LABORATORY / FIELD EXERCISES

Study / microscopic observation of vegetative, sectional / anatomical and reproductive structures of the following using temporary or permanent slides / specimens / mounts:

1. ALGAE

1. SPIROGYRA

Spirogyra (spiro = coiled andgyra = curved).

Kingdom : Plantae
Divison : Thallophyta
Class : Chlrophyceae
Order : Conjugales
Family : Zygnemataceae

Occurrence:

This is very common free floating fresh water alga found in fresh water pools,Lakes, etc, inabundance. This is also known as 'pond silk' or 'water silk'. The filaments are slimy in nature because of the presence of mucilaginous substance around them.

External Features and Cell Structure:

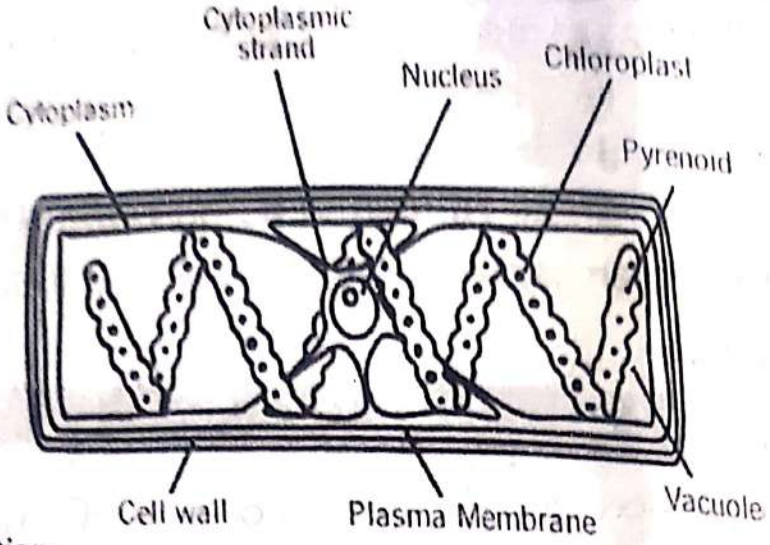
1. The filaments are unbranched and consist of the cylindrical cells arranged end to end.
2. The cell wall of the filament is usually two layered. The outermost layer consists of pectic substances and the layer just outside the protoplast consists of cellulose.
3. Each cell is cylindrical and several times longer than its breadth.
4. The cells are uni-nucleate. The nucleus is usually situated in the centre of the cell and connected by cytoplasmic strands to the dense cytoplasm of the peripheral region.
5. There is a big central vacuole.
6. The chloroplasts are spiral and band like. They may be serrated or smooth at their margins.
7. The number of chloroplasts ranges from 1-14 in different species.
8. Many pyrenoids are found in each ribbon-like chloroplast.

External features and cell structure :-

* The cell wall of the filament is usually two layered. The outermost layer consists of pectic substances and the layer just outside the protoplast consists of cellulose.
* The cells are uni-nucleate.
* The chloroplasts are spiral and band like. The number of chloroplasts ranges from 1-14 in different species
* Many pyrenoids are found in each ribbon-like chloroplast
* Reproduction occurs by both vegetative and sexual type.

Identification-

By the above said reasons, the given sheet is External features and cell structure of Spirogyra.



Reproduction:

- Vegetative: By fragmentation.

Sexual:

1. Sexual reproduction takes place by special gametes called 'aplanogametes'.
2. Sexual process is known as 'aplano-gamy'.
3. Motile gametes always lacking.
4. Aplanogamy takes place by conjugation, which may be 'scalariform' or 'lateral'.
5. In each cell, a single aplanogamete is produced which moves in the other cell througha conjugation tube in amoeboid fashion.
6. The species may be homothallic or heterothallic.
7. Lateral conjugation takes place in homothallic species
8. In scalariform conjugation, the aplanogametes of two filaments unite whereas inlateral conjugation the aplanogametes of two adjacent cells of the same filamentunite.

Scalariform Conjugation:

9. This is found in most of species.
10. Two filaments taking part in conjugation lie side by side.
11. The outgrowths are given out from the lateral walls of the opposite cells of thefilaments.
12. The outgrowths of opposite cells touch each other, the wall of contact dissolves and atubular passage is formed.
13. This tubular passage is called 'conjugation tube'.
14. A single aplanogamete develops in each cell.
15. The aplanogametes formed in the cells of the one filament pass into the opposite cells of the other filament through conjugation tubes in amoeboid fashion.

Scalariform conjugation:-

* Two filaments taking part in conjugation lie side by side.
* The outgrowths of opposite cells touch each other, the wall of contact dissolves and a tubular passage is formed.
* This tubular passage is called 'conjugation tube'.
* The aplanogametes formed in the cells of the one filament pass into the opposite cells of the other filament through conjuation tubes in ameeboid fashion.
* The transferring aplanogametes are considered male gametes and the receiving aplanogametes are female gametes.

→ By the above said reasons, the given sheet is scalariform conjugation of Spirogyra.

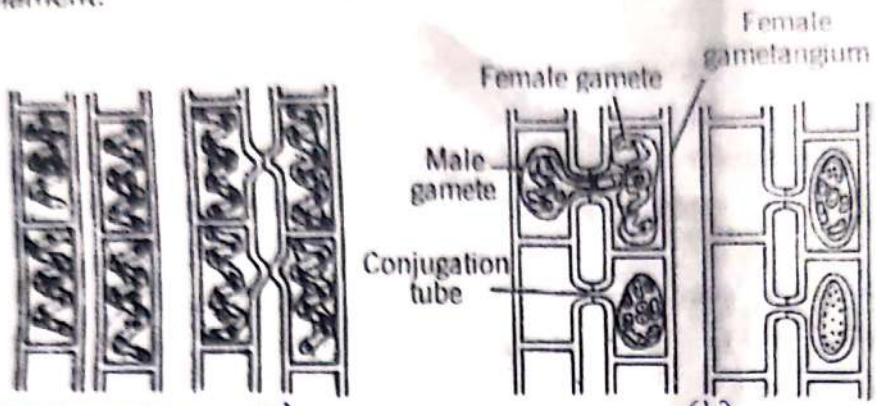
Lateral conjugation:-

* This type of conjugation is found occasionally and in homothallic species.
* Here the aplanogametes of the adjacent cells of the same filament unite.
* The empty cells are considered as male gametangia and the cells with zygotes as female gametaogia.
* The zygotes are found in alternate cells.

Identification-

By the above said reasons, the given sheet is lateral conjugation of Spirogyra.

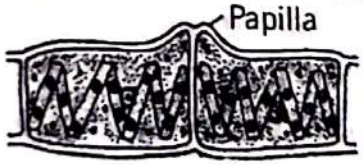
16. The transferring aplanogametes are considered male gametes and the receiving aplanogametes are female gametes.
17. A single thick-walled zygospore develops in each cell of the female filament.



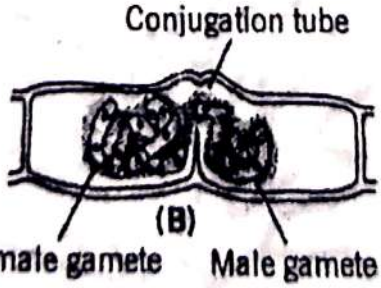
Lateral conjugation:

This type of conjugation is found occasionally and in homothallic species.

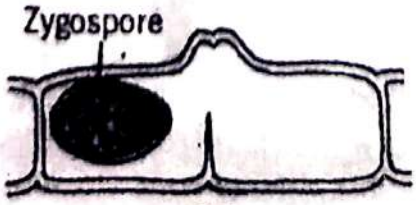
18. Here the aplanogametes of the adjacent cells of the same filament unite.
19. At the septum a tube like structure develops and through this opening the contents of one cell pass into the other.
20. The empty cells are considered as male gametangia and the cells with zygotes as female gametaogia.
21. The zygotes are found in alternate cells.
22. The zygote is dark-coloured and thick walled



(A)



(B)



(c)

Ectocarpus

Classification

Sub-division	—	**Algae**
Class	—	**Phaeophyceae**
Order	—	**Ectocarpales**
Family	—	**Ectocarpaceae**
Genus	—	***Ectocarpus***

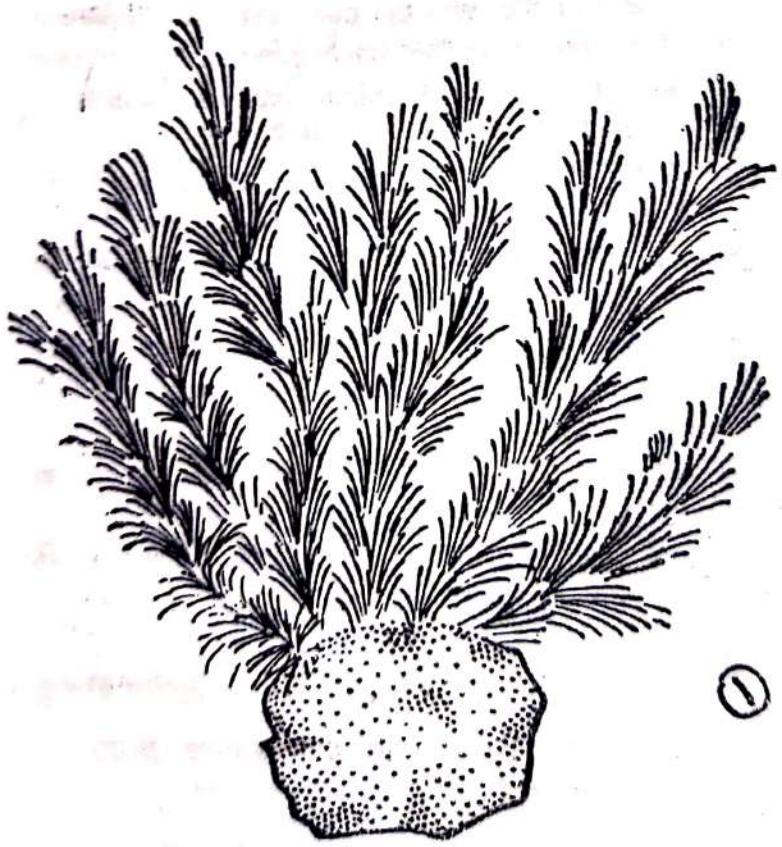


Fig. 1. ***Ectocarpus.*** Habit

Ectocarpus - Habit

* Thallus is multicellular, filamentous and branched
* Filaments are heterotrichous and differentiated into i) Prostrate portion and ii) an erect portion.
* In some species prostrate portion is irregularly and profusely branched or altogether absent.
* Main axis is broad from which lateral branches arise just beneath the septum and tapers into a point.

Identification -

By the above said reasons, the given sheet is Ectocarpus - habit.

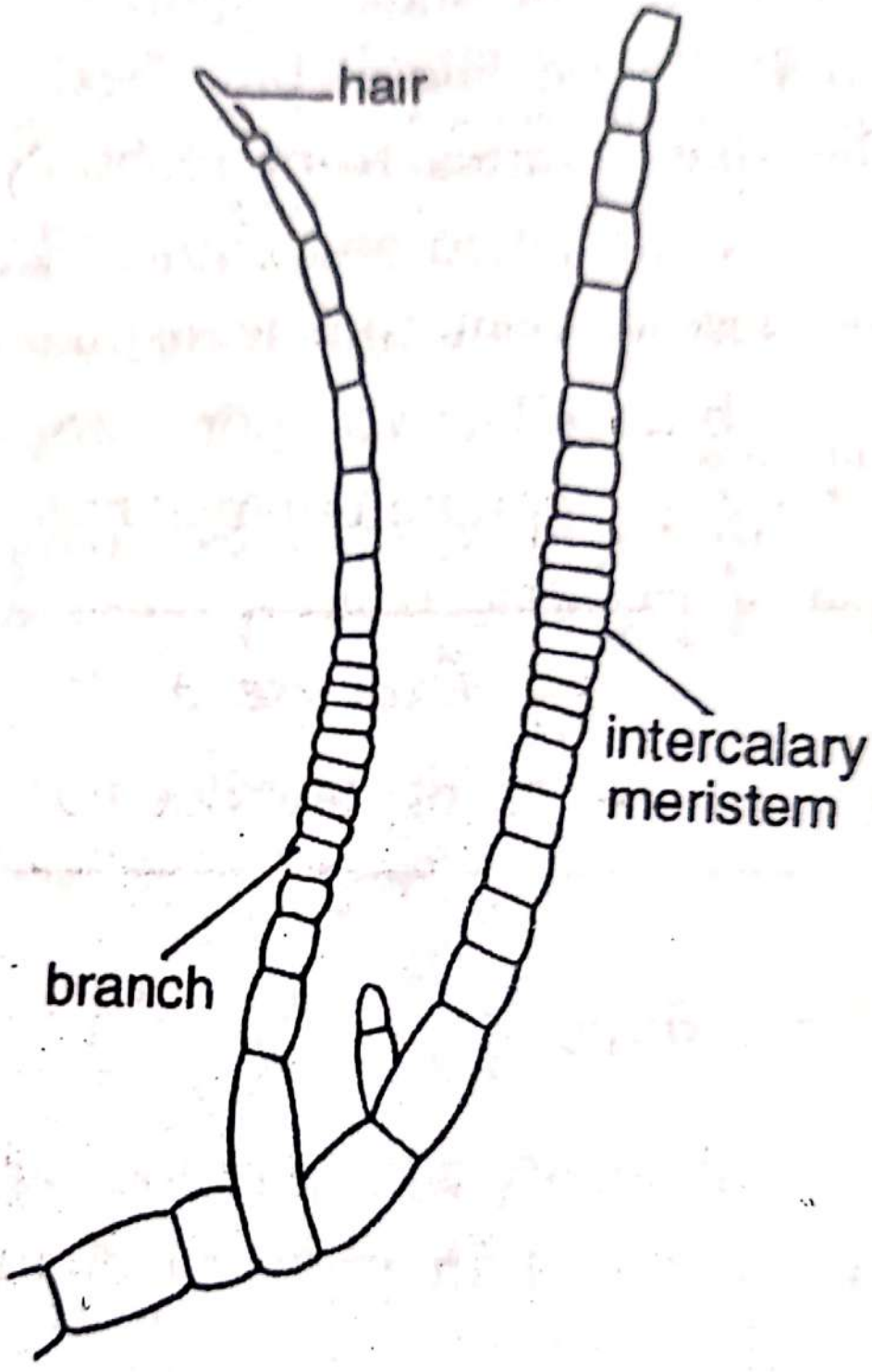


Fig. 2. *Ectocarpus*. A part of the filamentous thallus

Ectocarpus - A part of the filamentous thallus

* The branches and the main axis are uniseriate.
* The erect branches have intercalary meristem just below the terminal hair. It results in trichothallic growth.
* Erect portion is a crowded tuft of branches.
* Ultimate branches give an appes appearance of a hair.

Identification -

By the above said reasons, the given sheet is a part of filamentous thallus of ectocarpus.

