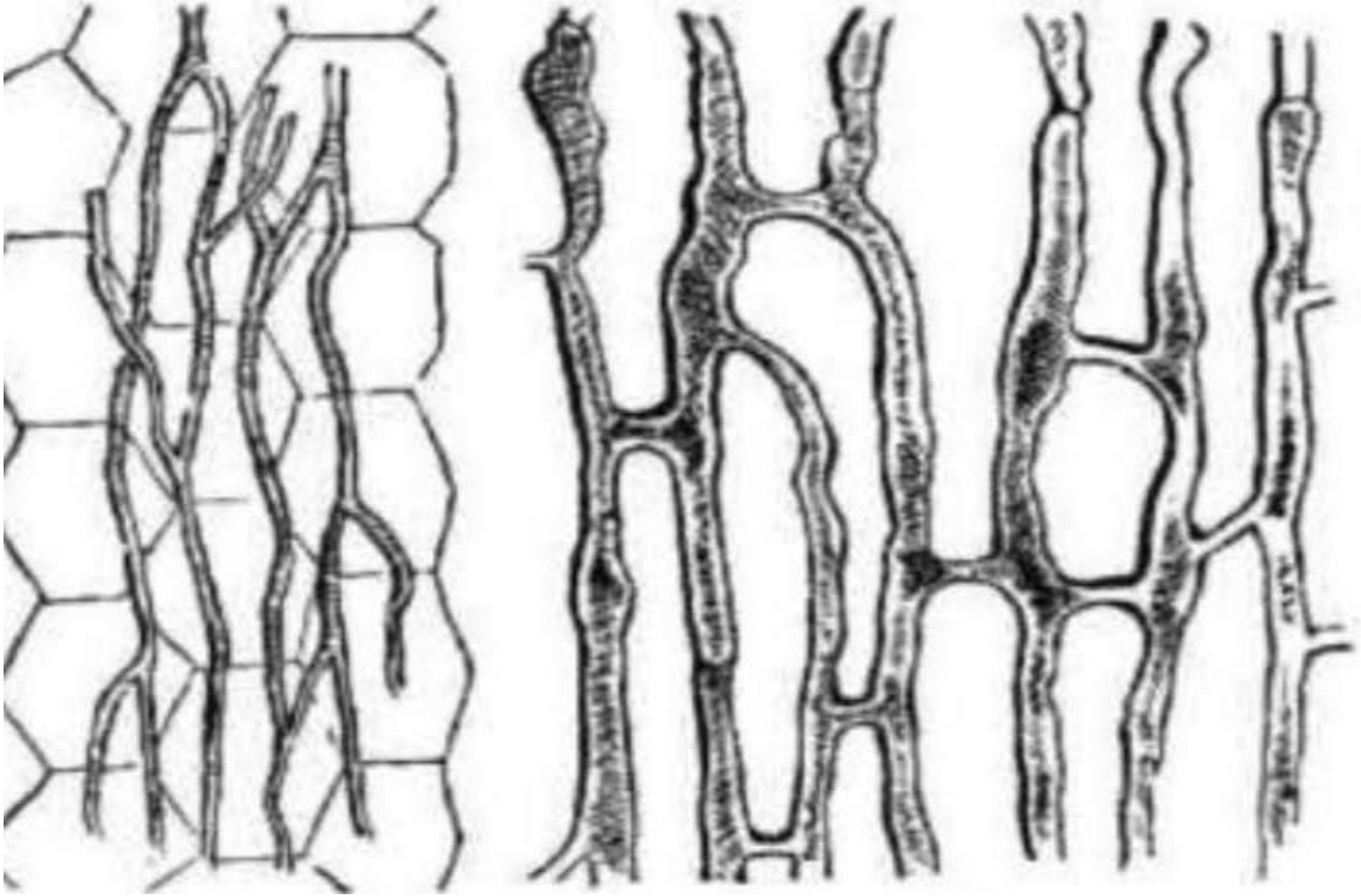

E

Articulated laticifers

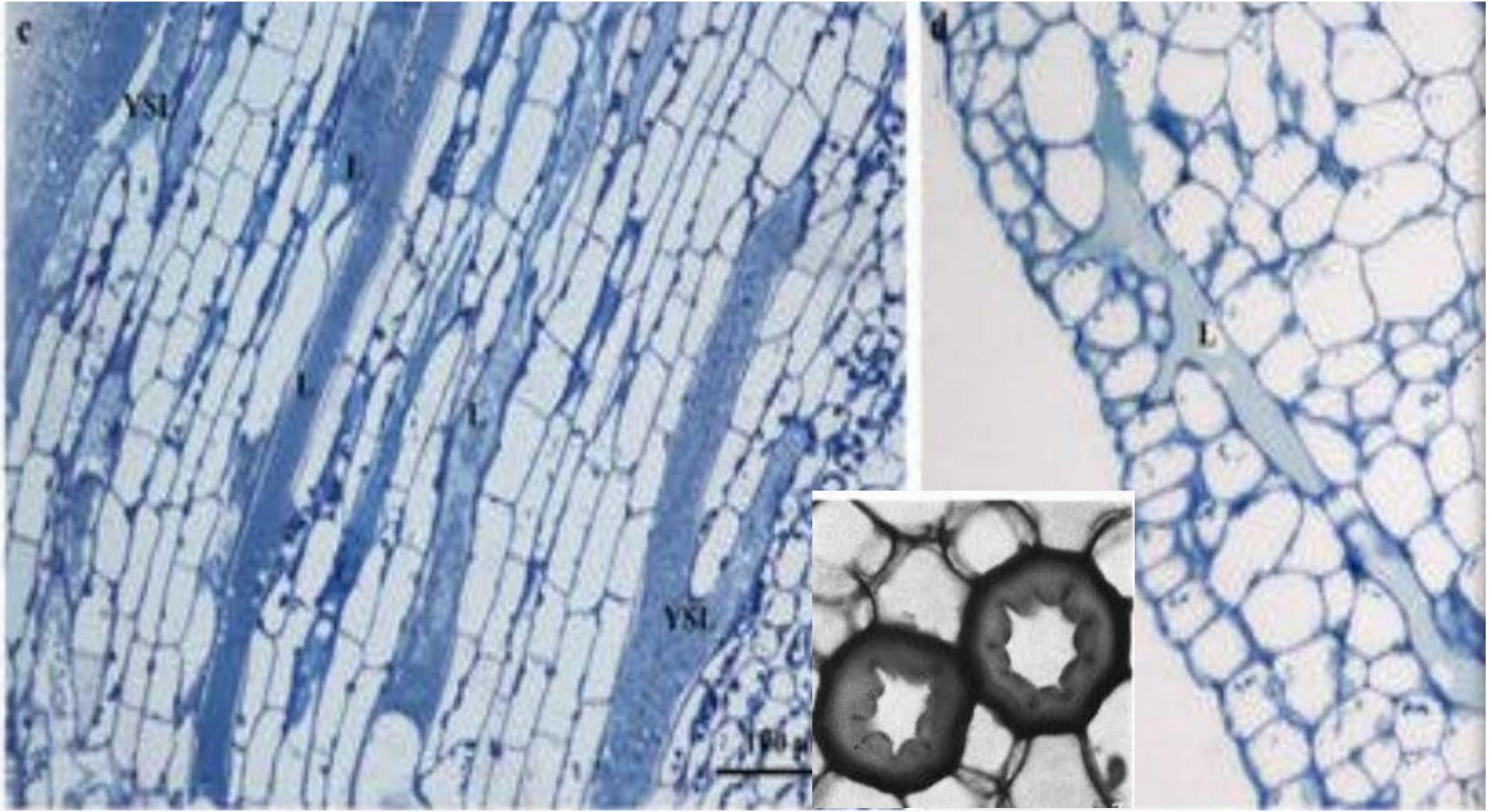
- composed of a series of cells joined together
- Fusion of wall of many cell
- Dissolution of septa
- Living and possess lateral branches.
- On meeting fuse to form coenocytic strcture.
- Other words known as latex vessels
- These are following family in which latax vessela are present:-
- Papaveracae
- Cactaceae
- Musaceae
- Aroideae



Non-articulated laticifers:-

- Similar in shape to the vessels.
- Some elongated and branched individual cells.
- Which contain numerous nuclei.
- Secrete latex
- Such plant having such tissue are known as non-articulated (latex cells)

- These latex cells are found in the members of the family:-
- Urticaceae
- Euphorbiaceae
- Moraceae


c
VSL
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L
L
VSL
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L

6. Laticiferous ducts

Preparation and staining—A thin L. S. through the cortex of *Calotropis* (for Latex cells) or *Carica papaya* (for Latex vessel) is cut and stained properly with Bismark Brown. It is then mounted either in glycerine or Canada Balsam.

Comment—(i) Elongated tube like bodies run longitudinally through the cortex. (ii) The cells are coenocytic. (iii) The cells are branched. (iv) The cells are either non-articulated i.e. latex cells or articulated i e. latex vessels. (v) The cells contain milky or watery latex.

Identification : ***Laticiferous ducts.***