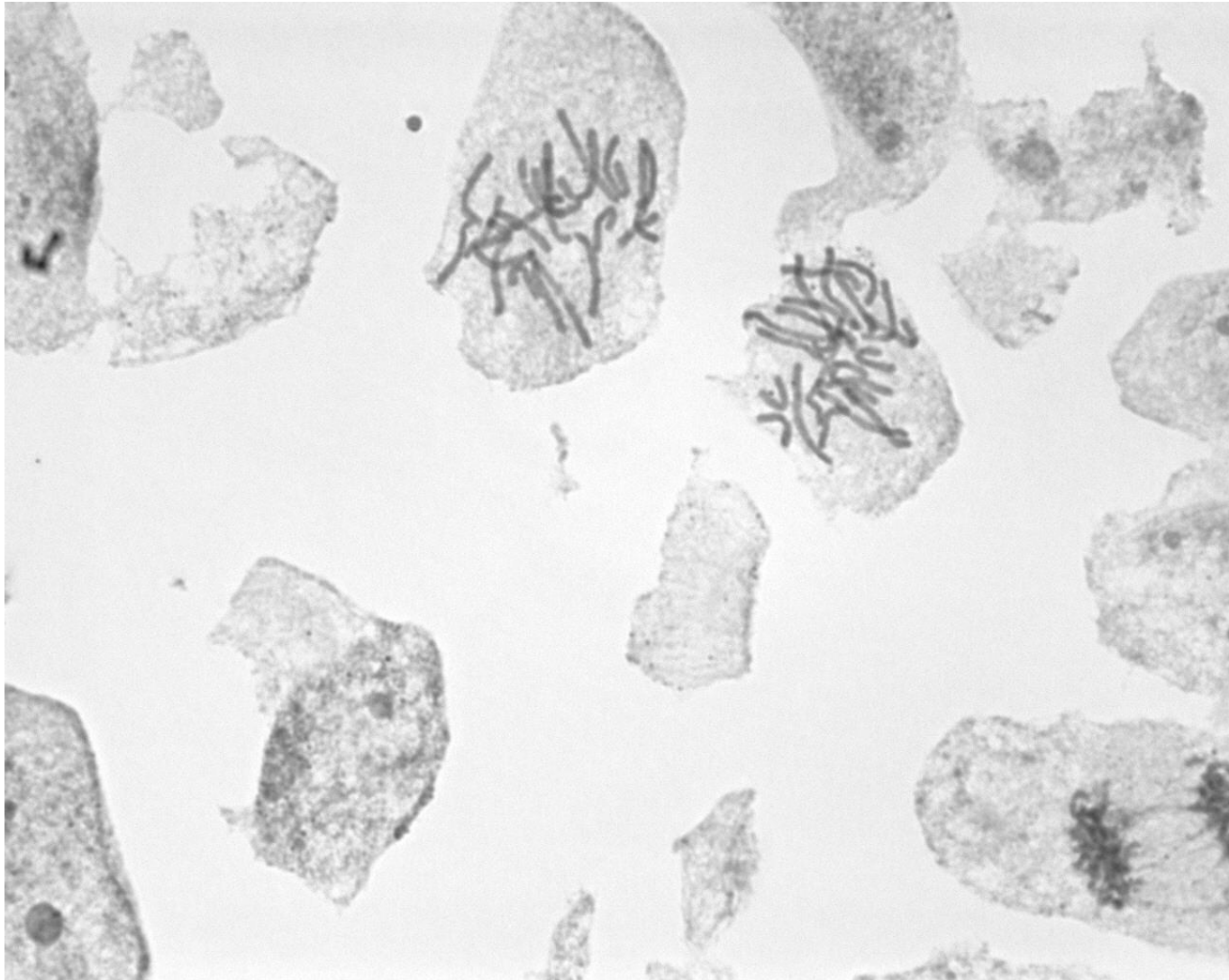


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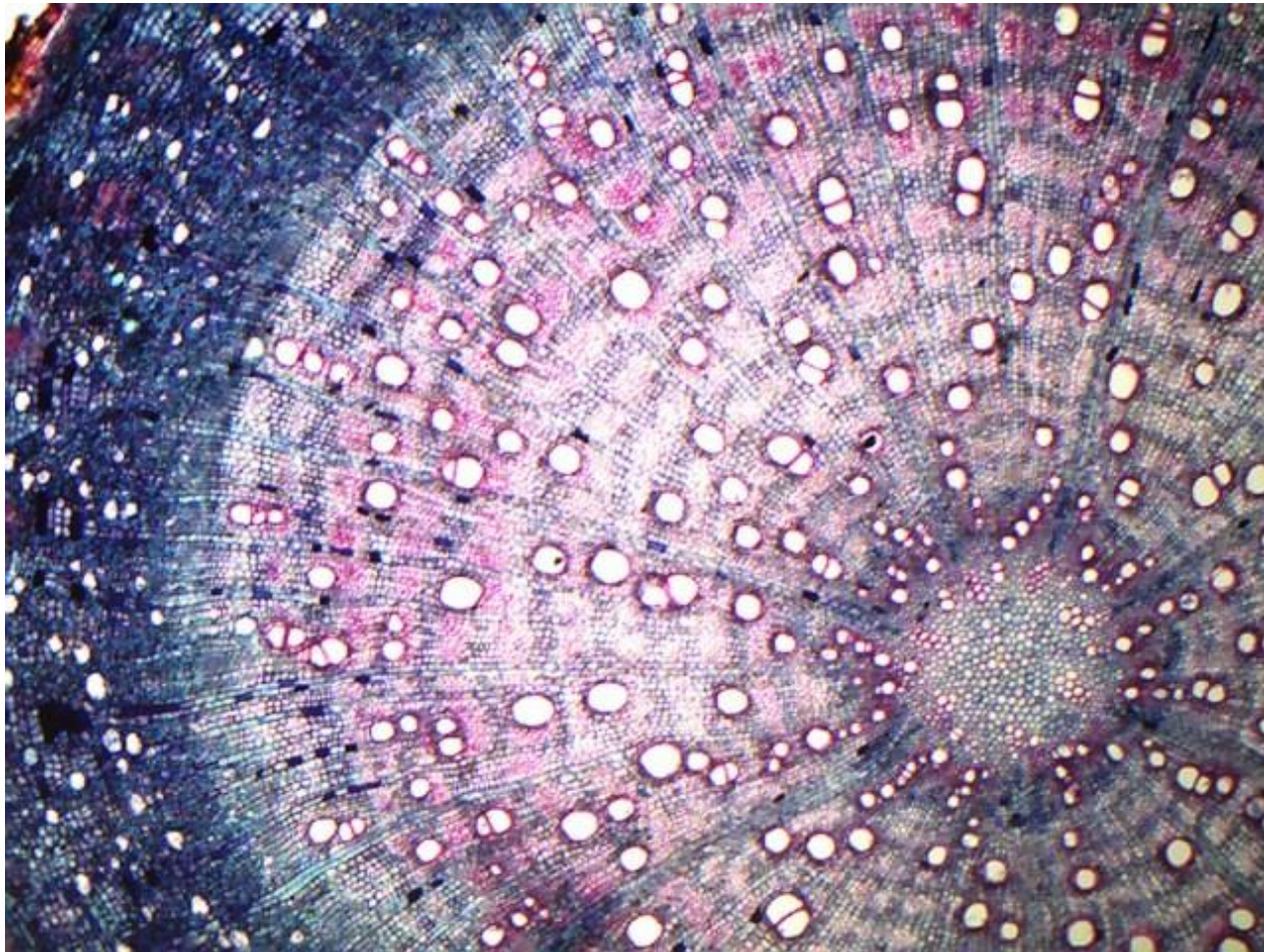
# Cell division: Mitosis metaphase