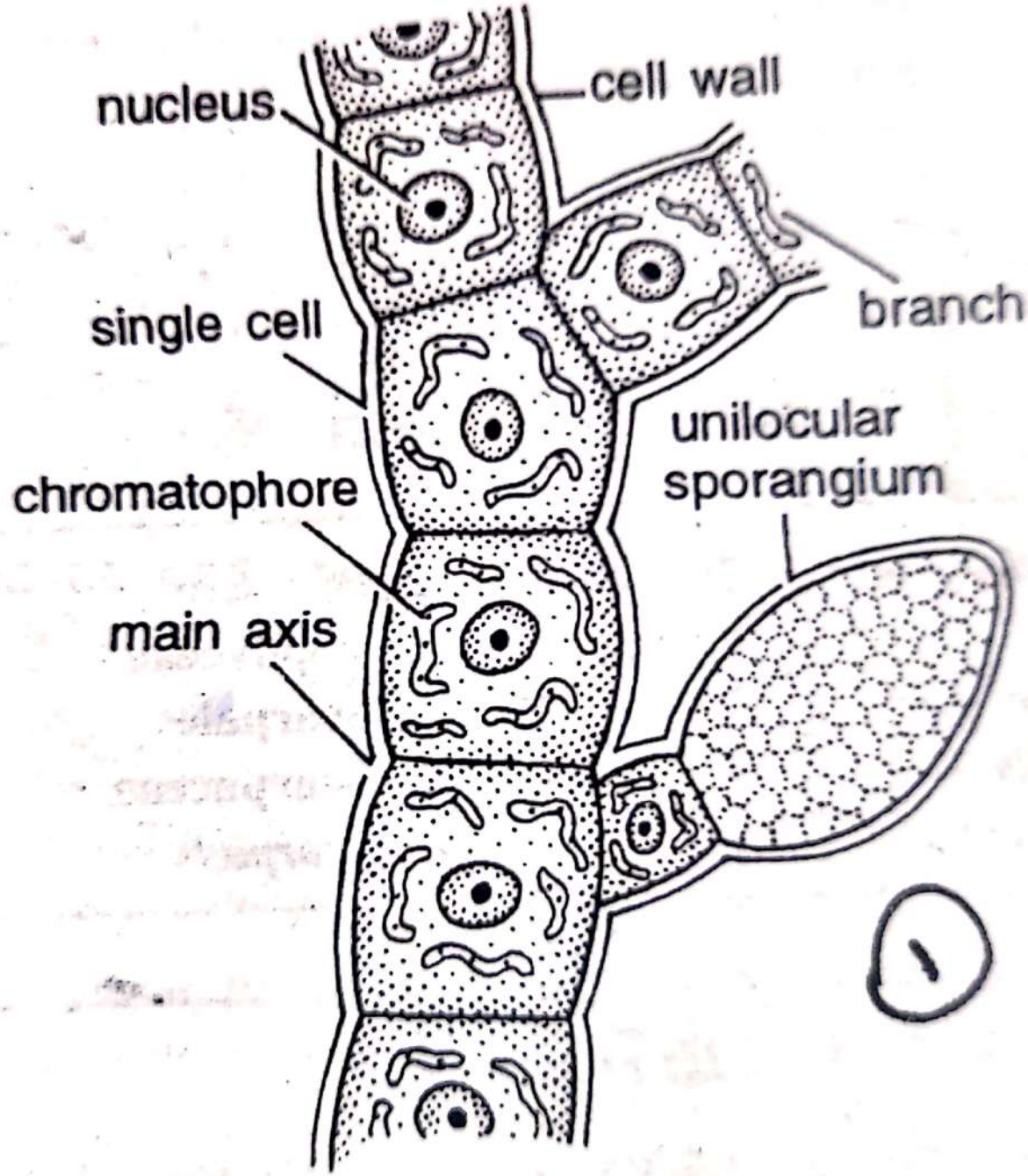


Fig. 4. ***Ectocarpus.*** A branch with unilocular sporangium.

Ectocarpus - A branch with unilocular sporangium

* Unilocular sporangium is a structure of asexual reproduction, always present on diploid plants.
* The sessile or stalked sporangium is situated terminally on lateral branches.
* It is a single celled wall and uninucleate when young but becomes multinucleate later.
* Many biflagellate zoospores are produced when unilocular sporangium matures.

Identification -

By the above said reasons, the given sheet is a branch with unilocular sporangium of Ectocarpus.

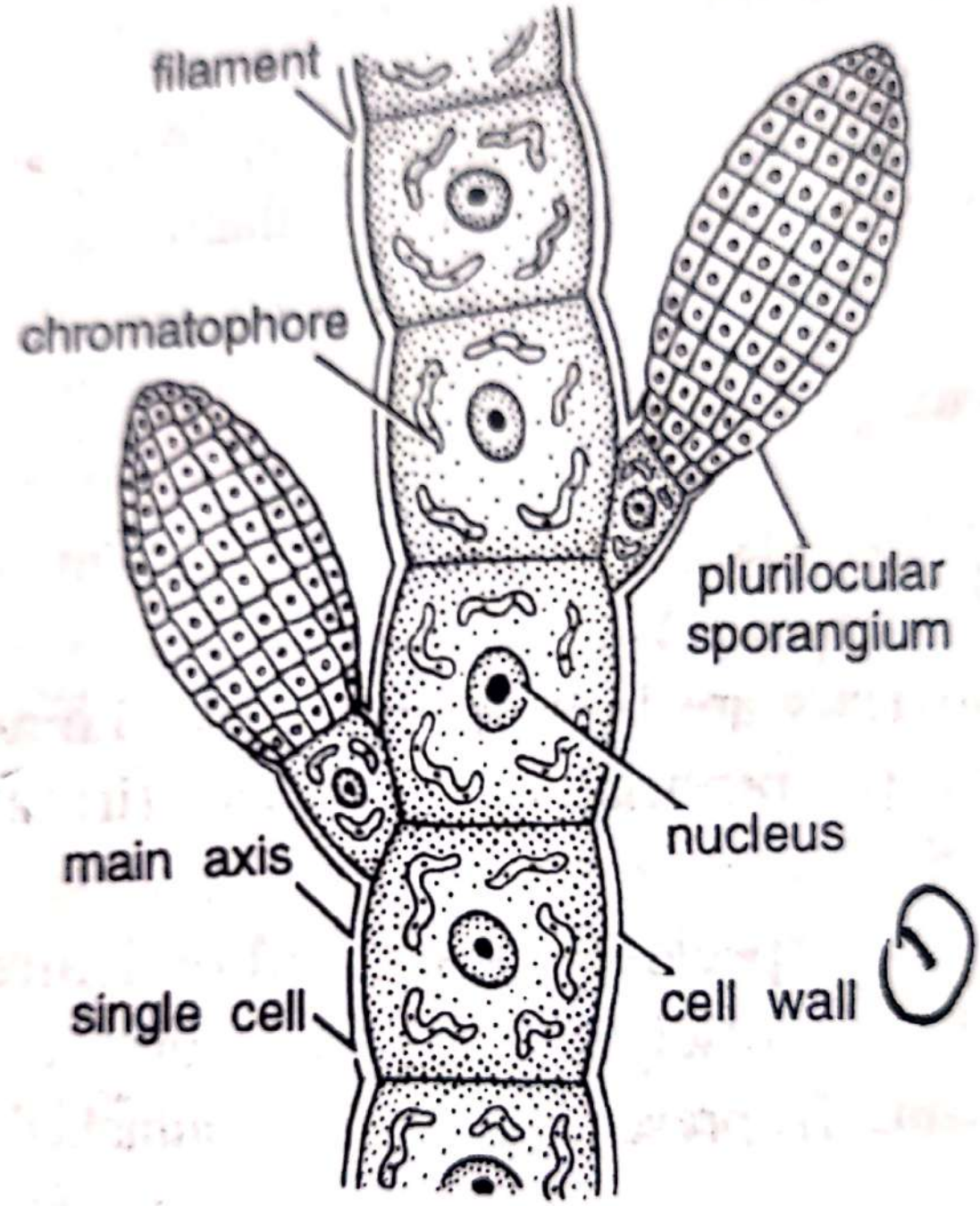


Fig. 5. ***Ectocarpus***. Filament with plurilocular sporangia.

Ectocarpus - Filament with plurilocular sporangia

* These occur on both haploid and diploid plants.
* The structure when borne by haploid plant serves as a gametangium whereas on diploid plant it functions as a sporangium.
* Sporangia situated laterally may be sessile or stalked. These may be ovate to siliquose.
* Plurilocular sporangium is divided into large number of cells.

Identification -

By the above said reasons, the given sheet is a filament with plurilocular sporangia of ectocarpus.

Vaucheria

Classification

Sub-division	—	**Algae**
Class	—	**Xanthophyceae**
Order	—	**Heterosiphonales**
Family	—	**Vaucheriaceae**
Genus	—	***Vaucheria***

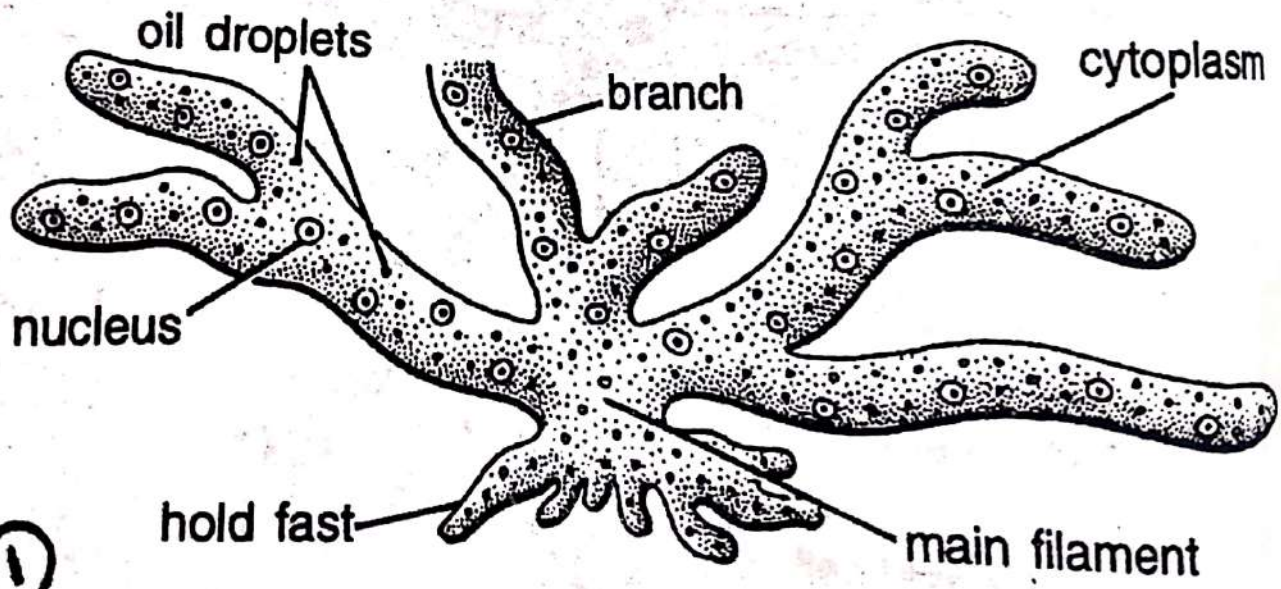


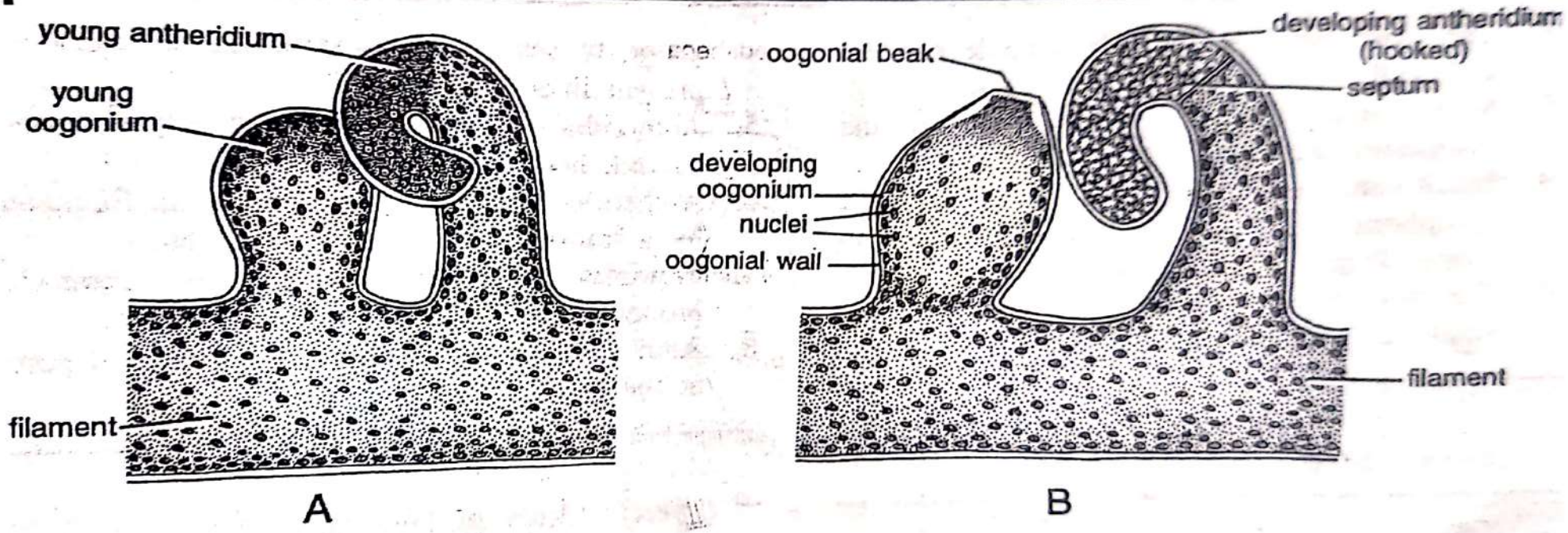
Fig. 1. ***Vaucheria.*** Thallus to show habit.

Vaucheria - Thallus to show habit :-

* Thallus is unicellular, multinucleate, filamentous and branched.
* If terrestrial in habitat, a few colourless rhizoidal branches are given out which penetrate soil.
* Cell wall is two layered. Outer layer is composed of pectose while inner is that of cellulose.
* The cytoplasm lies between vacuole and the cell wall.

Identification -

By the above said reasons, the given sheet is a thallus to show habit of Vaucheria.