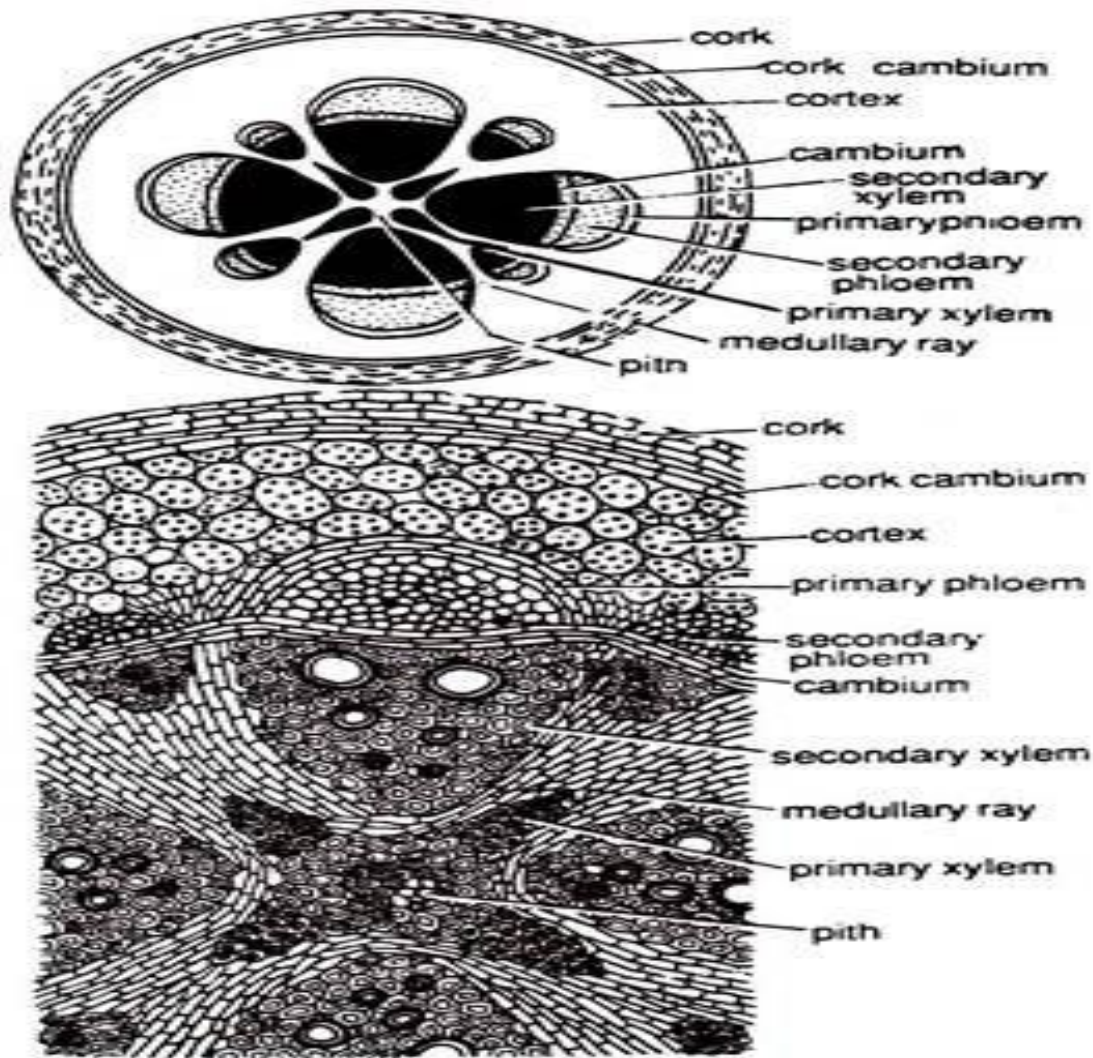
# Cell division: Mitosis Anaphase



# *Ficus* root T.S



# T.S. *Tinospora* root

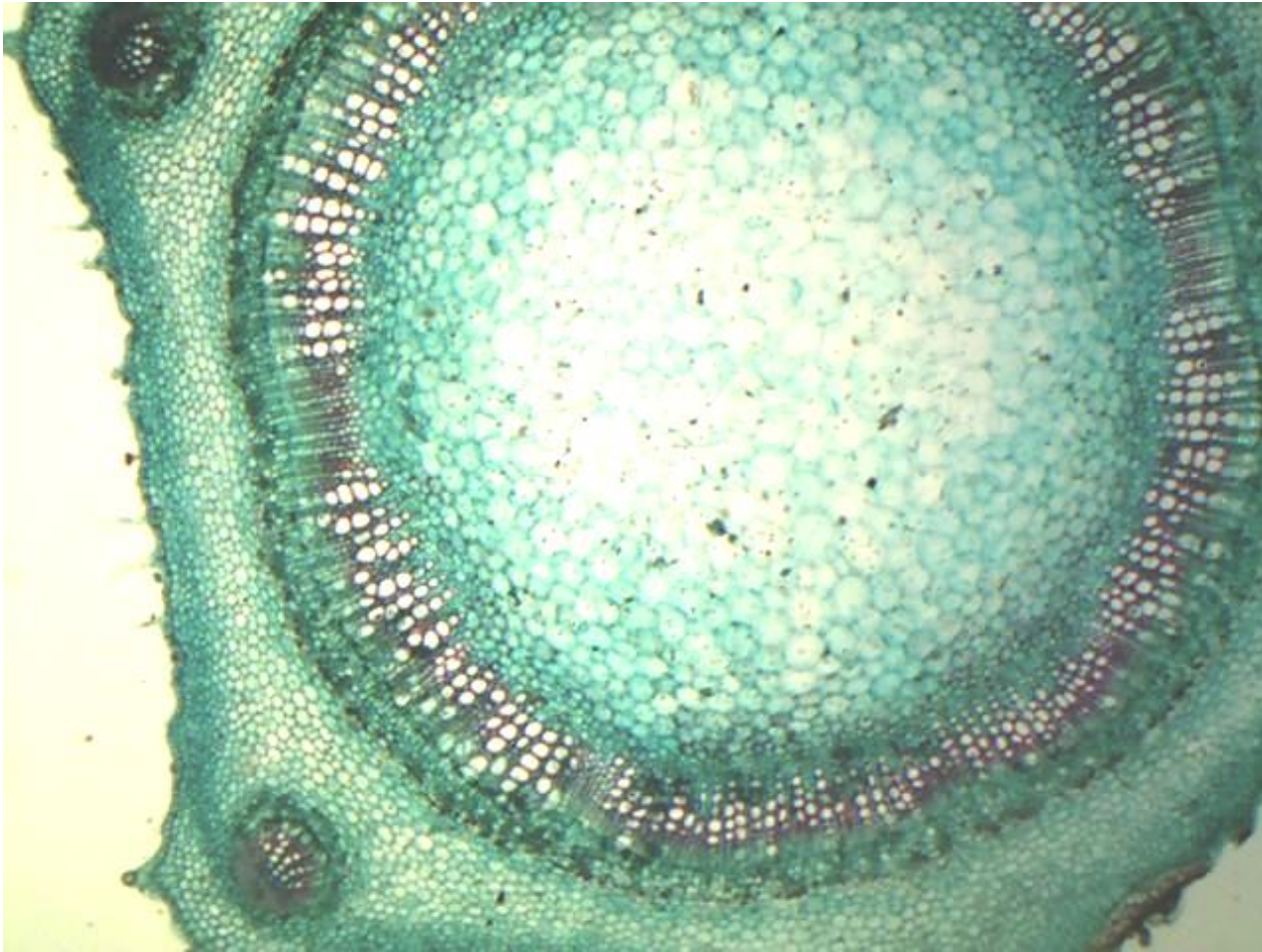


**Fig. 171.** *Tinospora*. Upper, T.S. root (diagrammatic); Lower, T.S. root (a part cellular).

# T.S. Orchid root



# T.S. *Nyctanthes* stem

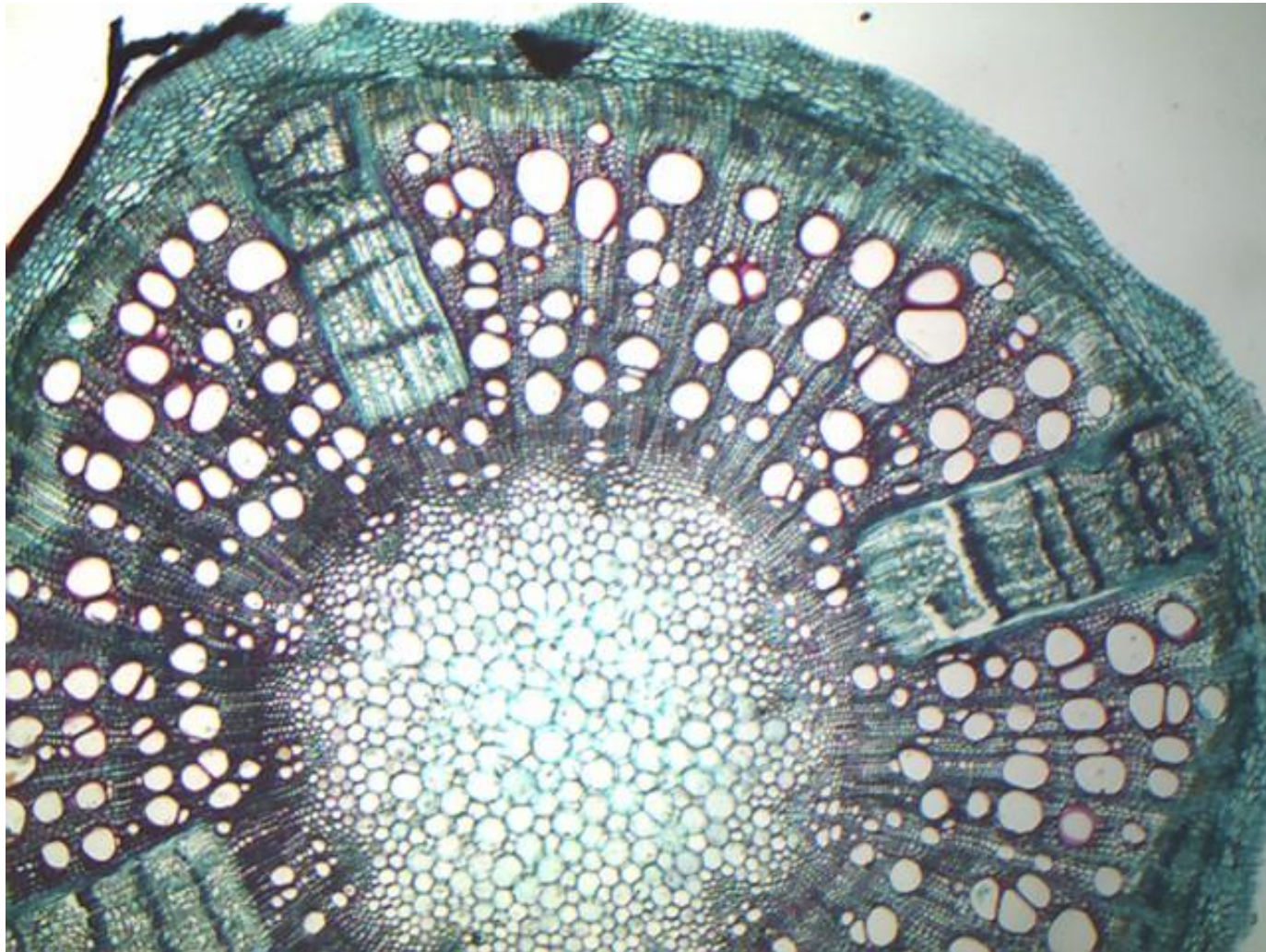


# T.S. *Boerhaavia* stem

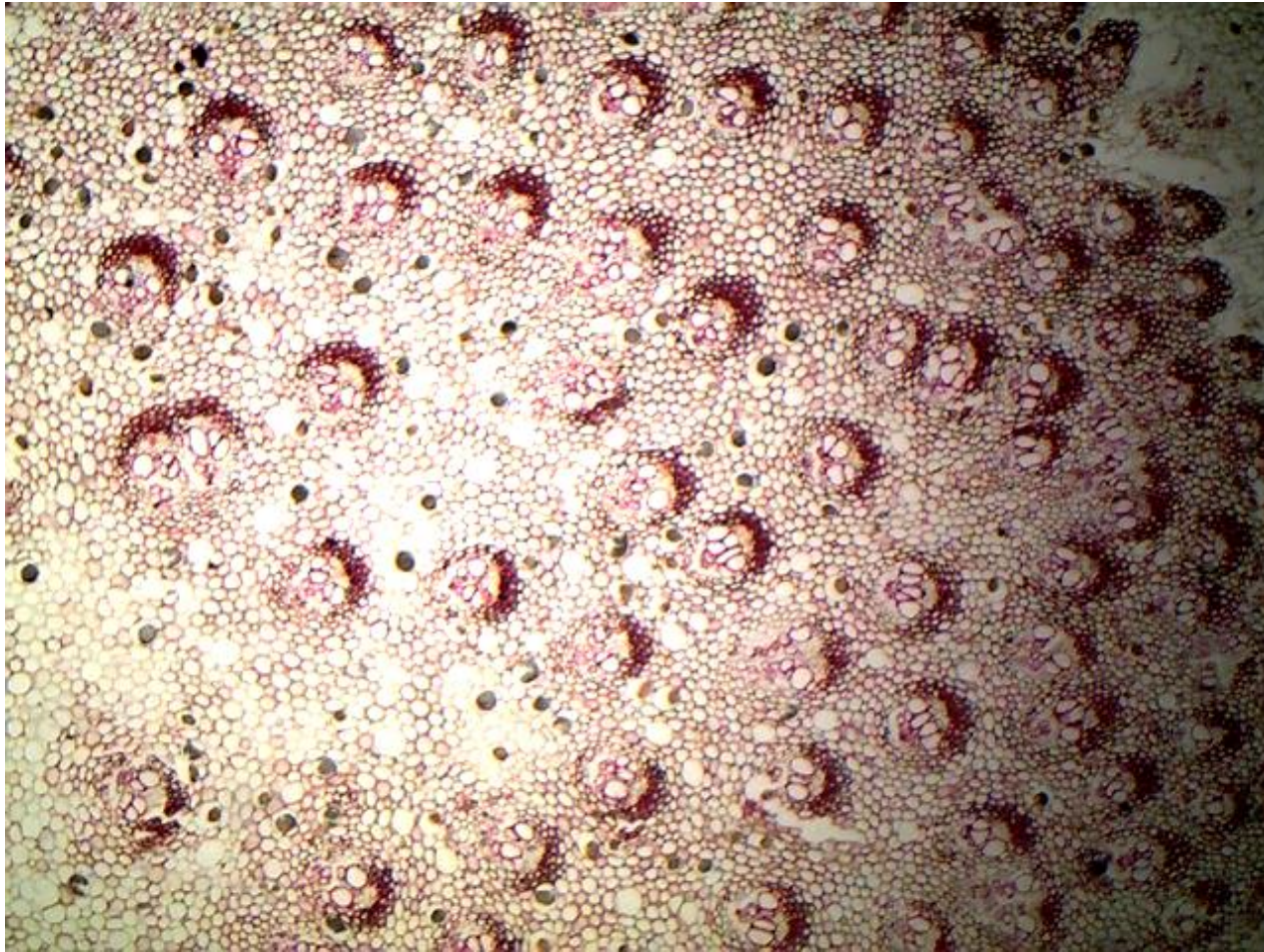




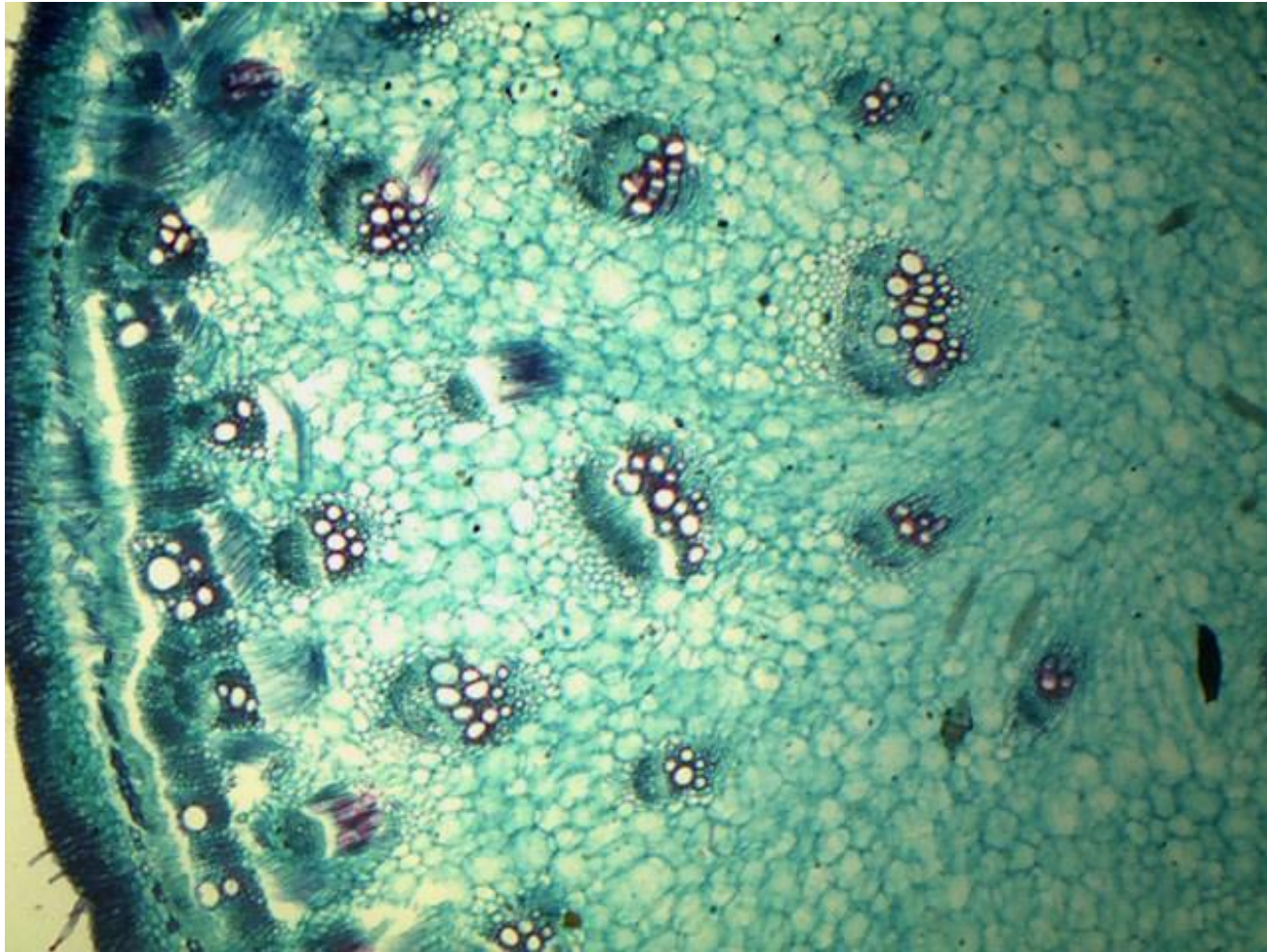
# T.S. Stem *Bignonia*



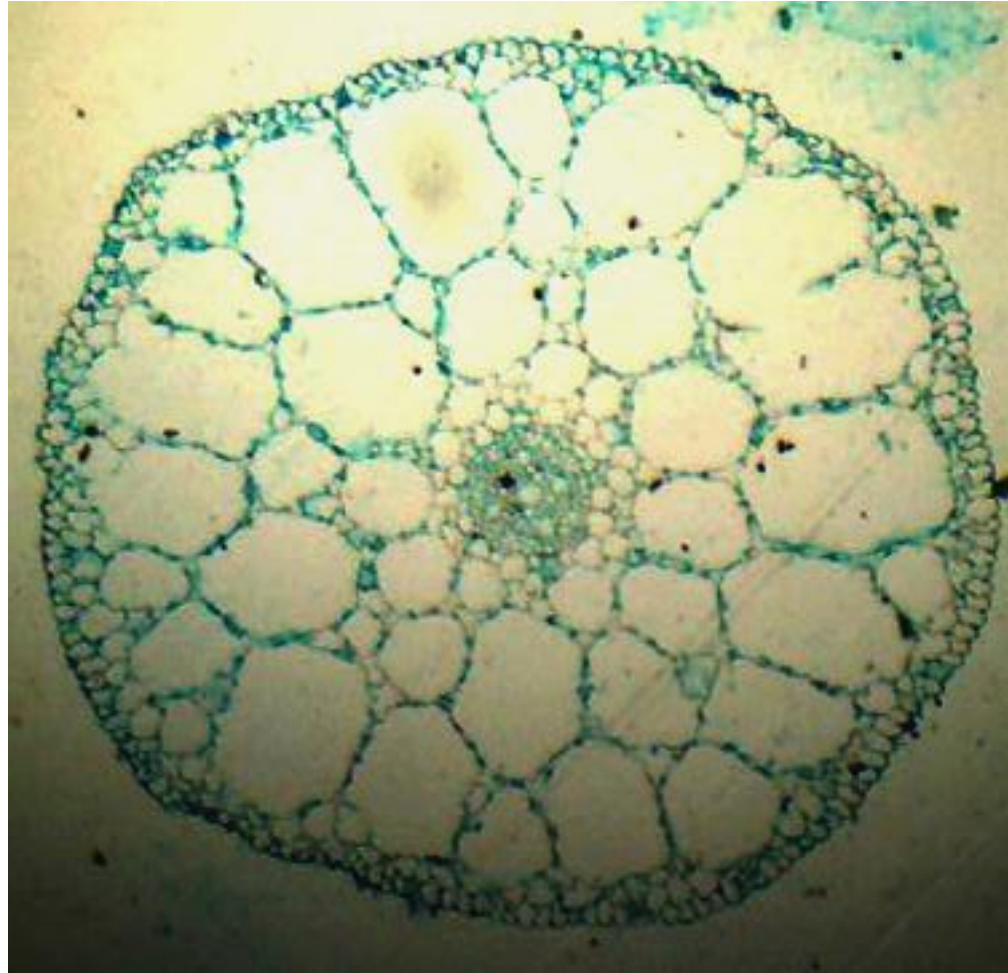
# T.S. Stem *Dracaena*



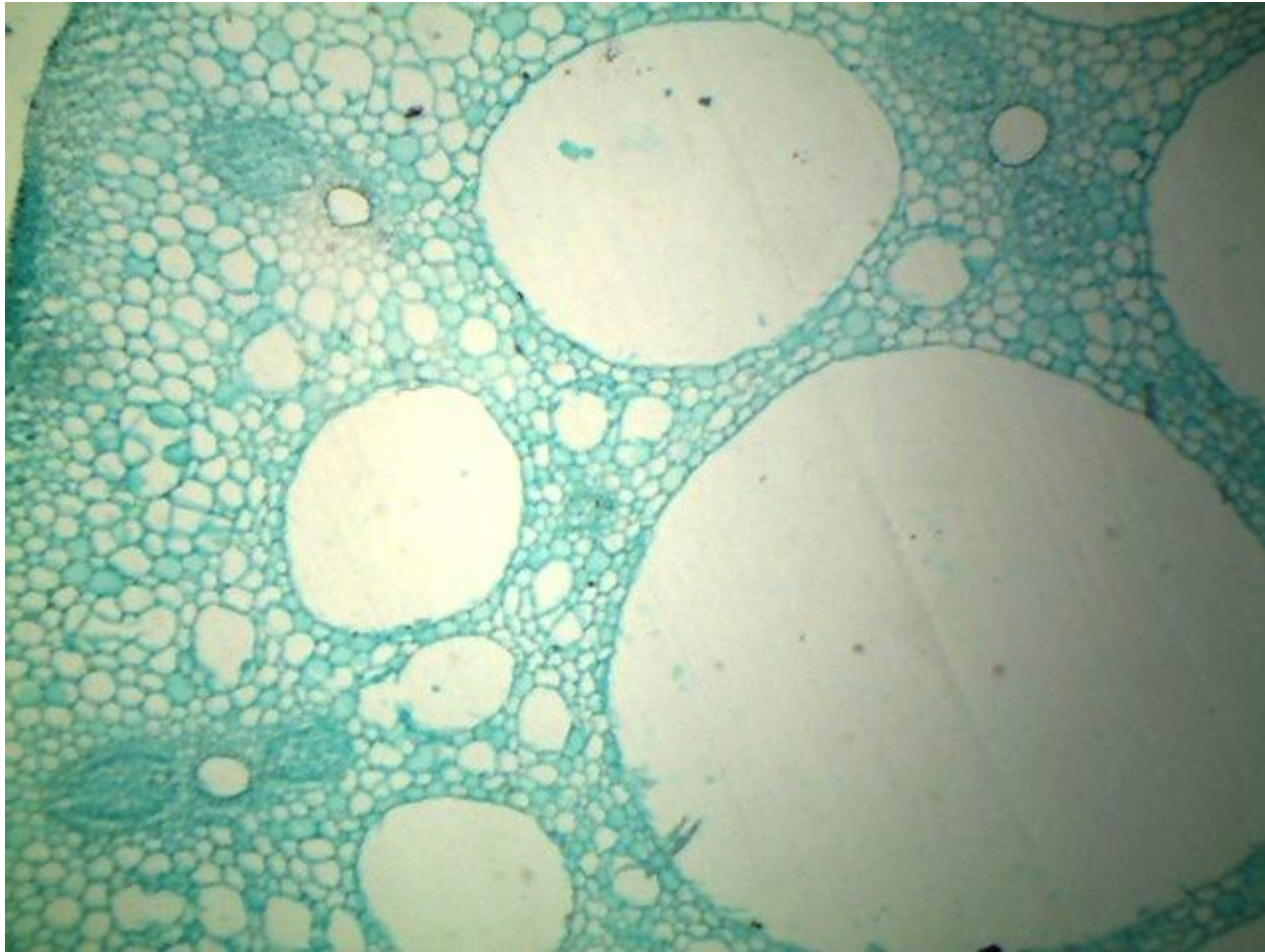
# T.S. Stem *Bougainvillea*



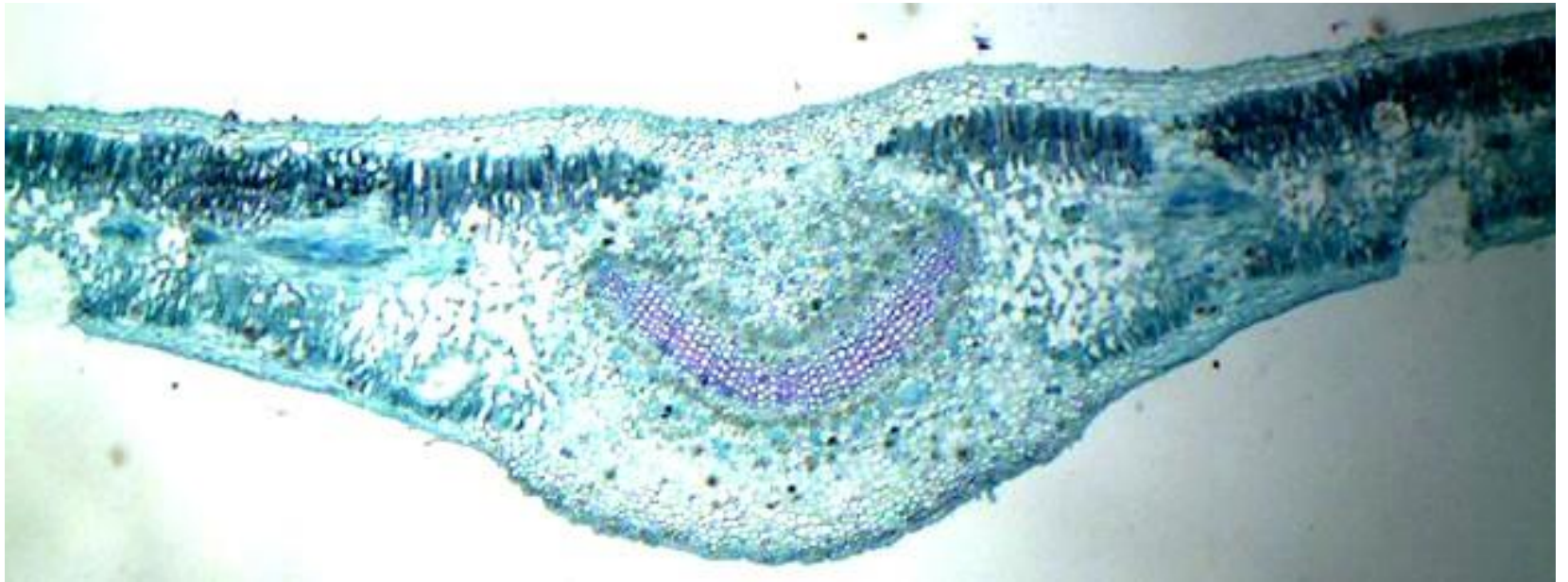
# T.S. *Hydrilla* Stem



# T.S. *Nymphaea* petiole



# T.S. *Nerium* Leaf



# T.S. *Cuscuta* on host

- It is a total stem parasite *Cuscuta reflexa* belonging to family Convolvulaceae
- The parasite is very long, filamentous, branched, non-chlorophyllous, pale yellow in colour and bear scale leaves.
- It produce bunches of whitish or yellowish bell shaped flowers.
- The parasite gets organic food, minerals and water from the host through some special absorbing organs called **haustoria**.
- The haustoria are infact modified adventitious roots which penetrate up to the vascular tissue of host.



# Germinating pollen grains on stigma

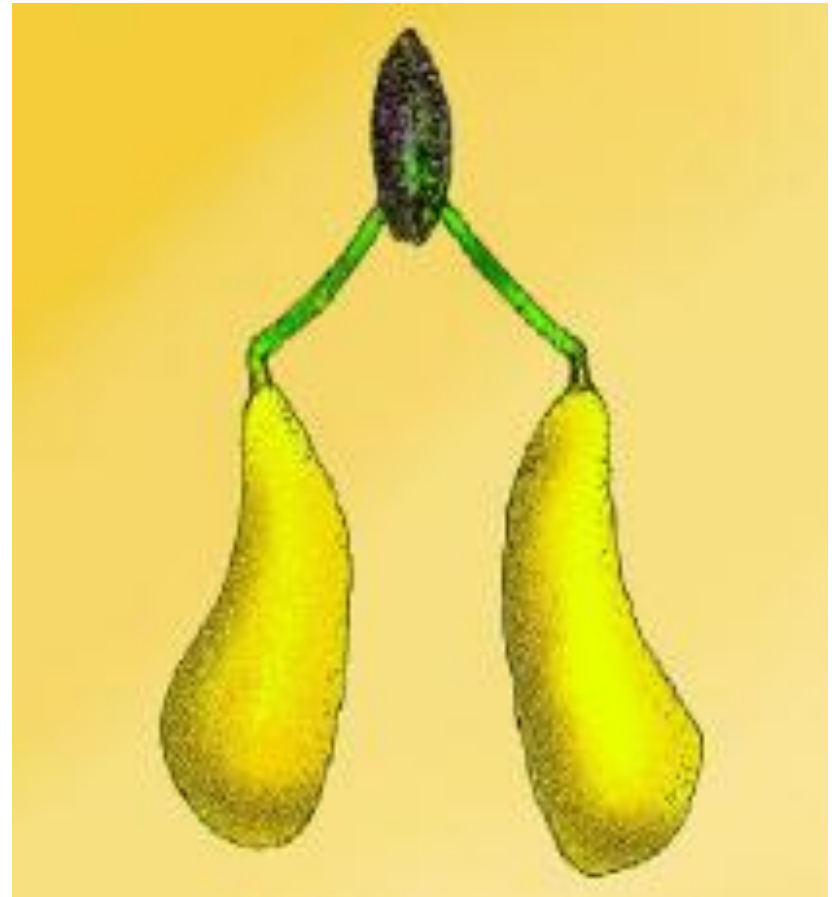
- A number of pollen grain show different stages of germination on same stigma.
- The pollen grain absorbs water and nutrient, swell up and rupture at germ pores.
- The thin intine protudes out through pore into slender pollen tube.
- The pollen tube elongates and tunnels it way through the stylar canal.
- The nucleus and cytoplasm of tube cell as well as generative cell pass down the tube.





- The flower of *Calotropis* characterised by the formation of pentangular stigmatic disc called **gynostegium**. It bears five stamens, the anthers of which are bicelled and coherent with the disc.
- All microspores of the pollen sac cling together forming a ovoid; pendulous, waxy mass of pollen called **Pollenium**
- The pollinia of *Calotropis* is paired structure consisting of two sac like pollinia joined together by means of short stalk of **caudicles** to a dot like gland, the **corpusculum**.