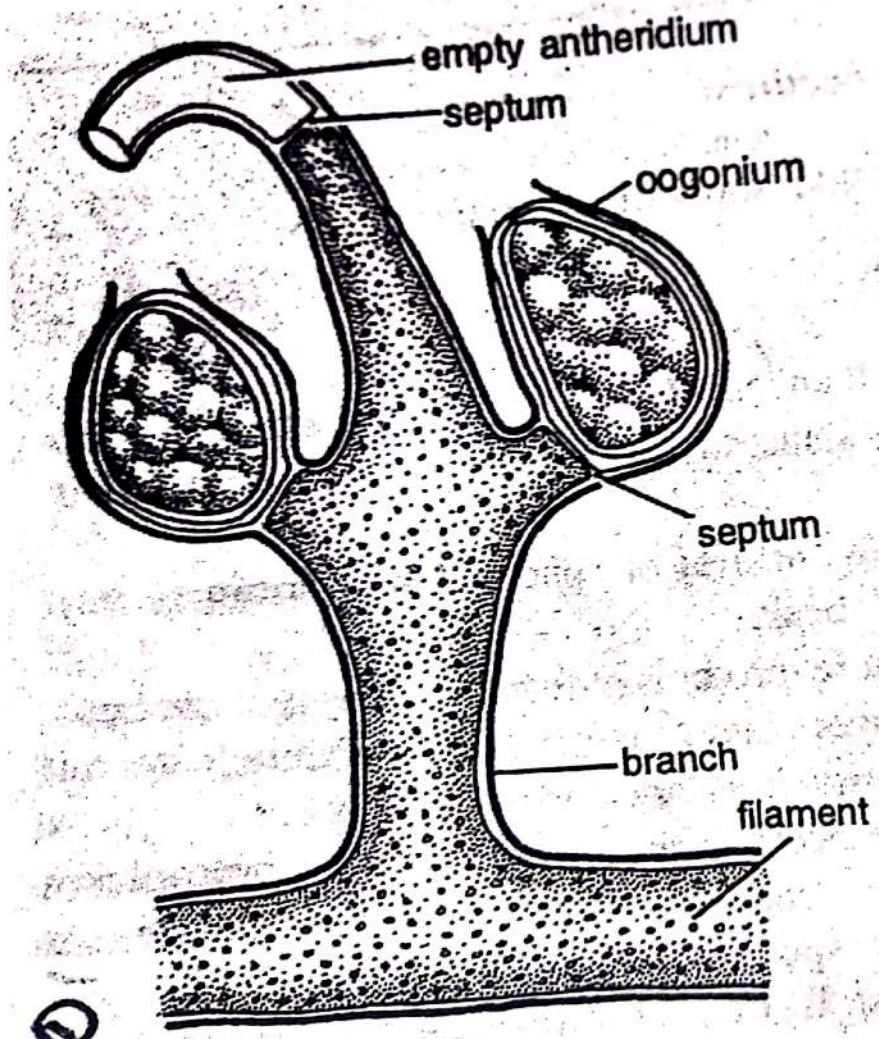


Vaucheria :- [A, B]

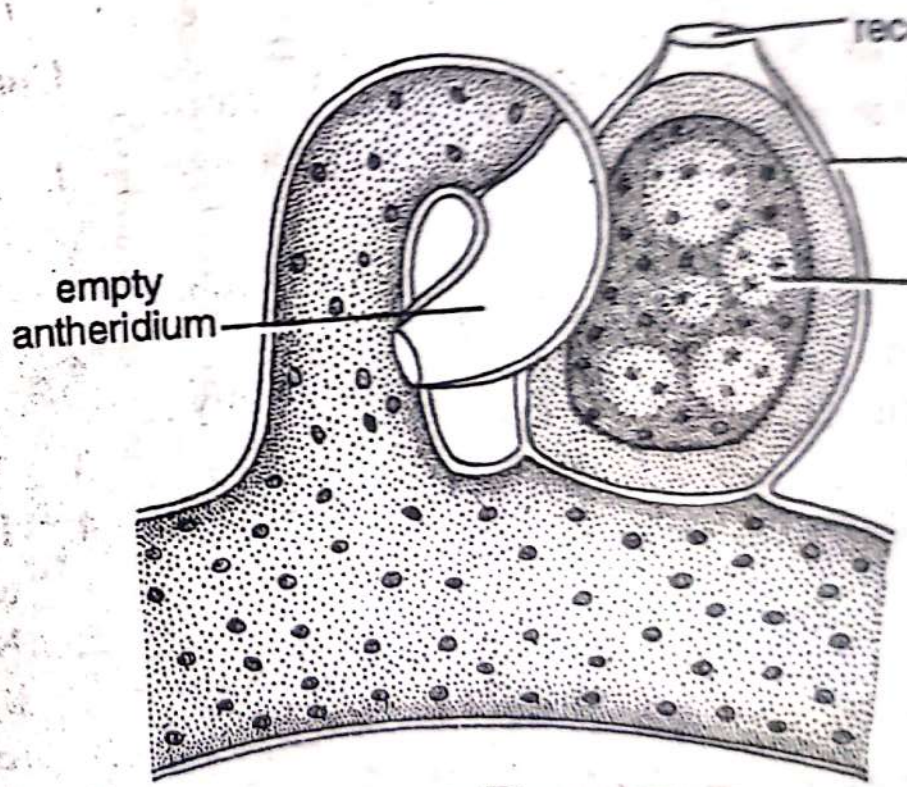
* Male reproductive bodies are antheridia and female reproductive bodies are oogonia.
* The antheridia and oogonia are borne side by side on the same filament. Sex organs are generally sessile but a stalk-like structure is present in a few species.
* Antheridia are terminal. These are strongly curved, hook-like and cylindrical.
* Antheridia are cut off from the main filament by a transverse septum at its base.

Identification -

By the above said reasons, the given sheet is various stages in sexual reproduction of Vaucheria showing young oogonium with young coiled antheridium and mature oogonium



C



D

Vaucheria :- [C, D]

* Zygote is the result of fertilization.
* It is present inside the oogonium.
* The protoplast of a zygote is very dense.
* It is considered to be a diploid structure, as such there is said to be possibility of zygotic meiosis.

Identification :

By the above said reasons, the given sheet is showing stalked sex organs in Vaucheria geminata and Empty antheium and zygote of Vaucheria.

Polysiphonia

Classification

Sub-division	—	**Algae**
Class	—	**Rhodophyceae**
Sub-class	—	**Florideae**
Order	—	**Ceramiales**
Family	—	**Rhodomelaceae**
Genus	—	***Polysiphonia***

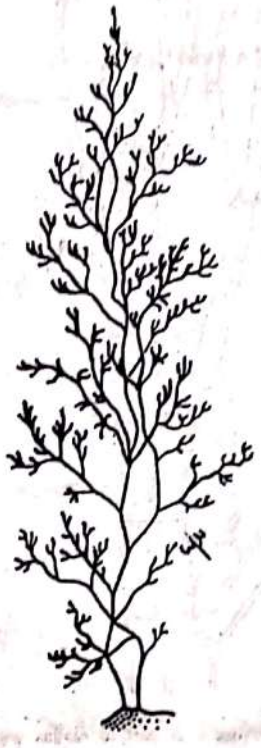


Fig. 1. ***Polysiphonia.*** Thallus to show habit.

Polysiphonia - Thallus to show habit :-

* Plant body is filamentous. Filaments are multicellular, branched and polysiphonous.
* Branching is dichotomous. Each branch terminates into a single celled apex, followed by a number of flat cells.
* Thallus is polysiphonous i.e made of series of parallel filaments.
* centre is occupied by a large barrel shaped cell.
* In the apical region, two or three cells below the apical cell, uniseriate, dichotomously divided, gradually tapering and multicellular filament is produced.

Identification :-

By the above said reasons, the given sheet is thallus of polysiphonia.

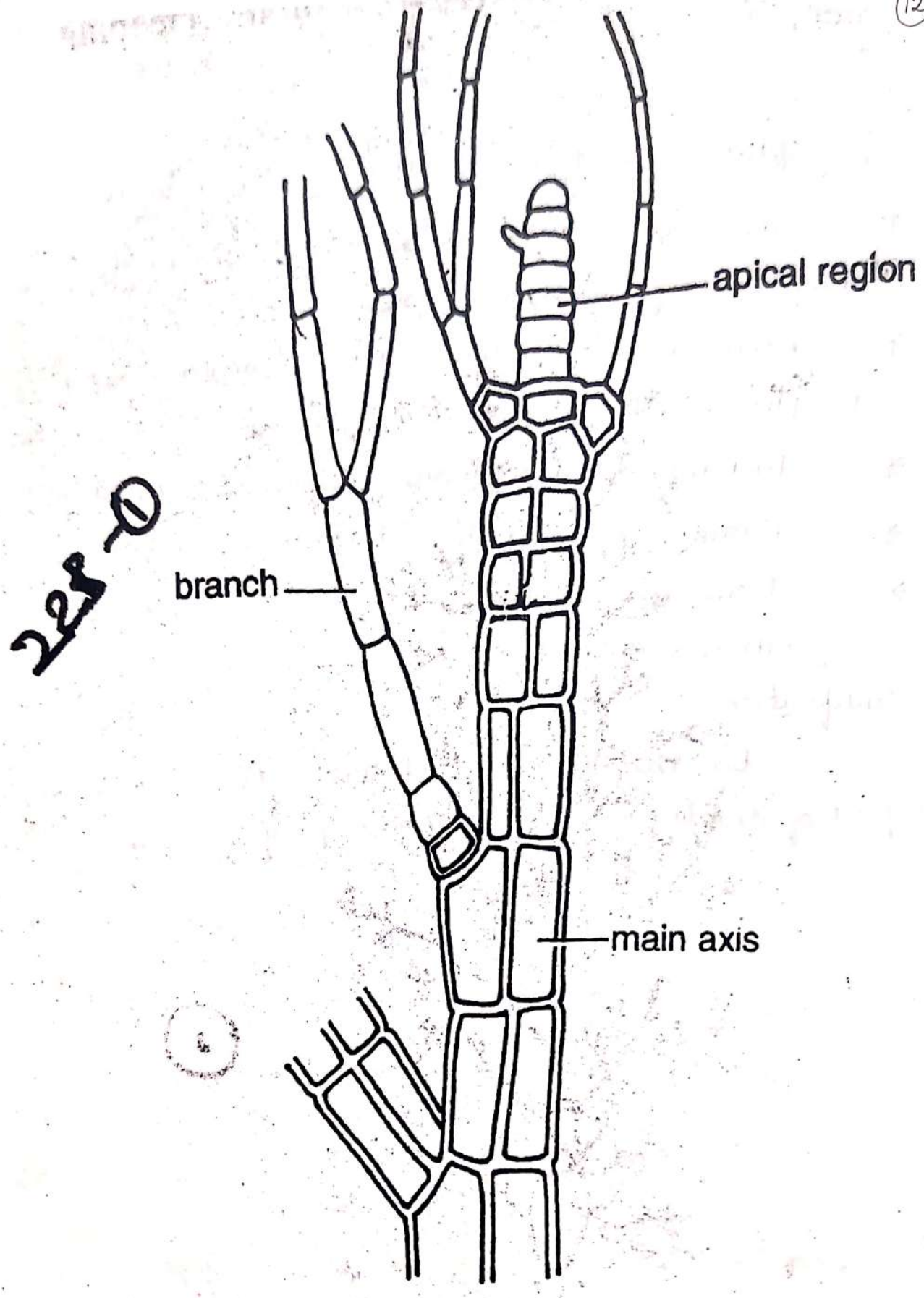


Fig. 3. ***Polysiphonia.*** A part of thallus with branche

Polysiphonia - A part of thallus with branches :-

* The cell wall is thick. Cell is uninucleate. It has a large central vacuole.
* Axial cells or central siphon is surrounded by 4-24 peripheral cells.
* Branching is dichotomous. Thallus is polysiphonous.
* Centre is occupied by a large barrel shaped cell.
* Many species remain attached to the substratum by thick walled.

Identification:-

By the above said reasons, the given sheet is a part of thallus with branches in polysiphonia.