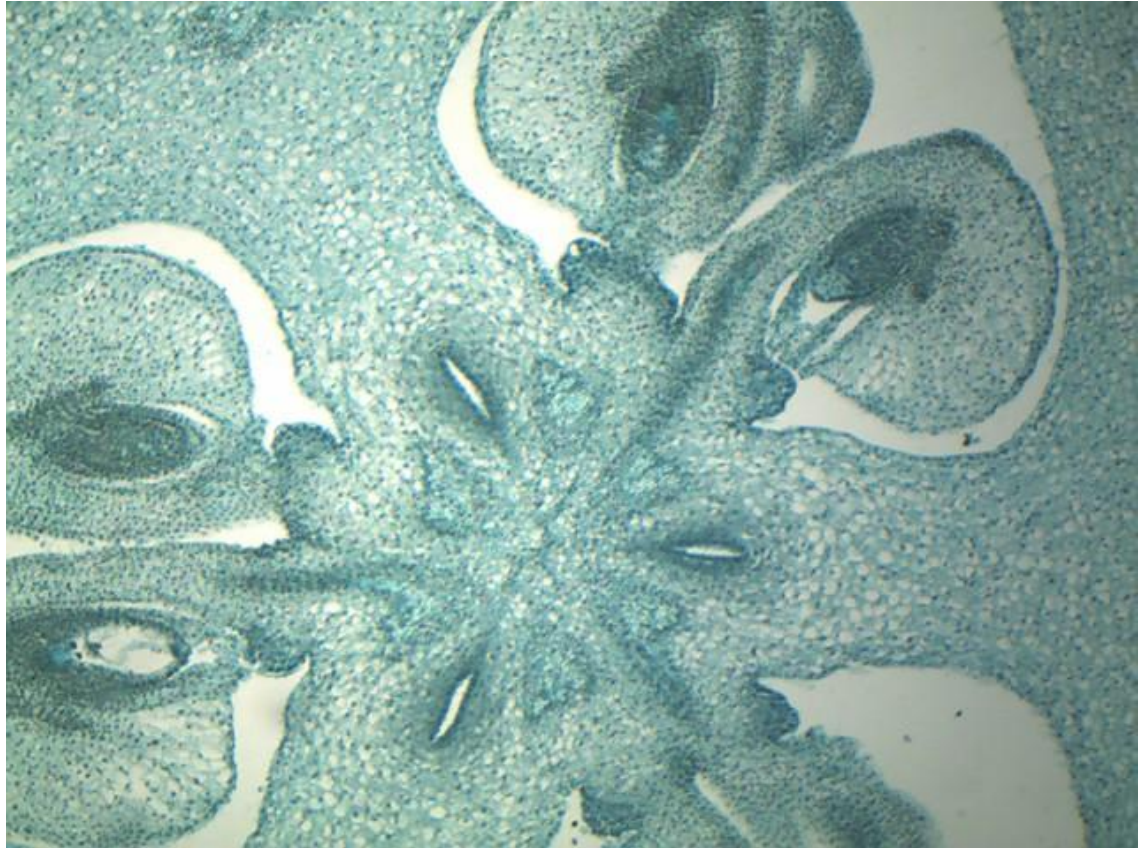
## Pollinia of *Calotropis*



## **Anatropous ovule:**

- It is of the most common occurrence more than 80% of angiosperm family).
- In this ovule, the funicle is long whole body of the ovule is inverted, through  $180^\circ$ .
- As a result the micropyle comes close to the funicle.
- Ex-Most common in dicots and monocots,
- Ex Asteraceae, Solanaceae.

# Anatropus ovule



# Orthotropus ovule

## **Orthotropous**

### **ovule:**

It is atropous or straight, where the micropyle, chalaza and the funiculus, all are in the same line.

Ex- Cycas, Family Polygonaceae and Piperaceae.

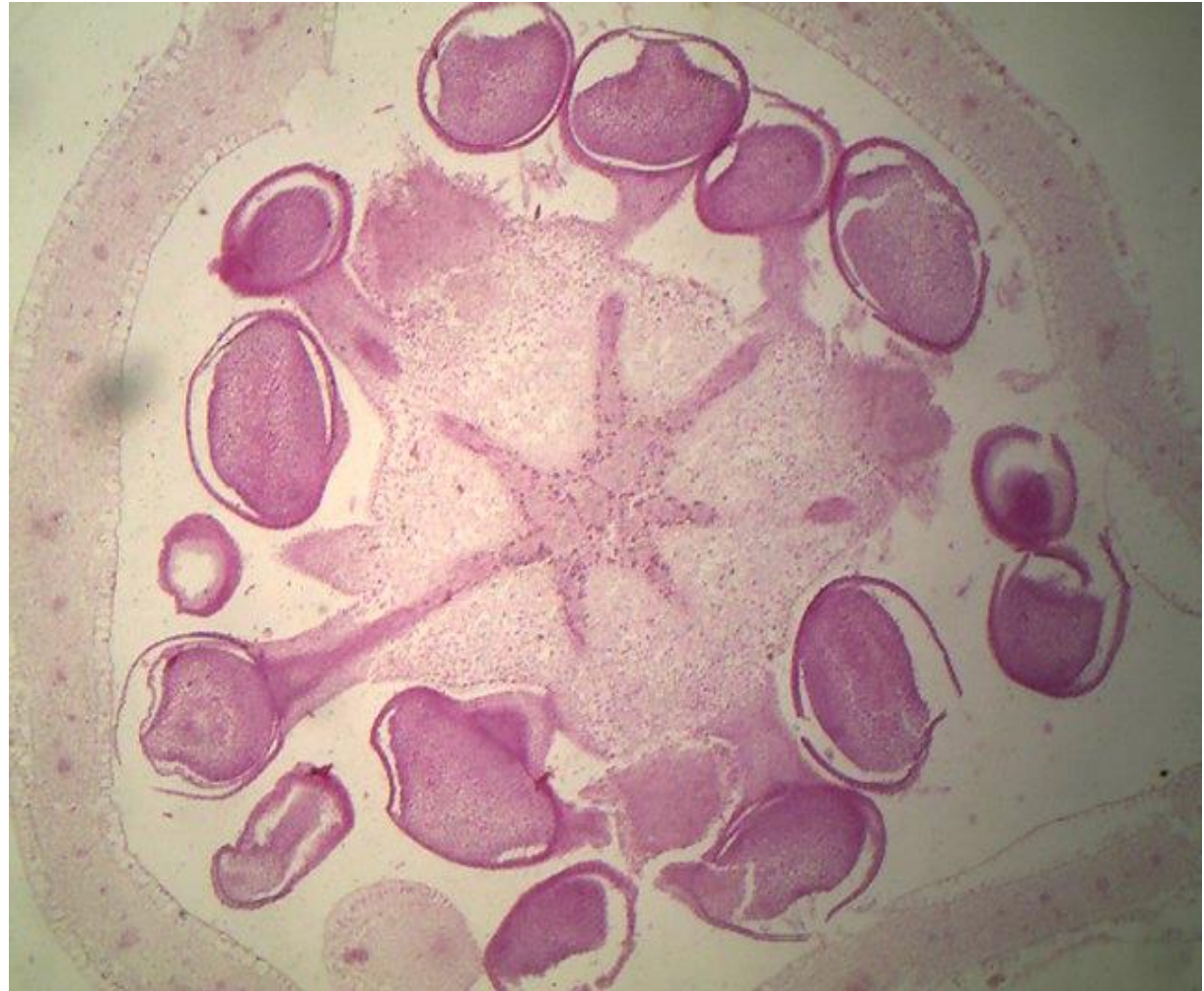


# Amphitropus ovule

## **Amphitropus ovule:**

It is similar to campylotropous, but in this case the nucellus/embryo-sac is also bent like 'horse shoe'

Ex- Family Alismaceae,



# Circinotropus ovule

## **Circinotropous ovule:**

It is of a very rare occurrence. Here the body of the ovule is bent through  $360^\circ$ , so that it takes a one complete turn. (Micropyle, chalaza and the nucellus are all in same plane).

Ex-Opuntia



# Mature anther w.m



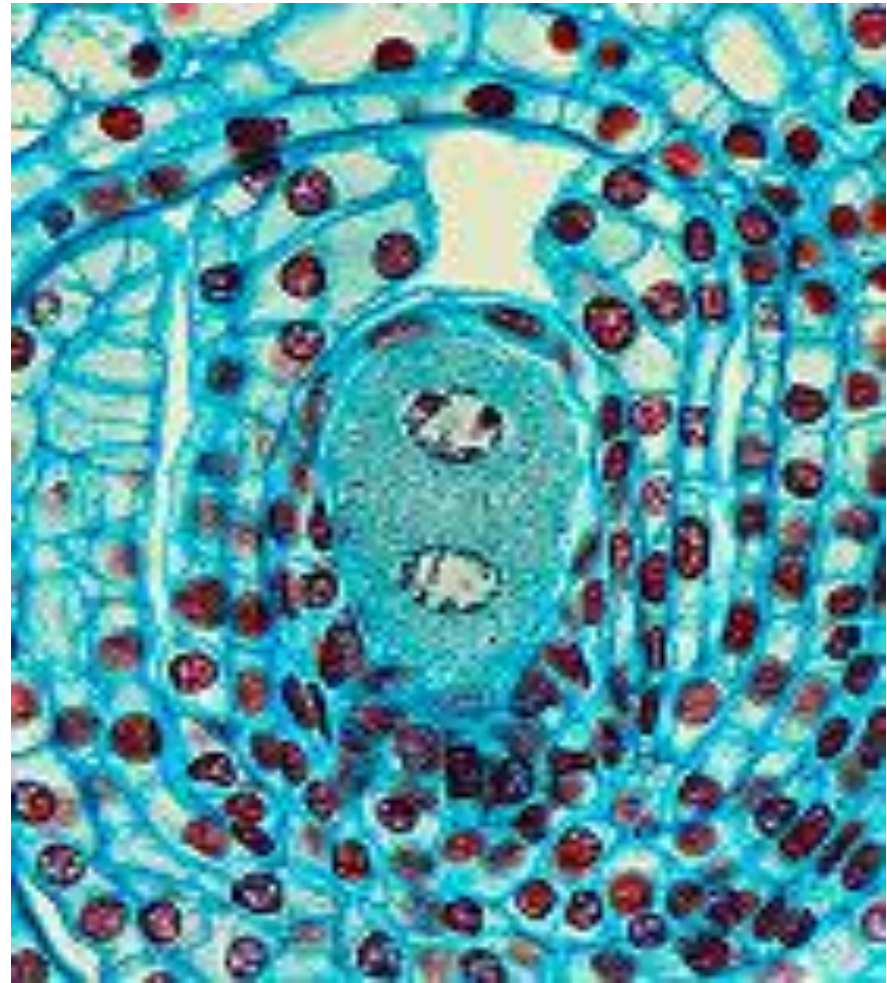
# T.S. Mature anther

- The section shows two lobes, each containing two microsporangia (pollen sac) filled with microspores (pollen grains).
- There is a vascular bundle in between the two lobes.
- The mature microsporangial wall consists of epidermis and endothecium.
- The cells of endothecium remain thin walled along the line of dehiscence and form stomium.
- The middle layer and tapetum become disorganised to form a nourishing fluid.
- The two pollen chambers in each lobe become fused due to disorganization.
- The pollen grain is released out through ruptured stomium.



- The ovary is tricarpeal, syncarpous and trilobular. There are two ovules in each locule.
- Placentation is axile.
- The ovule is anatropous. Each ovule is bitegmic and inverted with its micropyle near hilum.
- The nucellus encloses a large, single-celled developing embryo sac.
- The embryo-sac is 2-nucleate (one towards the micropylar end and is haploid and the other towards chalazal end is triploid)

## *Lillium* ovary 2 nucleate





# *Lillium* ovary tetra nucleate

- The ovary is tricarpeal, syncarpous and trilocular. There are two ovules in each locule.
- Placentation is axile.
- The ovule is anatropous. Each ovule is bitegmic and inverted with its micropyle near hilum.
- The nucellus encloses a large, single-celled developing embryo sac.
- The embryo-sac is 4-nucleate stage that develops from tetrasporic *Fritillaria* type of coenomegaspore.



# Placentation superficial

## **Superficial or Laminar:**

Here, the ovules develop over the entire inner surface of the carpels.

It occurs in multicarpellary ovary, e.g., *Nymphaea*

# Marginal Placentation

## **Marginal:**

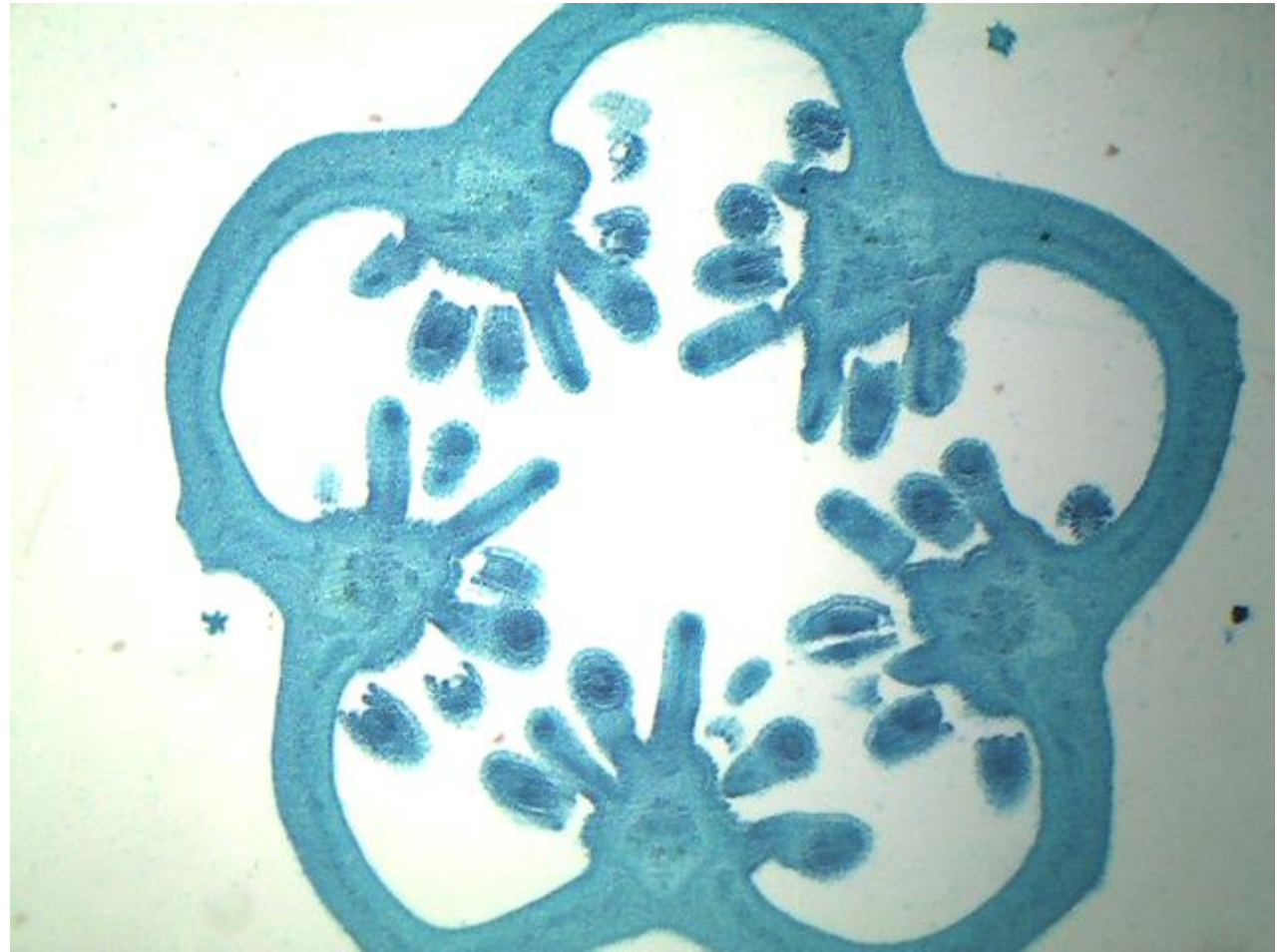
- Occurs in monocarpellary, unilocular ovary.
- The placenta develops and ovules are borne along the junction of the two margins of the carpel e.g., Pea.



# Parietal Placentation

## **Parietal:**

- The placenta is formed by the swelling up of cohering margins, and on the latter develop the ovules in rows.
- It occurs in bicarpellary or multicarpellary but unilocular ovary, e.g., Papaveraceae.

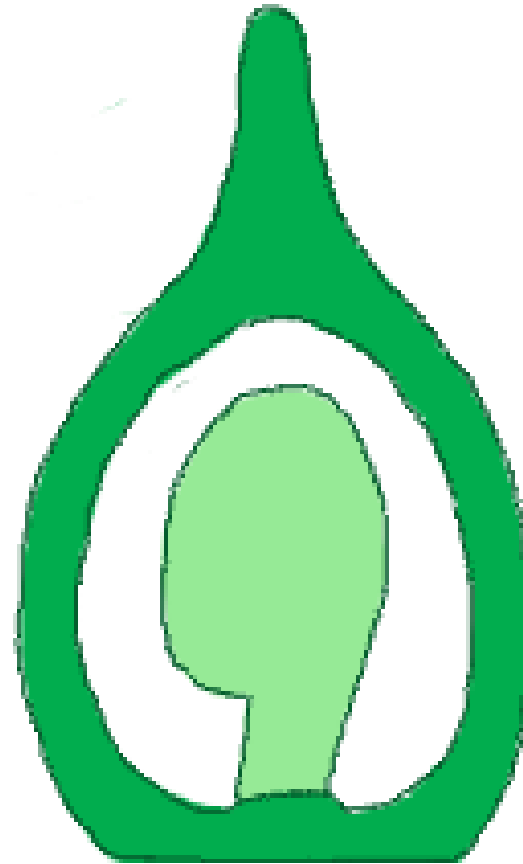


# Placentation Basal

## **Basal:**

It occurs in bicarpellary or multicarpellary but unilocular ovary

The placenta develops directly on the thalamus and bears a single ovule at the base of the unilocular ovary, e.g., Compositae.

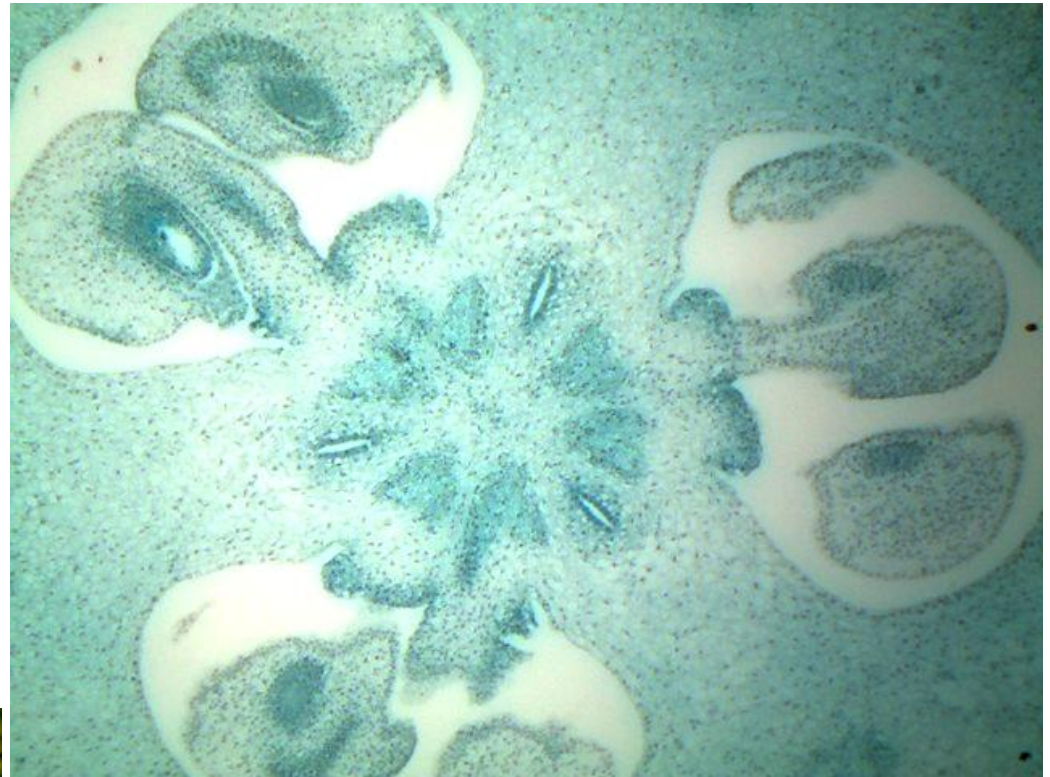


# Axile Placentation

## **Axile:**

Here, the placentae develop from the central axis which correspond to the confluent margins of carpels.

It occurs in bi- or multicarpellary and multilocular ovary, e.g., Solanaceae, Malvaceae.



# Free central Placentation

## Free-central:

- Here, the placenta develop in the centre of the ovary as a prolongation of floral axis and the ovules are attached on this axis.
- It occurs in multicarpellary but unilocular ovary, e.g., Primulaceae.
- it may also form by breaking down of septa from axile placentation e.g., Caryophyllaceae



# Inflorescence L.S. Capitulum

## Capitulum or Head:

In this type of inflorescence the main axis or receptacle becomes suppressed, and almost flat, and the flowers (also known as florets) are sessile (without stalk) so that they become crowded together on the flat surface of the receptacle.