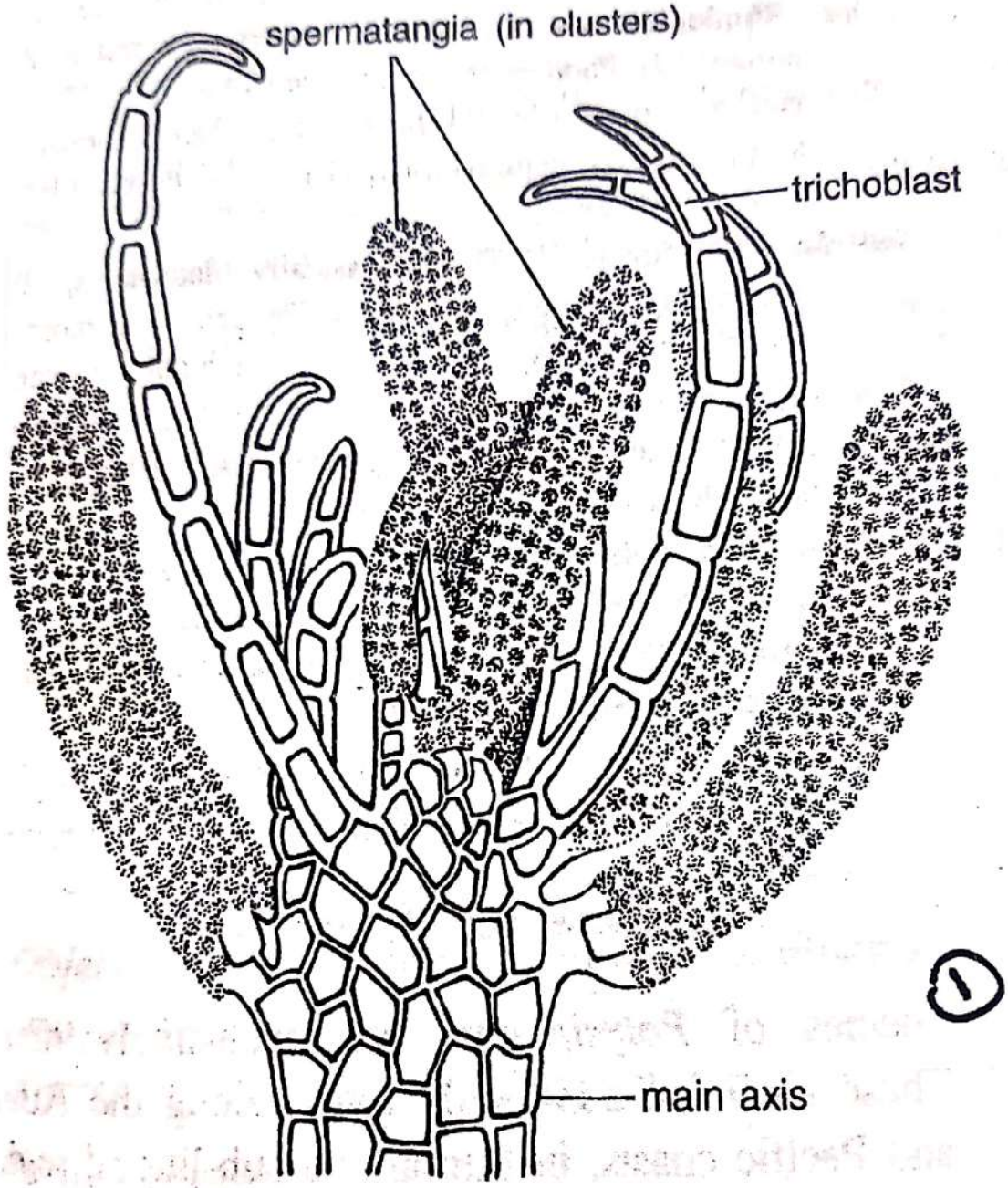


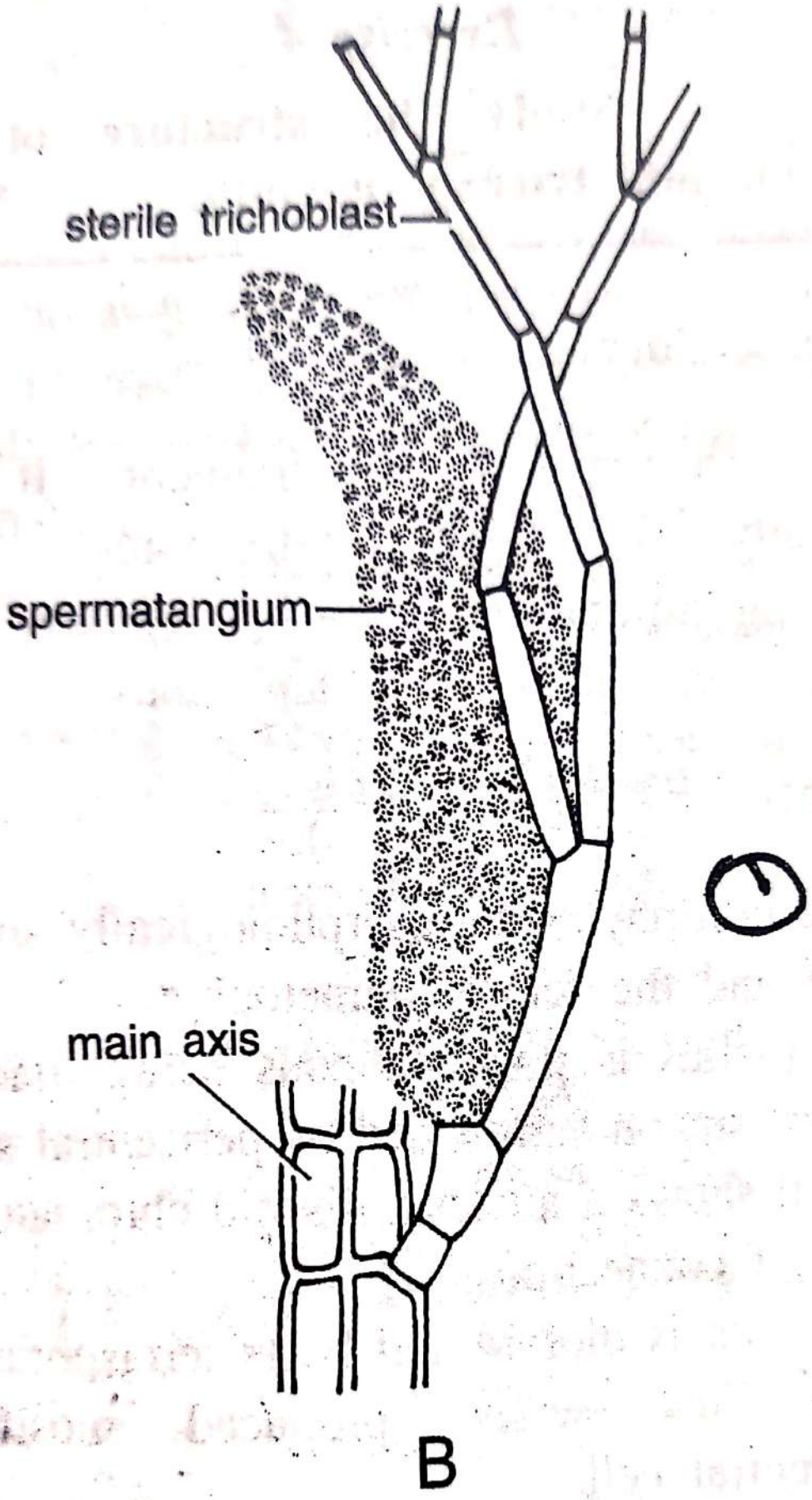
Fig. 6. ***Polysiphonia.*** **A-B A.** Cluster of spermatangia

Polysiphonia - cluster of spermatangia :-

* Antheridia are produced in clusters by fertile trichoblasts situated near the apex.
* Antheridium is known as spermatangium.
* It is small, oval, uninucleate and non-motile.
* The genus shows male plants bearing antheridia.

Identification -

By the above said reasons, the given sheet is cluster of spermatangia in polysiphonia.



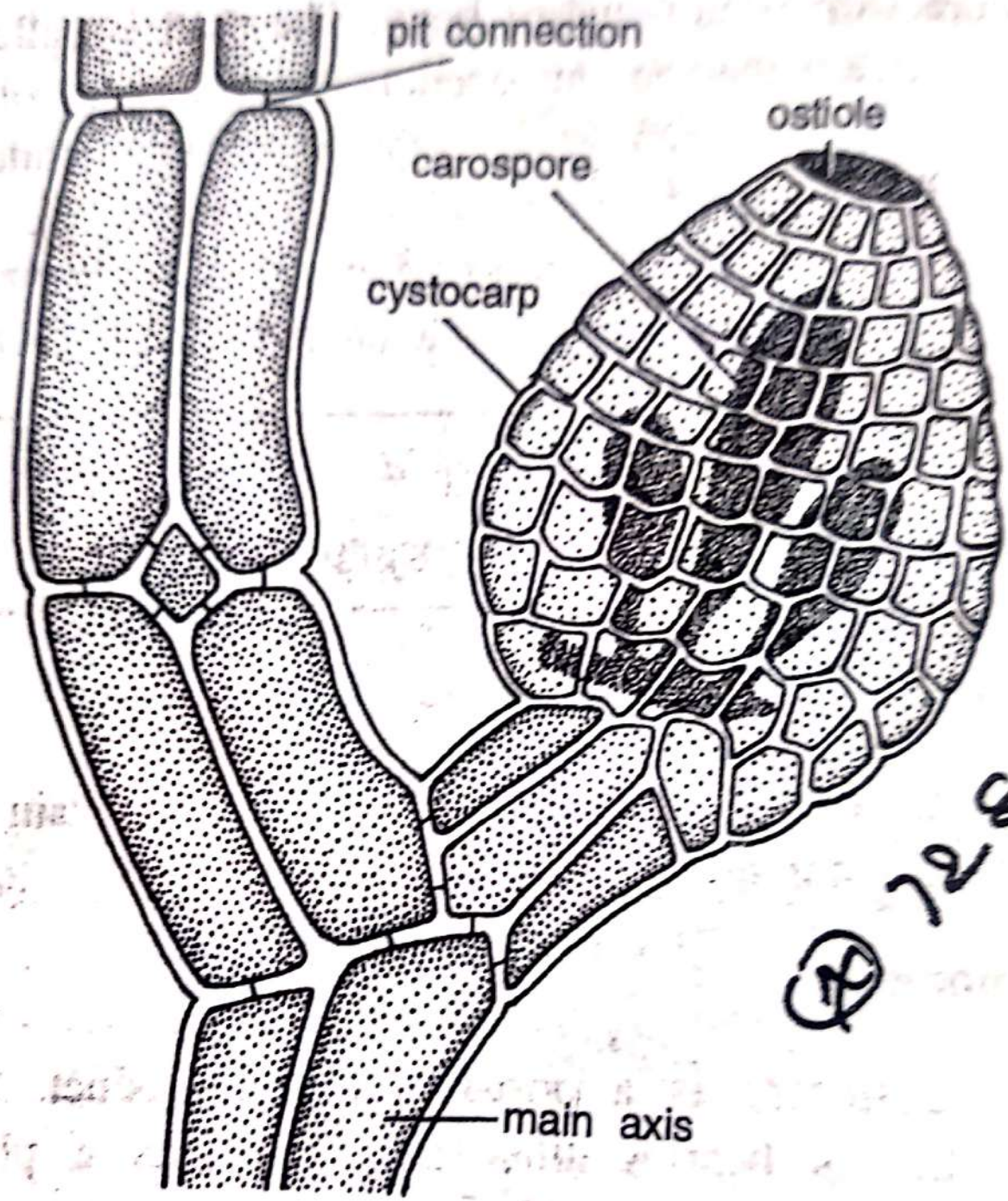
atangia, **B.** A spermatangium.

Polysiphonia - Spermatangium :-

* Antheridia are produced in cluster by fertile trichoblasts situated near the apex.
* Antheridium is known as spermatangium.
* It is oval in shape, naked and contains many non-motile spermatia.
* Each spermatium is small, oval to spherical, uninucleate and non-motile.

Identification-

By the above said reasons, the given sheet is a spermatogium of polysiphonia.



Fi.g 7. *Polysiphonia.* A part of thallus with cystocarp.

Polysiphonia - A part of thallus with cystocrap :-

* Cystocarp is a post-fertilization product. The thallus bearing this structure forms a phase called carposporophyte.
* Cystocarp opens to the exterior by an opening called ostiole.
* Wall of the cystocarp is called pericarp and is composed of a single layer of cells.
* Each carpospore is oval, uninucleate and diploid.

Identification -

By the above said reasons, the given sheet is a part of thallus with cystocrap.

Phytophthora

Classification

Kingdom	—	**Mycota**
Division	—	**Eumycota**
Sub-division	—	**Mastigomycotina**
Class	—	**Oomycetes**
Order	—	**Peronosporales**
Family	—	**Pythiaceae**
Genus	—	***Phytophthora***

Fig. 1. *Phytophthora.* Potato twig and tubes infected by *P. infestans.*

Phytophthora - potato twig and tubes infected by P. infestans

* of all the species, P. infestans is economically the most important as it causes late or Irish blight of potato.
* The first symptoms appear on the leaves as small black patches which increase in size with time.
* Infection soon spreads to the stems and in earlier stage there is discolouration of skin.
* Later infection spreads inwards, so that the entire tuber turns brown and decays giving off pungent odour.

Identification -

By the above said reasons, the given sheet is potato twig and tubes infected by P. infestans.

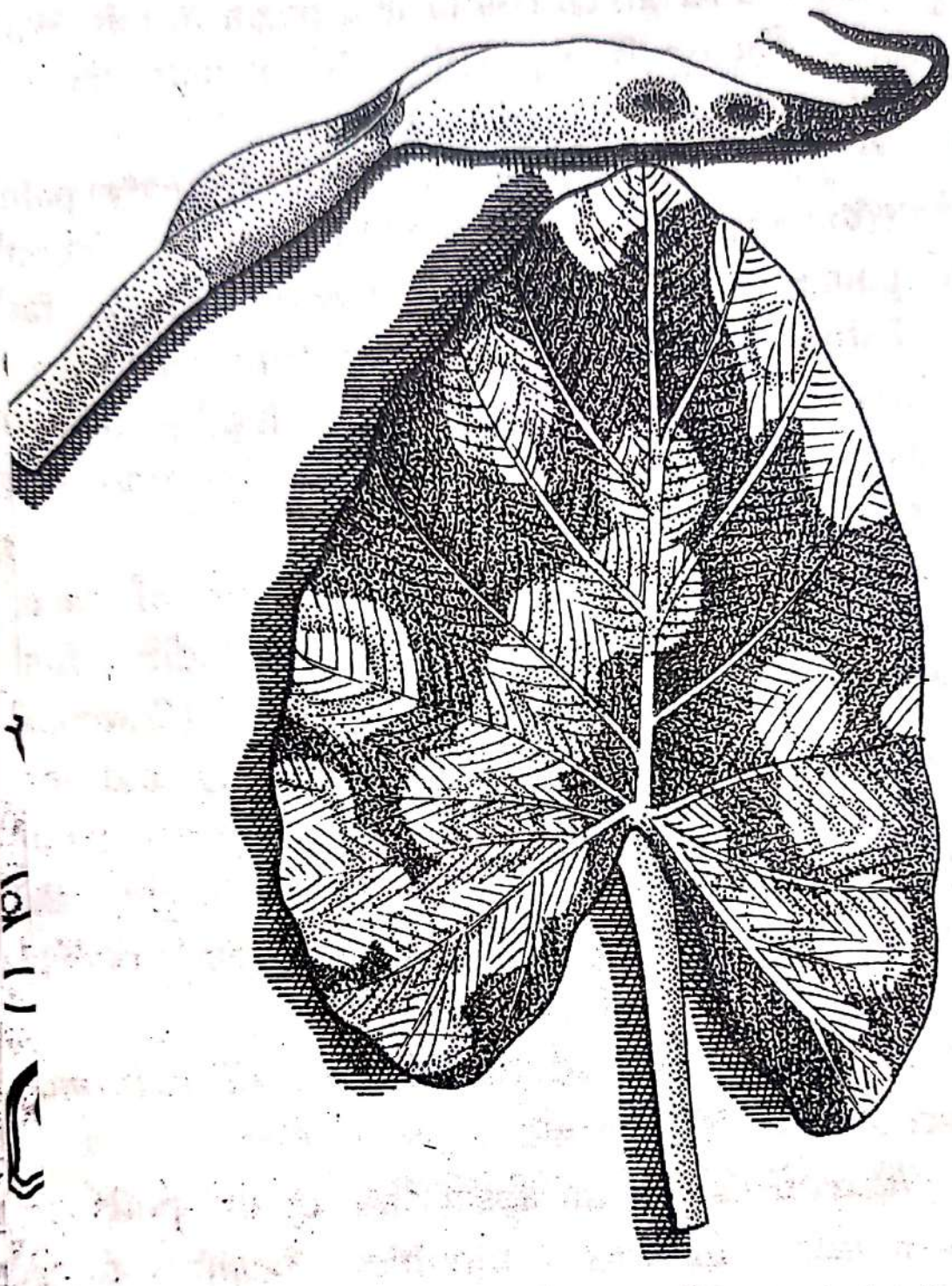


Fig. 2. *Phytophthora.* Inflorescence and the leaf of *Colocasia* infected by *P. colocasiae.*

Phytophthora - Inflorescence and the leaf of Colocasia infected by P. colocasiae :-

* P. colocasiae causes the blight of colocasia leaves and rot of succulent corms of colocasia antiquorum.
* In the blight of colocasia, small, dark, roundish specks are formed on leaves.
* These widen rapidly by centrifugal growth and become circular, oval or triangular.
* If the conditions are favourable, the petioles and inflorescences also get infected, and in severe cases the corms may rot completely.

Identification :

By the above said reasons, the given sheet is inflorescence and leaf of colocasia infected by P. colocasiae.