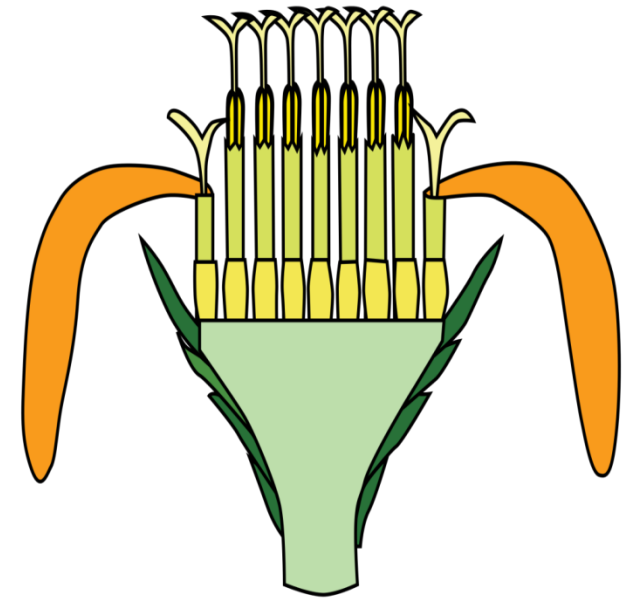
The florets are arranged in a centripetal manner on the receptacle, i.e., the outer flowers are older and open earlier than the inner ones.

The individual flowers (florets) are bracteate. In addition the whole inflorescence remains surrounded by a series of bracts arranged in two or three whorls.

## The flowers (florets) are usually of two kinds:

- (i) Ray florets (marginal strap-shaped flowers) and
- (ii) Disc florets (central tubular flowers).

A capitulum or head is characteristic of Asteraceae (Compositae) family, e.g., sunflower (*Helianthus annuus*), marigold (*Tagetes indica*), safflower (*Carthamus tinctorius*). Zinnia, Cosmos, Tridax, Vernonia, etc. Besides, it is also found in Acacia and sensitive plant (*Mimosa pudica*) of Mimosaceae family.



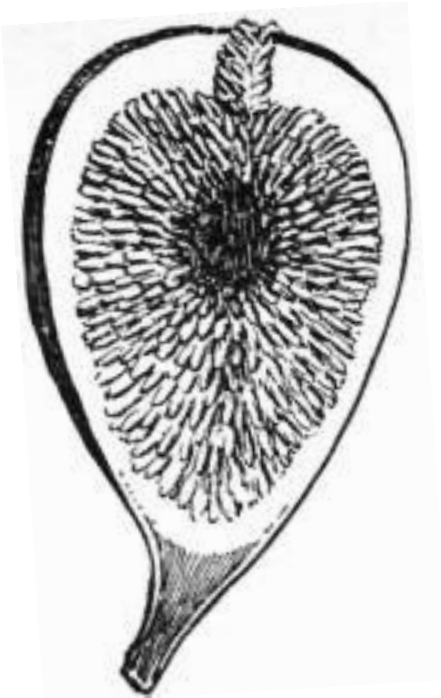


# Inflorescence, L.S. Hypanthodium



## Hypanthodium:

- In this type of inflorescence the receptacle forms a hollow cavity with an apical opening guarded by scales. Here the flowers are borne on the inner wall of the cavity.
- The flowers are unisexual; the female flowers develop at the base of the cavity and the male flowers towards the apical pore. The examples are found in genus *Ficus* of Moraceae family, e.g., *Ficus carica*, *F. glomerata*, *F. benghalensis*, *F. religiosa*, etc.



## Cyathium:

This type of inflorescence is found in genus *Euphorbia* of family Euphorbiaceae; also found in genus *Pedilanthus* of the family.

In this inflorescence there is a cup-shaped involucre, often provided with nectar secreting glands.

The involucre encloses a single female flower, represented by a pistil, in the centre, situated on a long stalk.

This female flower remains surrounded by a number of male flowers arranged centrifugally.

Each male flower is reduced to a solitary stalked stamen. It is evident that each stamen is a single male flower from the facts that it is articulated to a stalk and that it possesses a scaly bract at the base.

The examples can be seen in poinsettia (*Euphorbia*), *Pedilanthus*, etc.

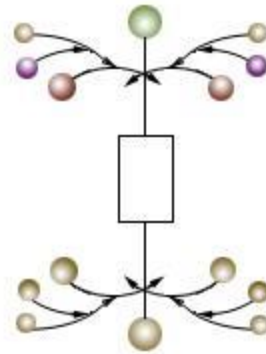
# Inflorescence Cyathium



## Verticillaster:

- This type of inflorescence is a condensed form of dichasial (biparous) cyme with a cluster of sessile or sub-sessile flowers in the axil of a leaf, forming a false whorl of flowers at the node.
- The first of main floral axis gives rise to two lateral branches and these branches and the succeeding branches bear only one branch each on alternate sides.
- The type of inflorescence is characteristic of Lamiaceae (Labiatae) family. Typical examples, are—*Ocimum*, *Coleus*, *Mentha*, *Leucas*, etc.

# Inflorescence Verticilaster



# LS flower bud

## Epigynous

An **inferior ovary** lies below the attachment of other floral parts.

Flowers with inferior ovaries are termed **epigynous**.

Some examples of flowers with an inferior ovary are orchids (inferior capsule), *Fuchsia* (inferior berry), banana (inferior berry), Asteraceae (inferior achene-like fruit, called a cypsela) and the [pepo](#) of the squash, melon and gourd (Cucurbitaceae) family.



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# L.S. Flower bud: Hypogynous

- A **superior ovary** is an ovary attached to the receptacle above the attachment of other floral parts. A superior ovary is found in types of fleshy fruits such as true berries, drupes, etc.
- A flower with this arrangement is described as **hypogynous**. Examples of this ovary type include the legumes (beans and peas and their relatives).

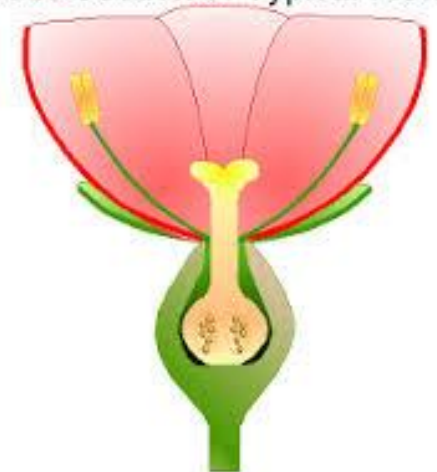


# L.S. Flower bud: Perigynous

- A **half-inferior ovary** (also known as “half-superior”, “subinferior,” or “partially inferior,”) is embedded or surrounded by the receptacle.
- This occurs in flowers of the Lythraceae family, which includes the Crape Myrtles. Such flowers are termed **perigynous** or **half-epigynous**.
- In some classifications, half-inferior ovaries are not recognized and are instead grouped with either the superior or inferior ovaries.
- E.g. Asteraceae, Rosaceae, Lythraceae , Papilionaceae.

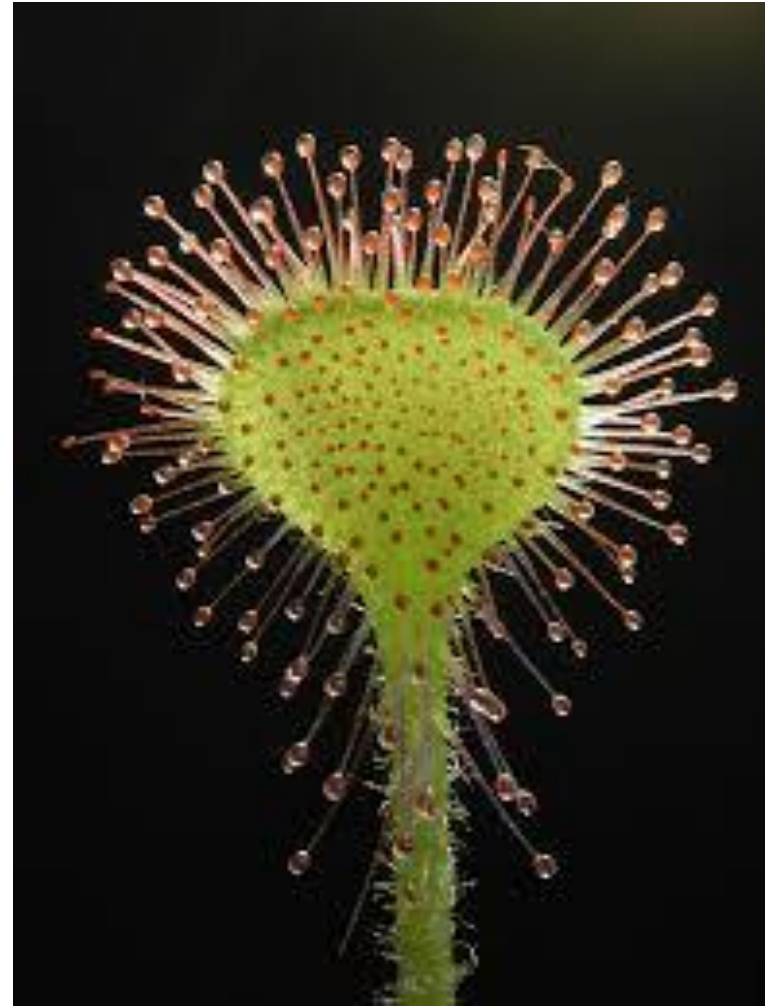


ROSACEAE FLOWERS  
Cross Section of Typical Flower



# *Drosera*

- it is an insectivorous plant, commonly called **sundew** belonging to family Droseraceae
- Plant are herbaceous, rosette like and grow in water logged places.
- Mature leaves are mostly spoon shaped and possess a large number of glandular hair called tentacles, mostly on upper surface.
- Each tentacles is stalked, mucilage secreting gland which is bright red in colour.
- The tip of gland secretes a sticky purple juice which shine like a dew drop in sunlight.
- Insects are attracted to shining leaf surface