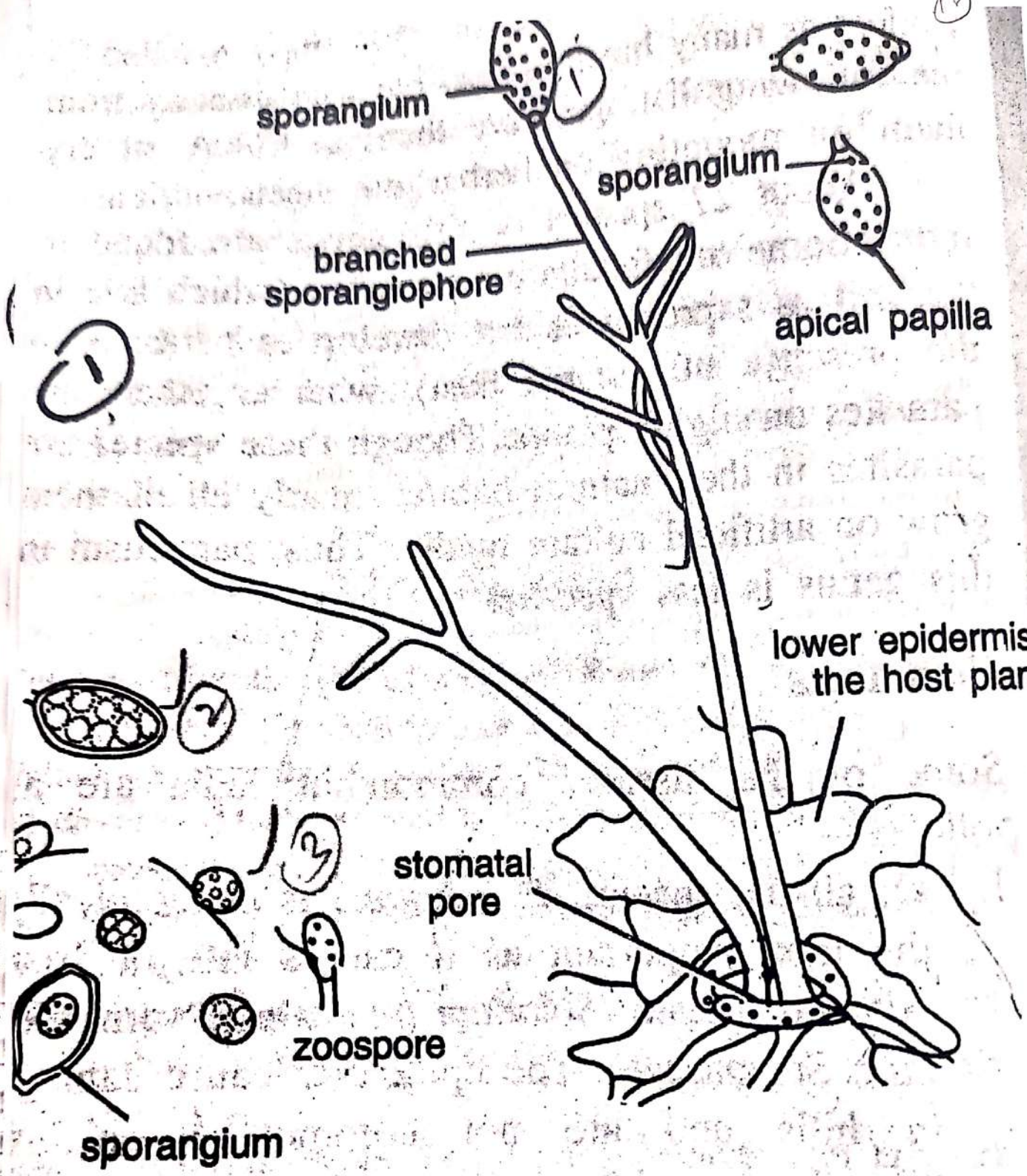


Fig. 3. *Phytophthora.* T. s. of infected leaf showing sporangiophores with sporangia.

Phytophthora - infected leaf showing sporangiophores with sporangia :-

* Asexual reproduction takes place by sporangia or conidia.
* In a diseased patch, certain septate hyphae form the conidiophores which grow out from the stomata on the underside of the leaf.
* The conidiophore produces ovoid or lemon-shaped, multinucleate, papillate conidia.
* Each conidium forms many biflagellate zoospores which emerge through papilla.

Identification-

By the above said reasons, the given sheet is infected leaf showing sporangiophores with sporangia of phytophthora.

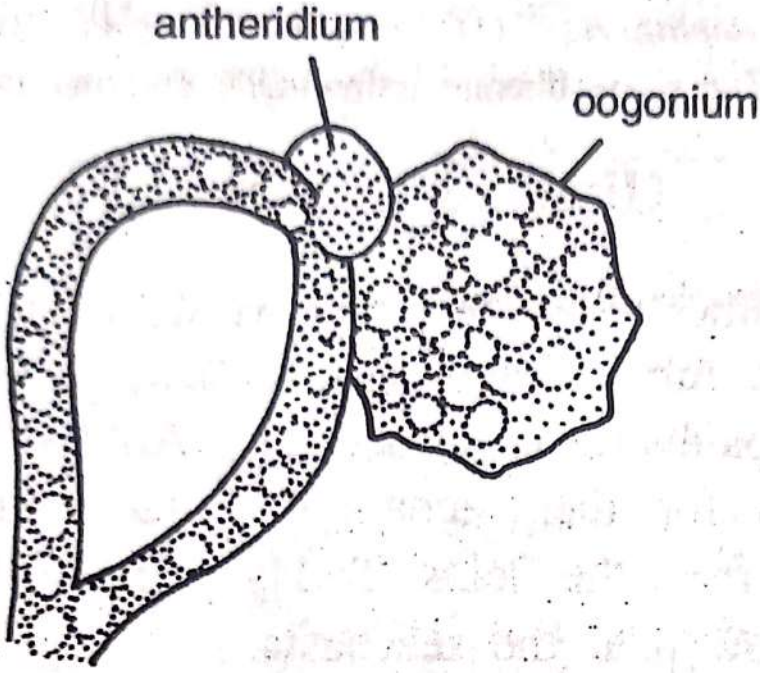


Fig. 4. ***Phytophthora.*** Sex organs.

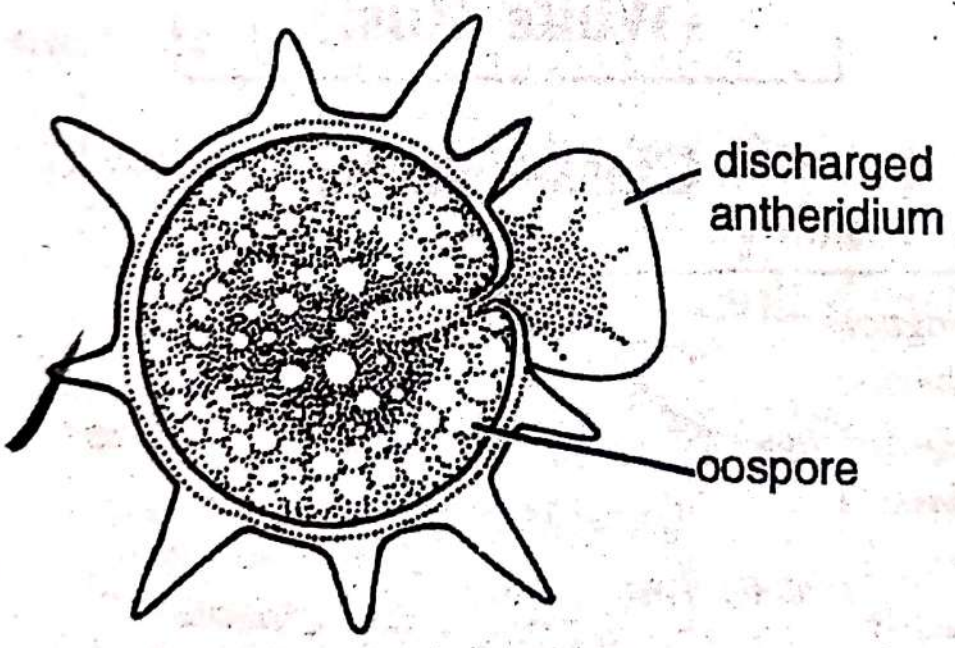


Fig. 5. ***Phytophthora.*** Oospore.

Phytophthora - oospore :-

* The sexual reproduction is of oogamous type.
* The oogonium is spherical to pyriform, smooth and hyaline to yellowish. In the centre is an uninucleate oosphere.
* The antheridium has many male nuclei.
* Male and female nuclei unite to produce oospore which develops a thick wall around itself.
* Oospore undergoes a rest for a few weeks or months.

Identification -

By the above said reasons, the given sheet is sex organs and oospore of phytophthora.

Rhizopus (Bread Mold)

Classification

Kingdom	—	**Mycota**
Division	—	**Eumycota**
Sub-division	—	**Zygomycotina**
Class	—	**Zygomycetes**
Order	—	**Mucorales**
Family	—	**Mucoraceae**
Genus	—	***Rhizopus***

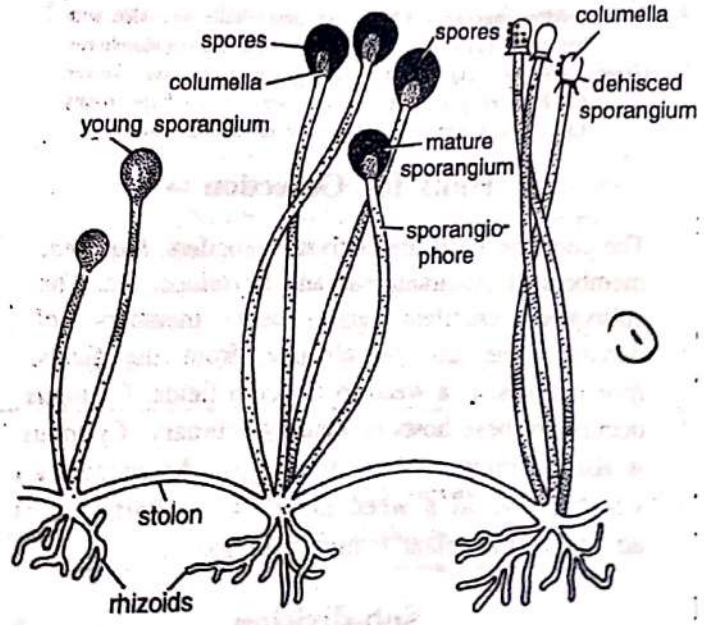


Fig. 1. ***Rhizopus.*** A portion of mycelium with sporangiophores.

1 Rhizopus - A portion of mycelium with sporangiophores

* The mycelium shows abundant, white cottony growth.
* The young mycelium is multinucleate, aseptate, with all the hyphae alike.
* In the older mycelium three parts of hyphae can be distinguished
  i) branched rhizoids that penetrate the substratum
  ii) Stolon or runner growing horizontally above the substratum
  iii) the sporangiophore which grows upward.

Identification:-

By the above said reasons, the given sheet is a portion of mycelium with sporangiophores of Rhizopus.

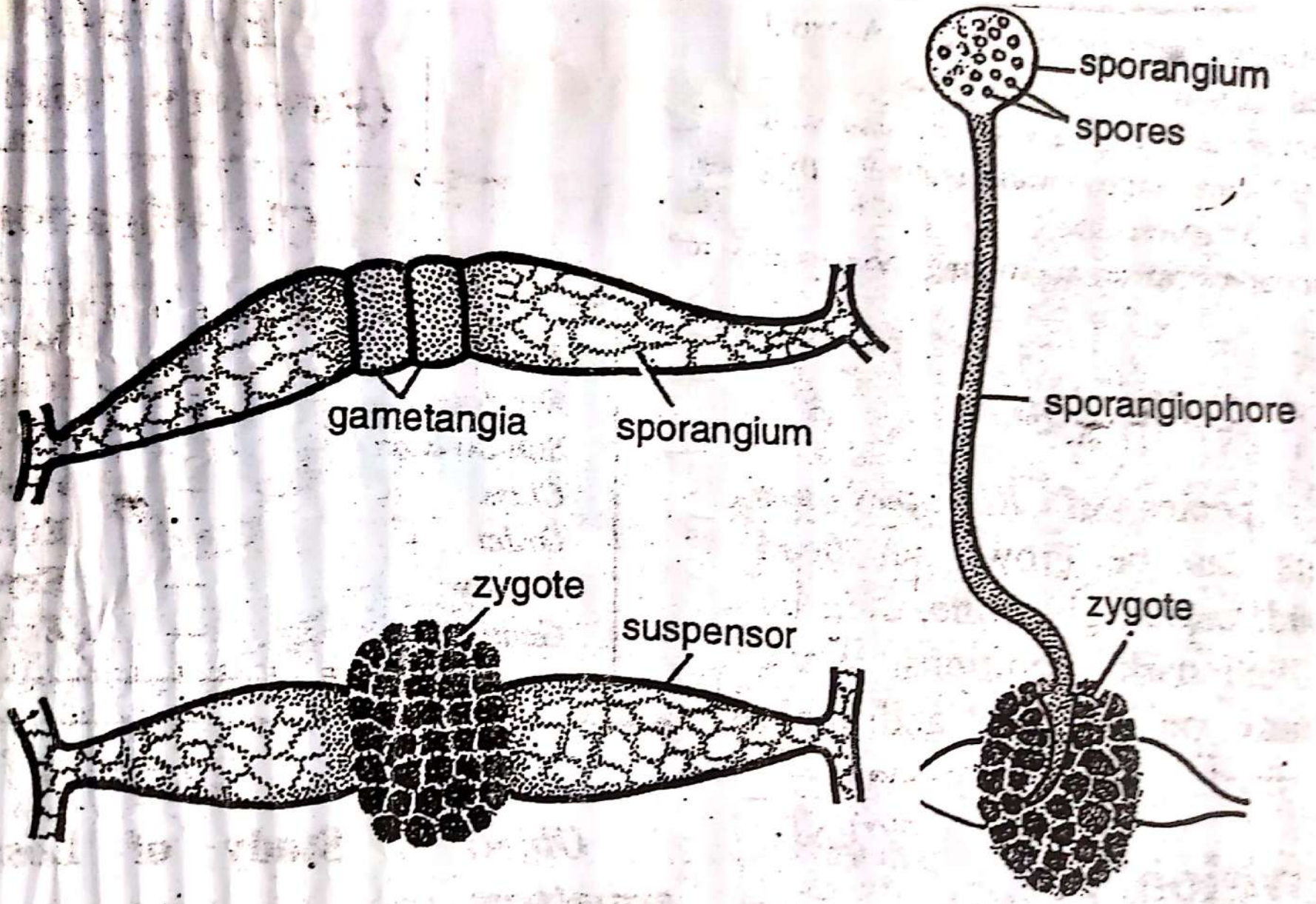


Fig. 3. ***Rhizopus.*** Various stages in sexual reproduction.

Rhizopus - Various stages in sexual reproduction

* The genus is heterothallic and the sexual reproduction takes place only when mycelia of + (plus) and - (minus) strains meet.
* The hyphae of the opposite strains produce erect branches.
* The transverse division separates the terminal gametangium from a proximal suspensor cells.
* Zygospore divides meiotically after a period of rest.

Identification:

By the above said reasons, the given sheet is various stages of sexual Reproduction of Rhizopus.

Penicillium
(Blue Mold)

Classification

Kingdom	—	**Mycota**
Division	—	**Eumycota**
Sub-division	—	**Ascomycotina**
Class	—	**Plectomycetes**
Order	—	**Eurotiales**
Family	—	**Eurotiaceae**
Genus	—	***Penicillium***

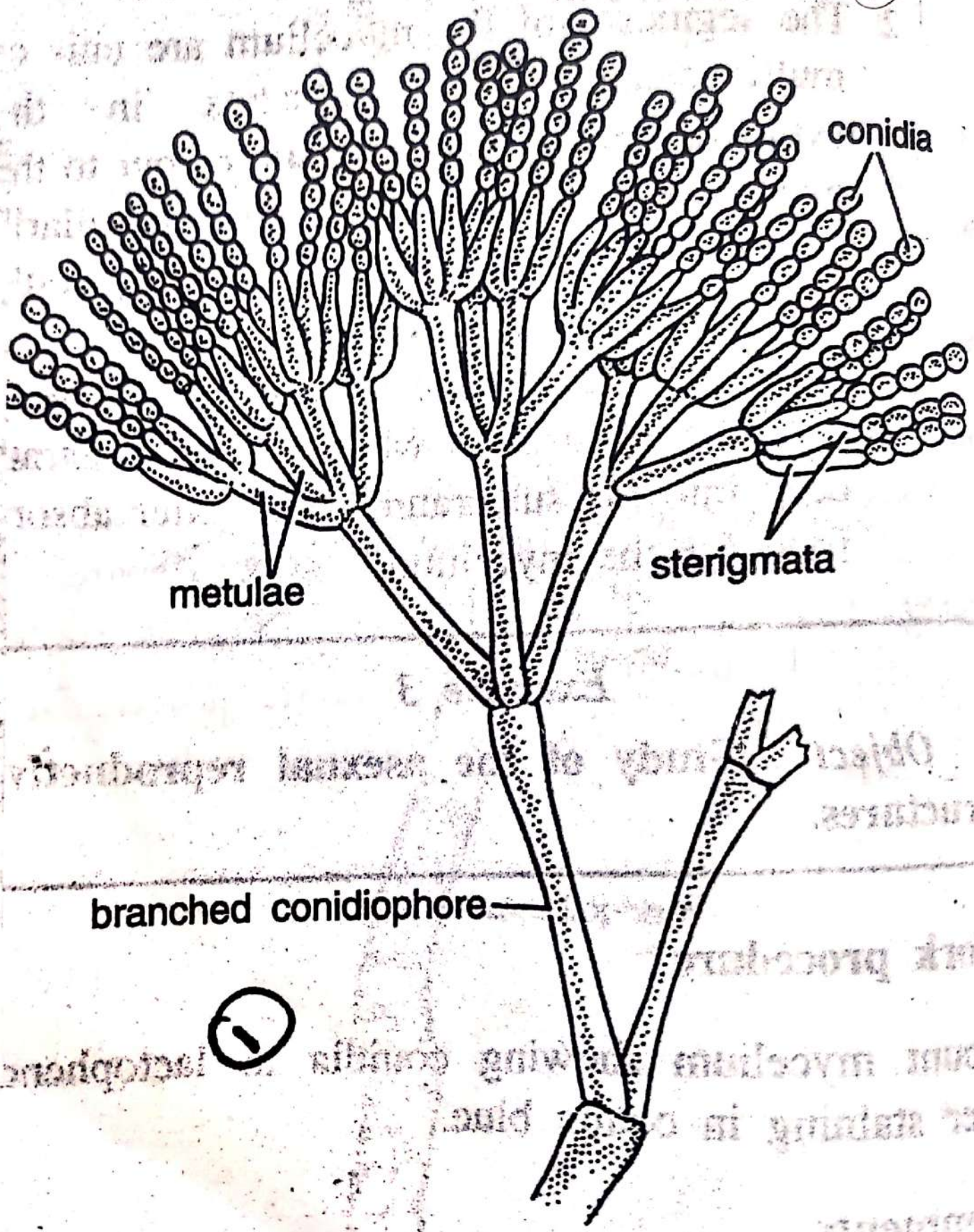


Fig. 1. *Penicillium.* Mycelium bearing conidiophore and chains of conidia.

Penicillium - Mycelium bearing conidiophore and chains of conidia :-

* The mycelium is freely branched, septate and each cell is uni - or multinucleate.
* The conidia are the asexual spores borne on long, erect and branching conidiophores.
* The branched conidiophore, with its conidia looks like a small 'Penicillus'.
* Each conidiophore grows vertically from the mycelium and branches at its upper end. The ultimate branches are known as metulae.

Identification :

By the above said reasons, the given sheet is mycelium bearing conidiophore and chains of conidia of penicillium.

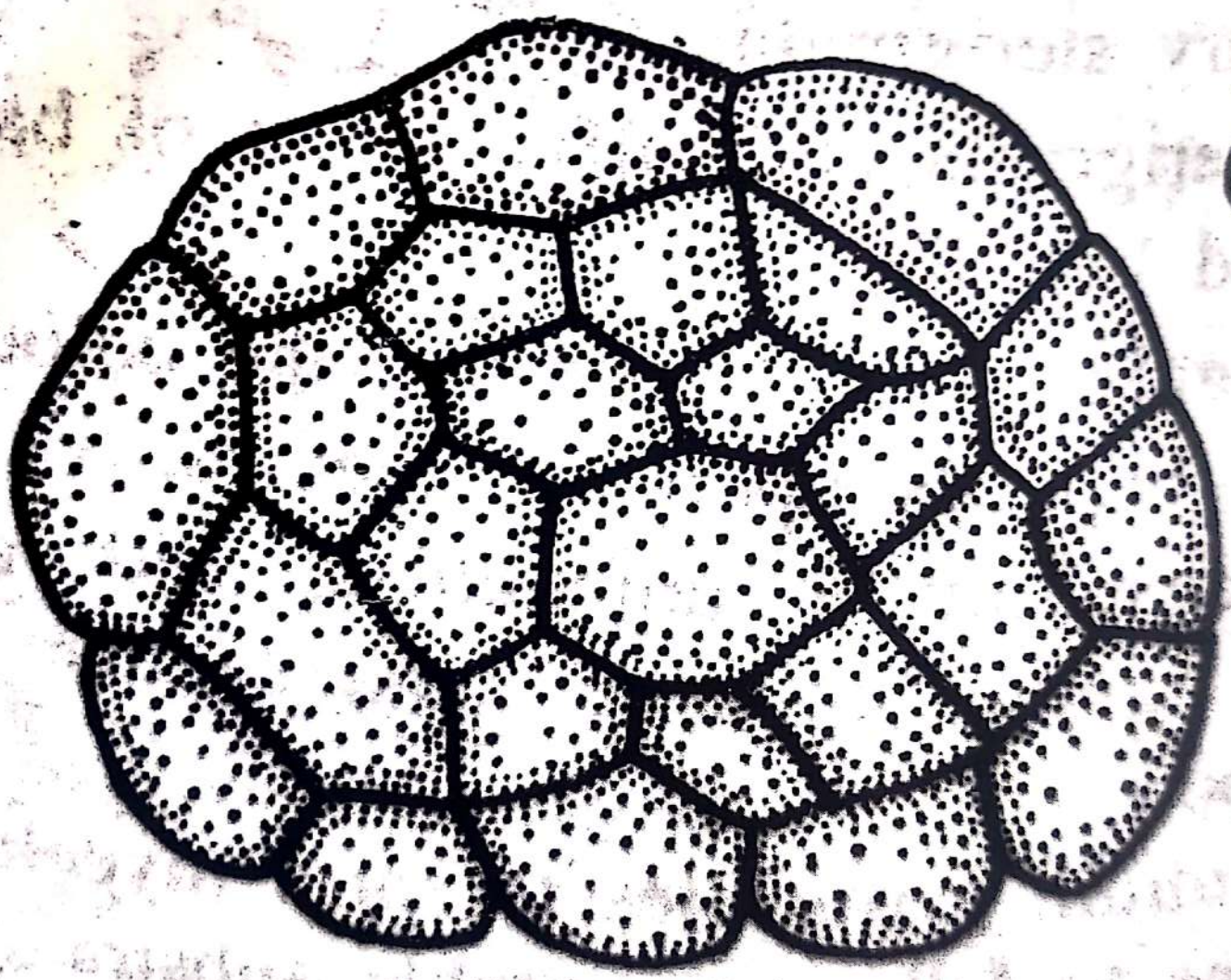


Fig. 2. *Penicillium.* A cleistothecium.

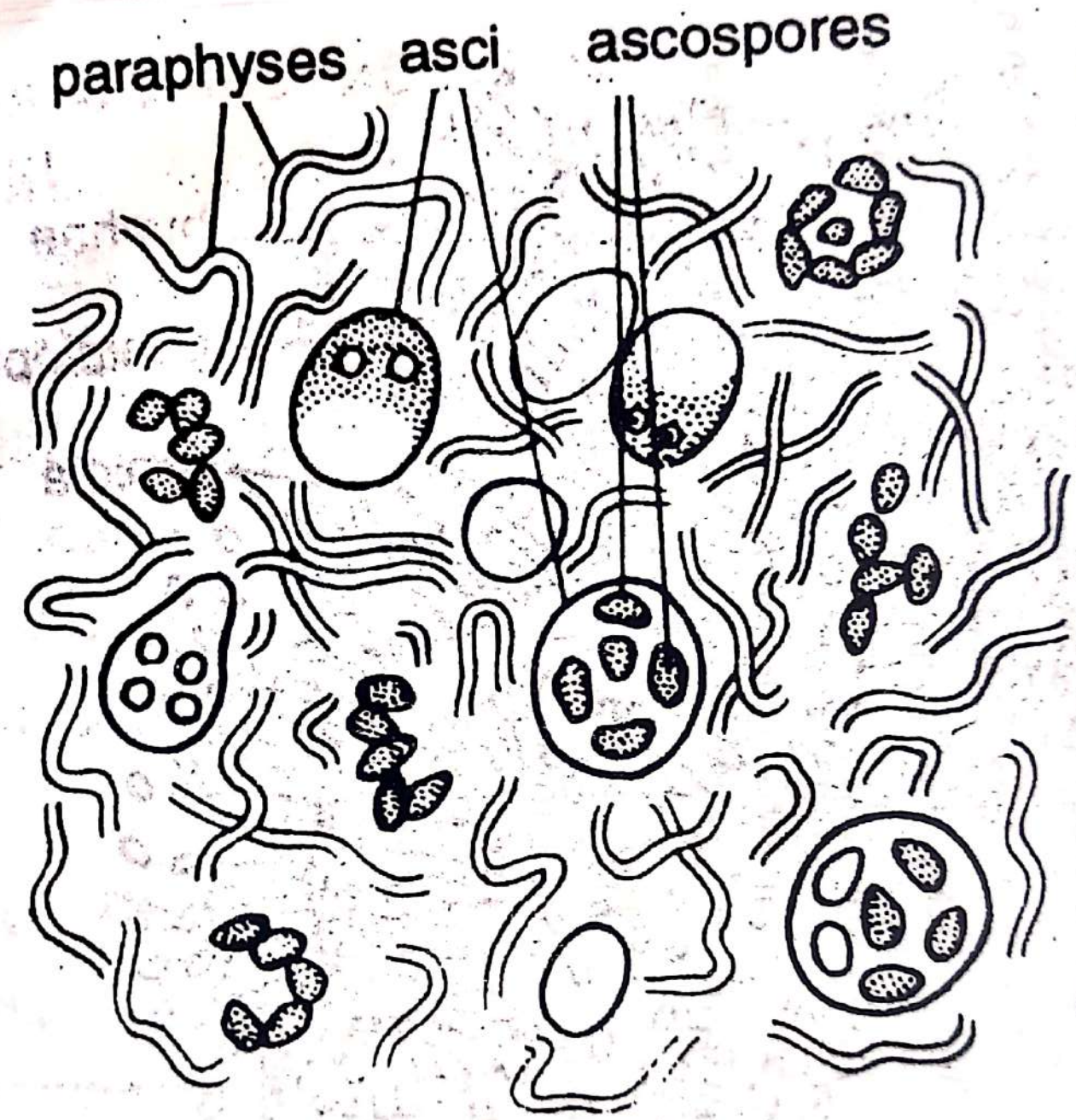


Fig. 3. ***Penicillium.*** A part of cleistothecium in cross section.

Penicillium - A cleistothecium

A part of cleistothecium in cross Section

* The fruiting body or ascocarp is called cleistothecium. It has a wall - peridium made of sterile hyphae which encloses many asci and paraphyses.
* The globose or pear-shaped asci lie scattered inside the cleistothecium.
* Each ascus has eight uninucleate and wheel-shaped ascospores.
* The perfect stage i.e. cleistothecium is known as Eupenicillium, Teleromyces, Carpenteles.

Identification :-

By the above said reasons, the given sheet is a cleisthothecium and a part of cleisthothecium of penicillium.

Puccinia (Rusts)

Species of *Puccinia* are known as Rusts, because the infected parts look like rusted iron. Rusts are known from very ancient times, because of the enormous loss caused by them to the crop. In ancient Rome, cereal rust diseases were thought to be caused by two Gods, Robigus and Robigo. To please these Gods, the ancient Romans used to annually celebrate a festival, Robigalia.

Classification

Kingdom	—	**Mycota**
Division	—	**Eumycota**
Sub-division	—	**Basidiomycotina**
Class	—	**Teliomycetes**
Order	—	**Uredinales**
Family	—	**Pucciniaceae**
Genus	—	***Puccinia***

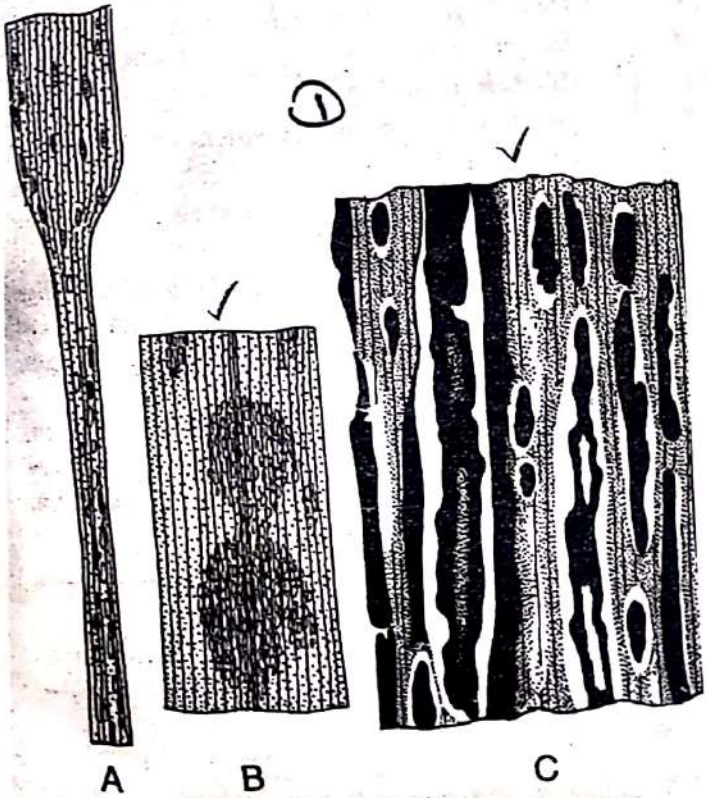


Fig. 1. *Puccinia graminis tritici.* Black or stem Rust. **A.** Leaf sheath showing pustules, **B.** A portion of leaf showing uredo-pustules, **C.** A portion of stem showing teleutopustules.

Puccinia graminis tritici :-

* P. graminis infect wheat, the primary host and barberry, the alternate host.
* They cause black rust or stem rust and yellow or stripe rust respectively on wheat.
* In black or stem rust, dark brown or black, oblong to linear lesions are produced on leaves.
* Stem which in case of severe infection, coalesce to form large patches.