# *Utricularia*

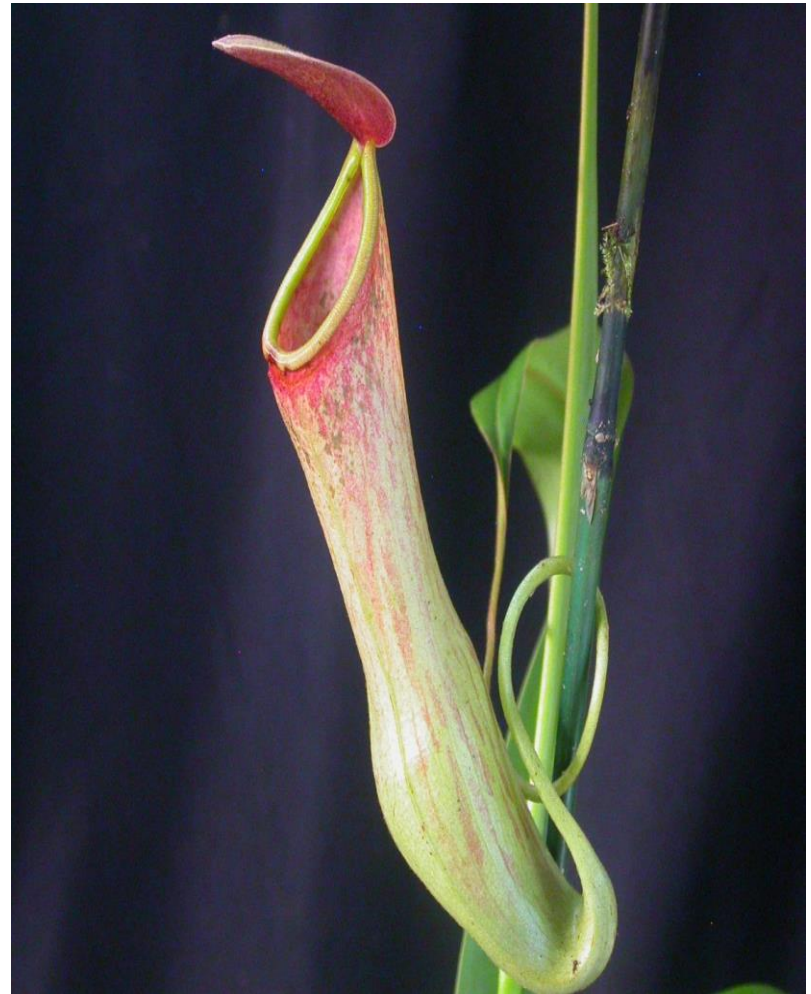
- it is an insectivorous plant, commonly called **bladder wort** belonging to family Utriculariaceae.
- Plant are mostly aquatic, commonly found in the Dal lake of Kashmir.
- Plant body is free floating, rootless, much branched shoot with dissected leaves.
- Some of the leaf lobes are modified into sensitive little sac like traps called Bladder.
- Each bladder is stalked, pear shaped, hollow chamber which open by a small opening gaurded by valve. The valve opens inwardly.
- Opening of bladder bears sensitive filiform hairs.





# *Nepenthes*

- It is an insectivorous plant, commonly called **pitcher plant** belonging to family Nepenthaceae.
- The plant may be climbers or epiphytes.
- The leaves are large with elongated tendril like petiole and lamina modified into pitchers.
- The apex of leaf is modified into a small and coloured lid which covers the opening of the pitcher.
- The attractive colour of lid and nectaries present at the rim attract the insects.
- The insect is destroyed by juice secreted by digestive glands situated inside the upper half of pitcher.



# *Dionaea*

- it is an insectivorous plant, commonly called **venus fly trap** belonging to family Droseraceae
- Plant is herb, which bear a rosette of leaves.
- The leaves are large which consist of winged petioles.
- The lamina of leaf is modified into two toothed jaws.
- The upper surface of each jaw bears prongs called sensitive hairs or bristles and irregularly scattered digestive glands.
- The insect is destroyed by juice secreted by digestive glands.



# *Hydrilla* plant

- It is the common submerged hydrophyte that grow suspended under water.
- Plant are perennial.
- The branched shoot is attached to the substratum by adventitious roots
- The stem is delicate, thin, spongy and flexible.
- It has nodes and internodes.
- Plants parts are covered with mucilage.



# *Pistia*

- The plant is free floating hydrophyte found in ponds.
- The plants grow by means of offset (stem which has node and internode).
- A rosette of sessile leaves arise in close spirals at each node.
- Older leaves are spread horizontally.
- A cluster of adventitious roots arise from each node.
- The roots are devoid of root caps instead they bear root pockets



# *Lemna*

- The plants are small free floating hydrophyte found in ponds and lakes.
- The plant body shows no distinction of stem and leaves.
- It looks like thallus.
- Each plant bears a single, unbranched, hairless peltately attached root.
- It possesses a smooth or winged root pocket.



# *Salvinia*

- The plants are small free floating hydrophyte belonging to pteridophyte.
- The upper surface of leaves is well protected from wetting by interlacing hairs.
- The plants grow in dense masses which cause partial shades.



- The plants are free floating water weeds, occur abundantly in ponds, lakes and ditches.
- Plants grow by means of spongy offsets, which show nodes and internodes.
- Cluster of pinkish adventitious roots arise from each node.
- The roots act as balancers.

# *Eichhornia*



# *Jussiaea*

- The plant are free floating hydrophytes.
- The stem is spongy and grow over the surface of water.
- It produce aerial leafy shoots from the nodes.
- Two kind of roots develops from the nodes- ordinary anchorage roots and modified floating root.
- Root hairs are absent.
- The root caps are elongated and form root pockets.





# *Nymphaea*

- The plant are floating leaved anchored hydrophytes mostly occur in shallow water.
- The leaves float at the surface whereas rhizome is rooted in mud.
- The leaves posses long cylindrical, flexible and spongy petioles.
- The lamina is large, peltate and show cordate outline.
- Submerged parts are coated with mucilage.



- It is a total stem parasite *Cuscuta reflexa* belonging to family Convolvulaceae
- The parasite is very long, filamentous, branched, non-chlorophyllous, pale yellow in colour and bear scale leaves.
- It produce bunches of whitish or yellowish bell shaped flowers.
- The parasite gets organic food, minerals and water from the host through some special absorbing organs called **haustoria**.
- The haustoria are infact modified adventitious roots which penetrate up to the vascular tissue of host.

## *Cuscuta* on host



# Root nodules

- The root of leguminous plants bear large number of small, granular, pink nodules on their branches.
- The nodules vary in size and shape.
- The nodules are formed due to penetrations of bacteria- ***Rhizobium*** sp and resultant stimulation of cell division in cortical cells.
- The host plant supplies the nodule bacteria with organic carbon and in return the bacteria supplies usable nitrogen to the host. Such association is known as **Symbiosis**.
- The invaded cells of nodules contain a reddish pigment called **leghaemoglobin**



# Poppy fruit



# Pome fruit



# Berry- Tomato fruit



# Pea fruit- pod



# Coconut fruit-Drupe





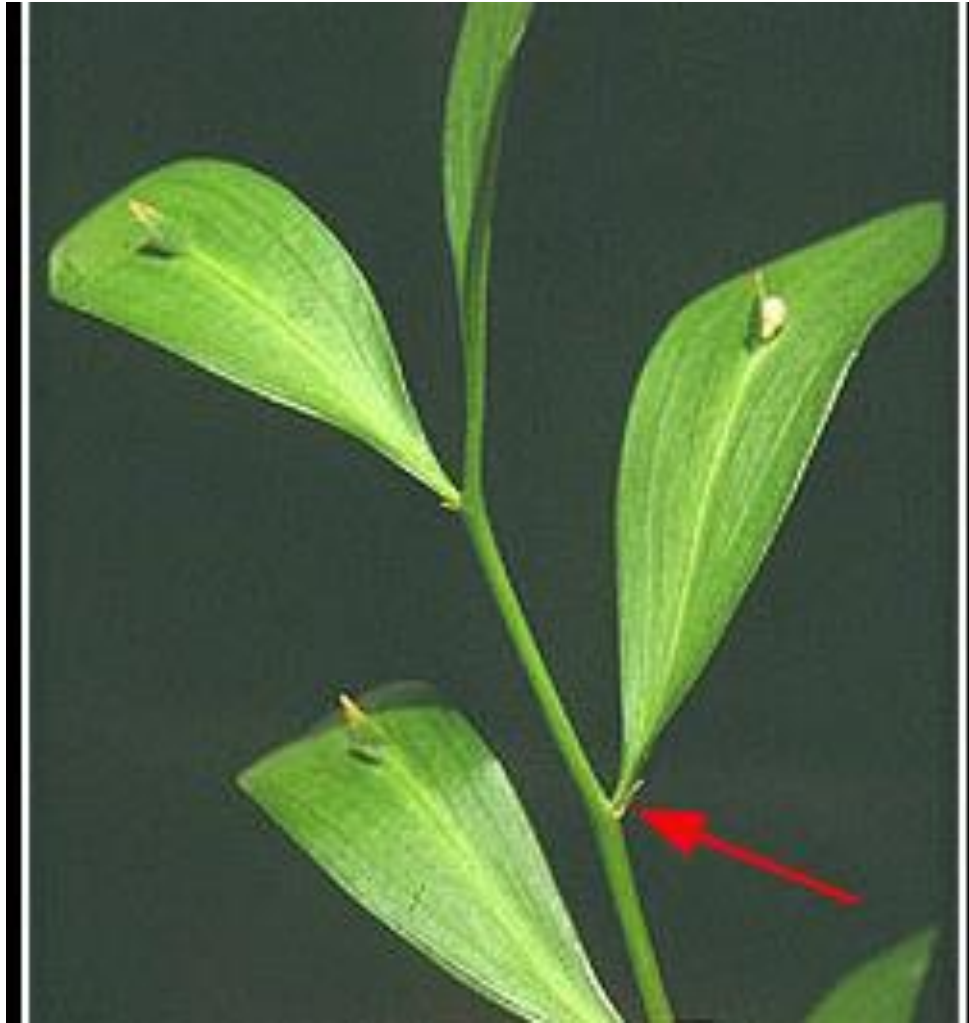
# Coriander fruit



# Cotton fruit



# Phyllode- Ruscus



# Phylloclade - *Opuntia*



# Cladode - *Asparagus*



# Phylloclade of *Muehlenbeckia*



# *Cucurbita tendril*



# Phyllode of *Parkinsonia*





# Phyllode of Australian Acacia



# *Vitis tendril*