Identification :-

By the above said reasons, the given sheet is a portion of leaf showing uredopustules and stem showing teleutopustules of puccinia graminis tritici.

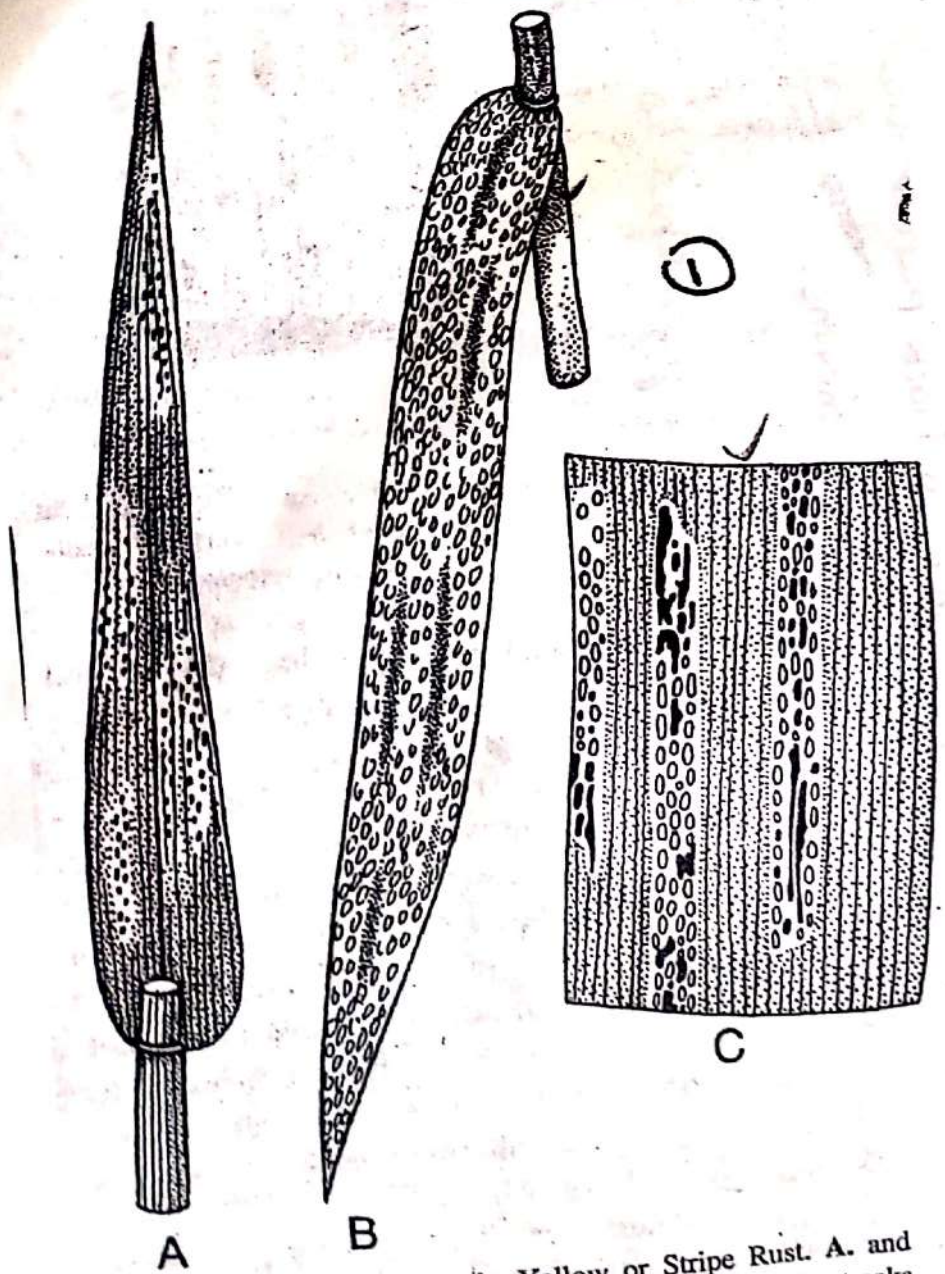


Fig. 2. ***Puccinia striiformis.*** Yellow or Stripe Rust. **A.** and **B.** Leaves showing pustules in the form of streaks **C.** A portion of leaf sheath showing uredo- and teleutopustules.

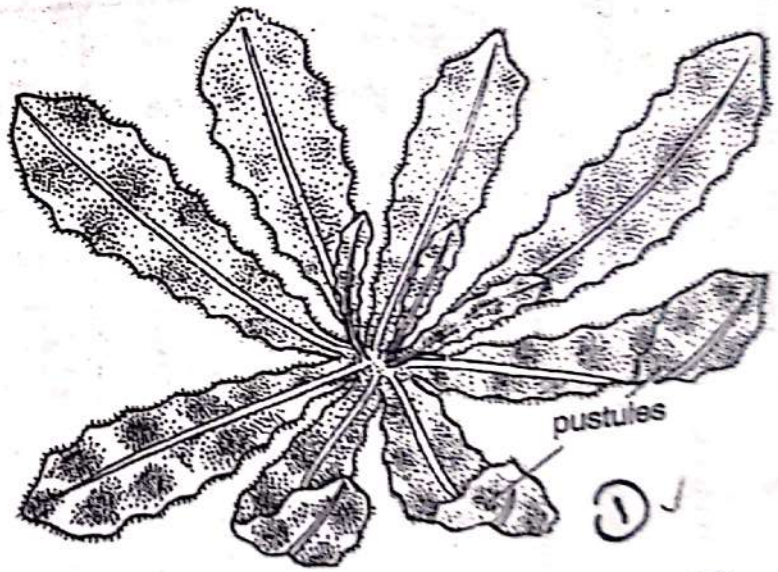


Fig. 4. ***Puccinia butleri.*** Infection on *Launea* sps.

Puccinia striiformis :-

* Apothecia are saucer-shaped Habiting Voddes.
* P. striiformis infect wheat.
* The symptoms of the disease are seen on leaves, leaf sheaths and sometimes on stem also.
* Yellow or stripe rust is ~~chiefly~~ chiefly confines to leaves but if the attack is ~~so~~ severe it may also spread to leaf sheaths and stalks.
* As such the green colour of leaves fades.

Identification:- By the above said reasons, the given sheet is leaves showing pustules in the form of streaks and portion of leaf sheath showing uredo and teleutopustules of puccinia striiformis.

Puccinia butleri :-

* P. butleri, an autoecious rust, attacks Launea sp.
* It causes leaf rust.
* In case of other leaf rusts orange to black pustules are seen on leaves and sometimes also on leaf sheaths.

Identification:-

By the above said reasons, the given sheet is infection on launea sps. of puccinia butleri.

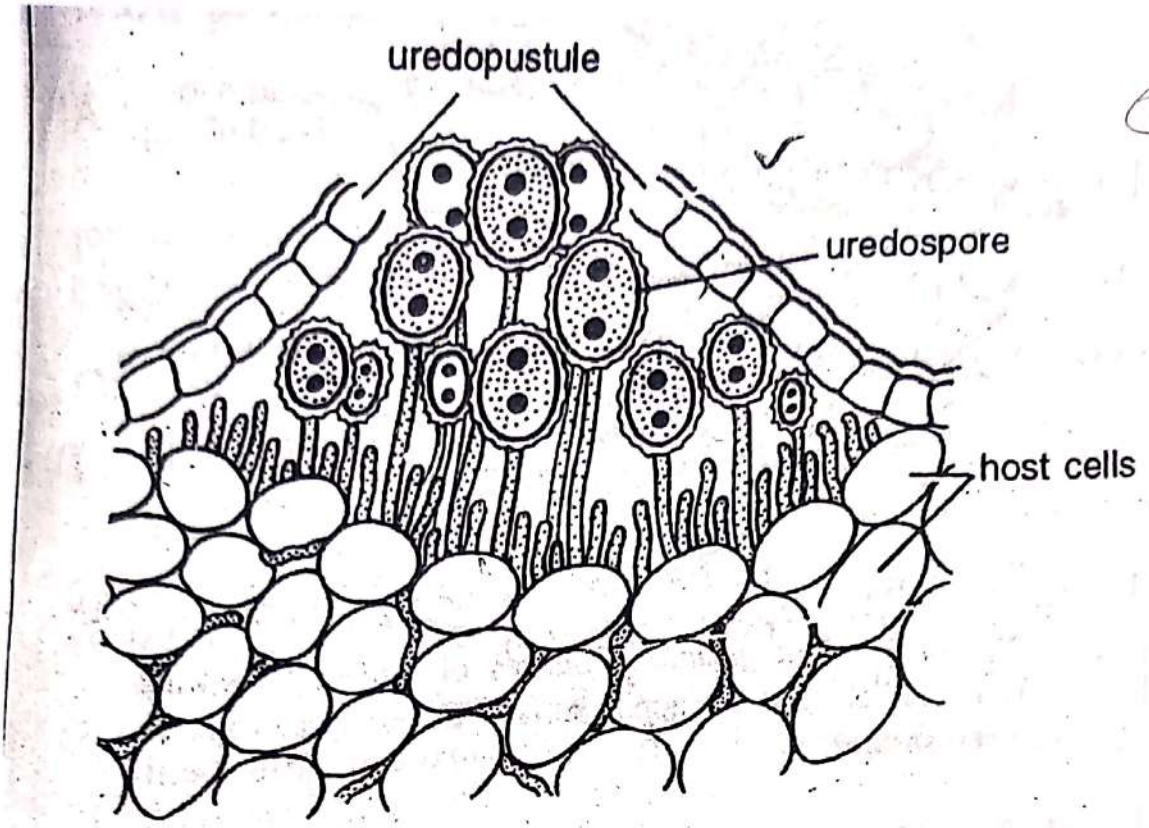


Fig. 5. *Puccinia.* T.s. of wheat leaf through uredopustule.

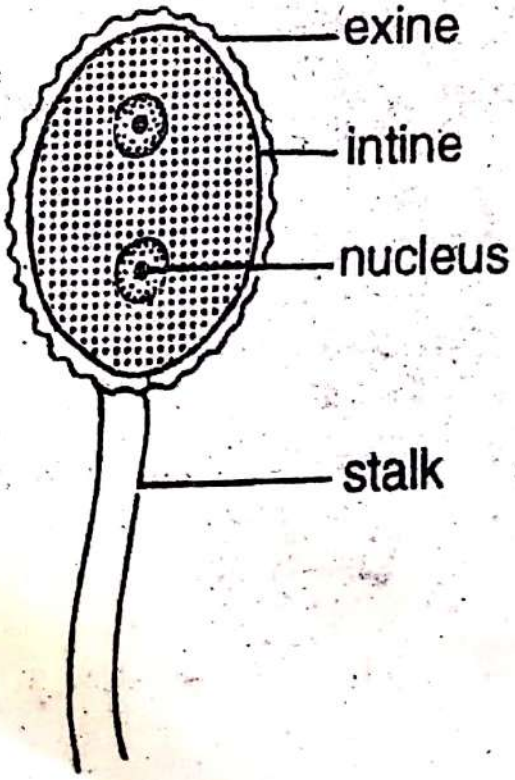


Fig. 6. *Puccinia.* Uredospore.

Puccinia - Uredopustule :-

* The uredosori or uredopustules appear as red, oval or lemon shaped lesions on the leaves and leaft sheaths.
* The uredospores are produced in massive groups from this mycelium.
* Each uredospore is binucleate, stalked and rounded or oblong in shape.
* Each uredaspore has four equatorial germ pores.

Identification :-

By the above said reasons, the given sheet is T.s of Wheat leaf through uredopustule and uredospore of puccinia.

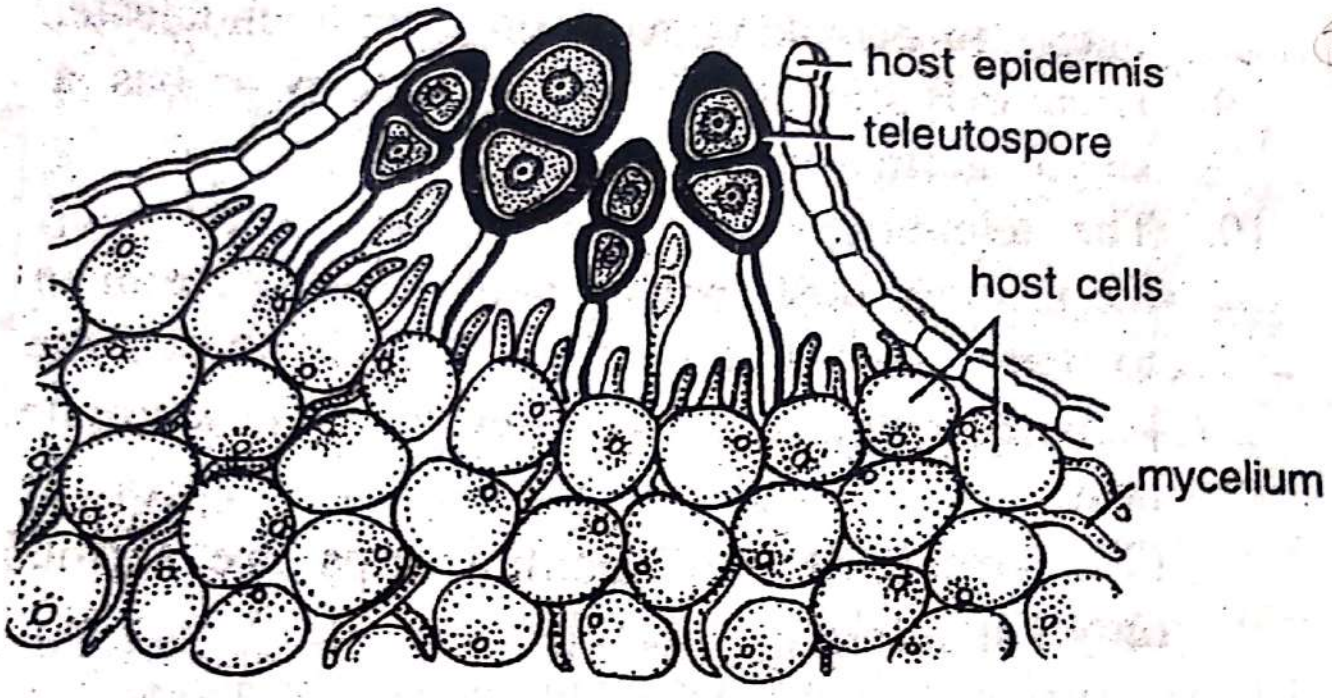


Fig. 7. *Puccinia.* T.s. of wheat leaf through teleutopustule.

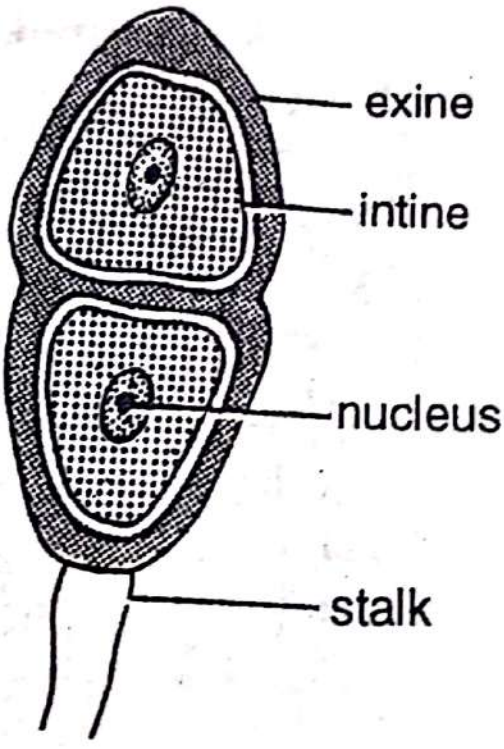


Fig. 8. *Puccinia.* Teleutospore.

Puccinia :- Teleutospore

* The teleutosori or teleutopustules appear on leaves, leaf sheaths and stem as black, oval pustules that fuse to form patches in case of severe infection.
* The host epidermis is ruptured due to the pressure of underlying teleutospores.
* The teleutospores are formed by the same mycelium which earlier produced uredospores.
* The teleutospore has a very thick but smooth exine and delicate thin intine. The exine turns black at maturity.

Identification -

By the above said reasons, the given sheet is T.s of Wheat leaf through teleutopustule and teleutospore of puccinia.

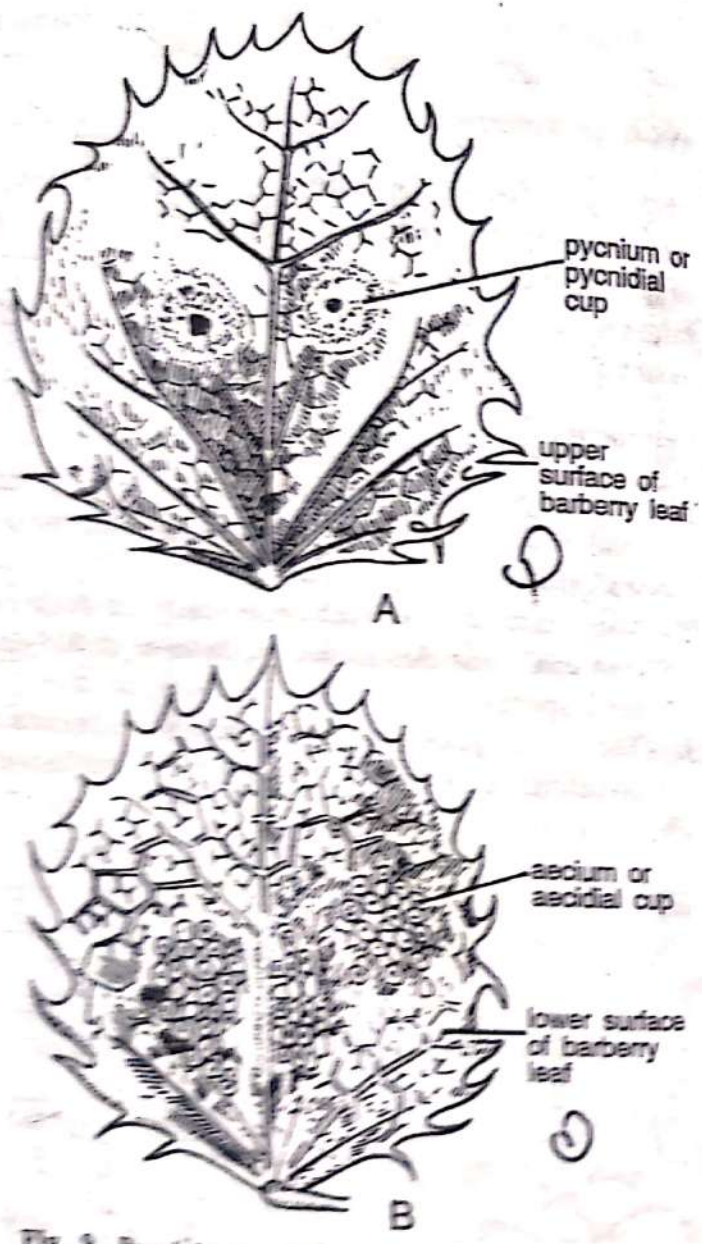


Fig. 9. *Puccinia graminis*. Leaves of barberry showing A. Pycnidial cups on upper surface B. Aecidial cups on lower surface.

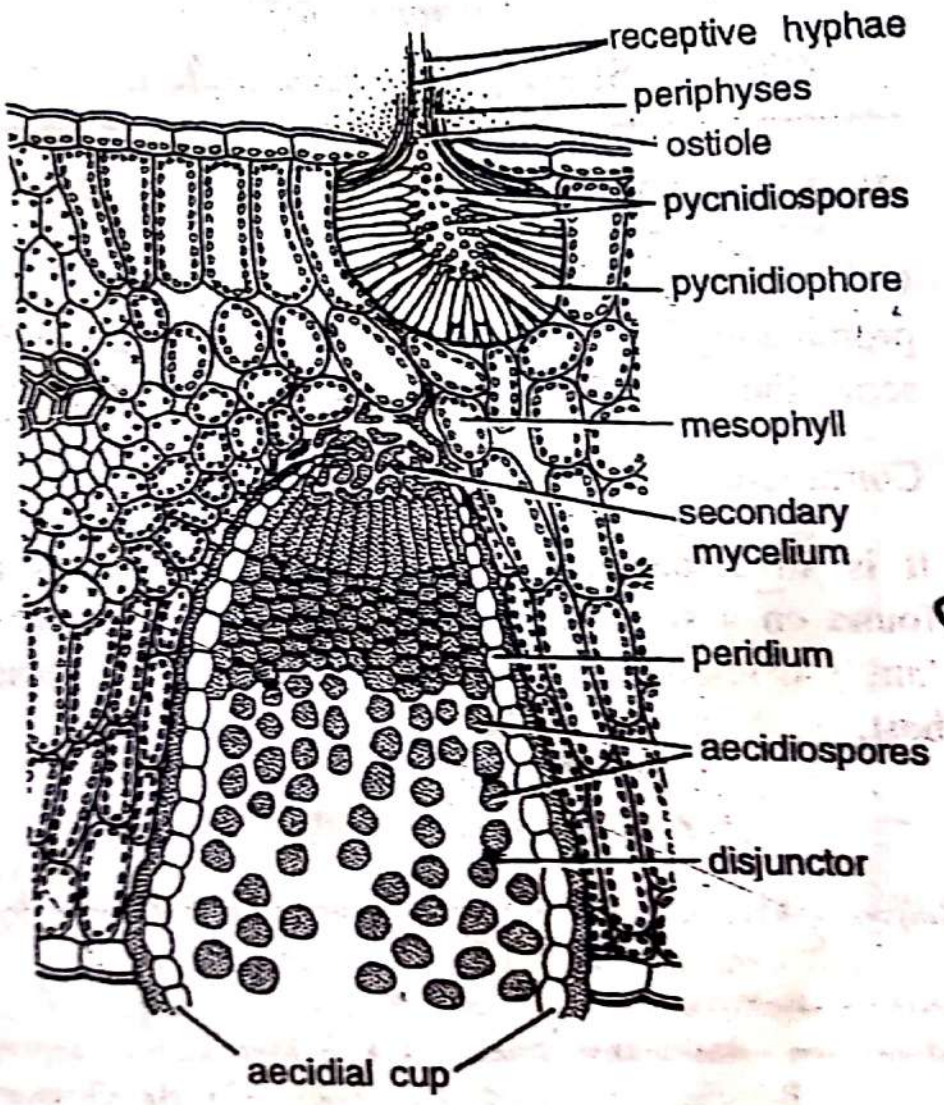


Fig. 10. *Puccinia*. T.s. of infected leaf of ***Berberis*** showing pycnidial and aecidial cups on upper and lower epidermis respectively.

Puccinia graminis:- [A, B]

* Each basidiospore germinates on the leaf of alternate host producing the mycelium, that ultimately forms the pycnicial cup or pycnidium.
* The pycnidia are generally present on the upper surface of the leaf and may be best studied in a transverse section of the host leaf.
* A mature pycnidium is flask-shaped with a pore known as ostiole at its apex.
* The hyphae near the ostiole are unbranched, pointed and organe coloured.

Identification:- By the above said reasons, the given sheet is Leaves of barberry showing pycnidial cups on upper surface and aecidial cups on lower surface of puccinia.

Puccinia - T.S of infected leaf of Berberis :-

* The aecidial cup or aecidium can only be formed by a dikaryotic mycelium.
* The aecidia are generally present on the lower surface of leaf.
* Each aecidium is cup-like structure with an outer protective layer called peridium.
* The developing aecidium elongates and is pushed through the host epidermis.

Identification -

By the above said reasons, the given sheet is T.s of infected leaf of Berberis showing pycnidial and aecidial cups on upper and lower epidermis of puccinia.

Crustose Lichens

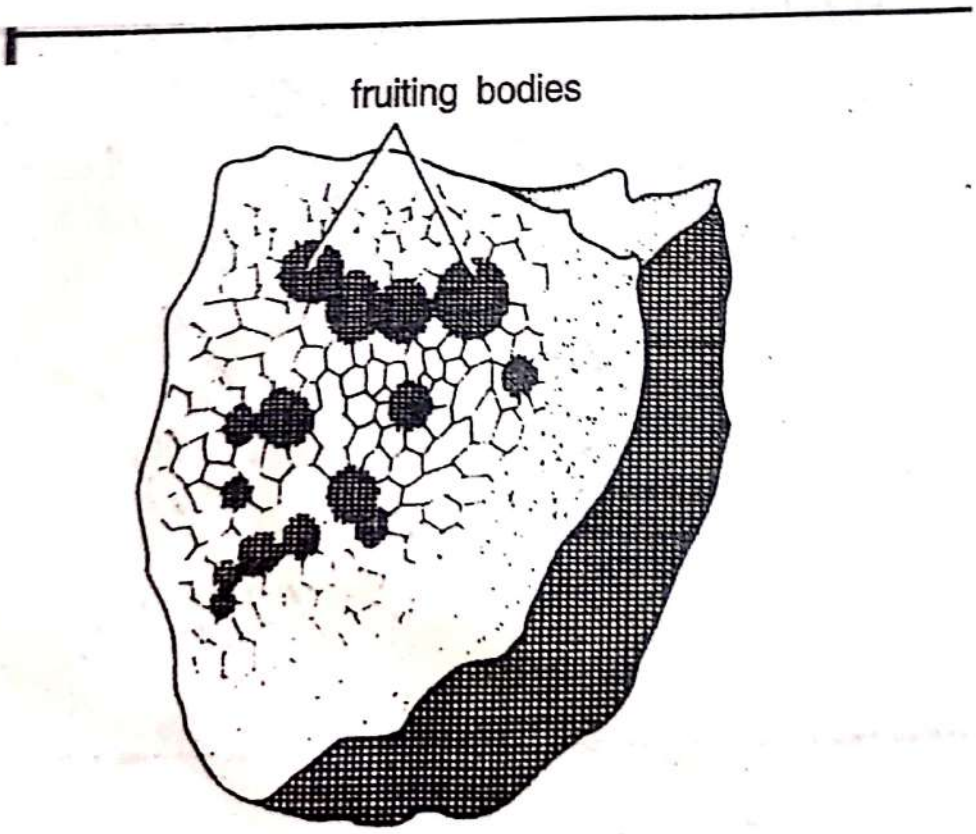


Fig. 1. ***Lecidia platycarpa.*** Crustose ascolichen growing on rocks : External features and fruiting bodies.

Lecidia Platycarpa :-

* The thallus is poorly differentiated.
* The tissues forming the thallus are arranged more of less in strata, one above the other.
* The upper cortex is made of rudimentary or sometimes highly developed hyphal layer.
* The lower cortex lies next to medulla. It may be well developed or entirely absent.

Identification :- By the above said reasons, the given sheet is External features and fruiting bodies of Lecidia platycarpa of Crustose lichen.

Foliose Lichens

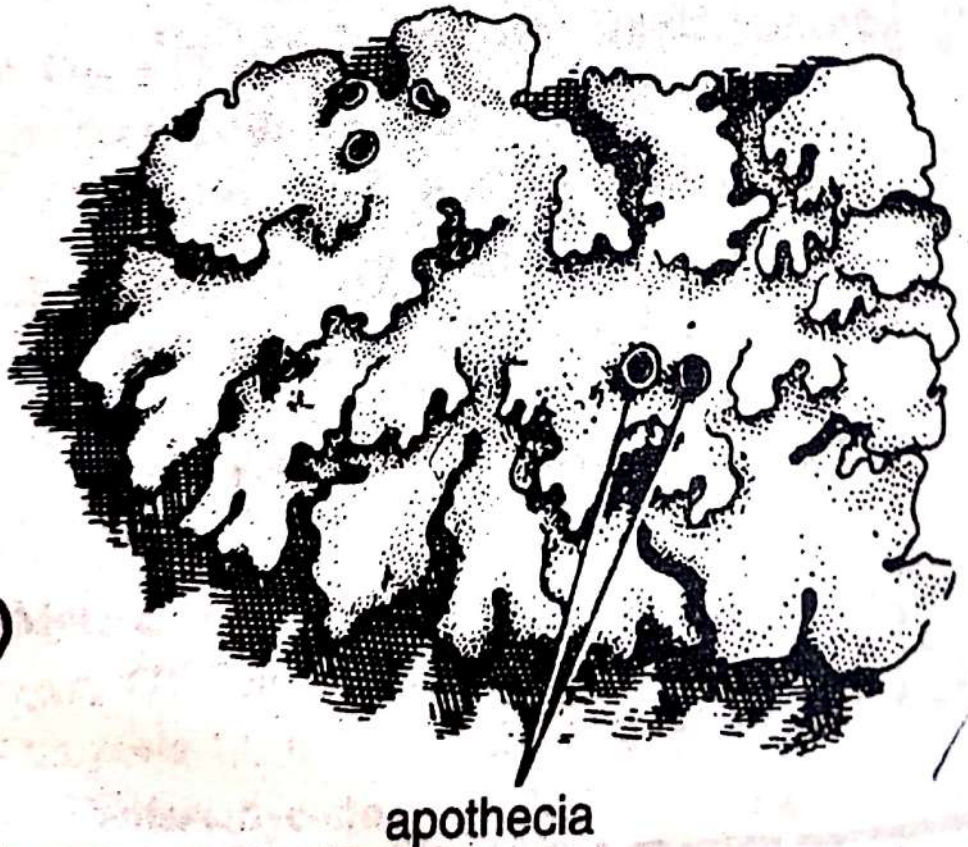


Fig. 2. ***Parmelia flavicens.*** Foliose ascolichen. A thallus showing external features and apothecia.

Parmelia flavicens :-

* The foliose lichens have a flat, leaf-like, lobed or deeply incised thallus.
* It is attached to the substratum only at certain points by rhizines.
* Rhizines are rhizoid-like outgrowths which arise from the under surface.
* The thallus is generally greyish or brownish in colour.

Identification :-

By the above said Reasons, the given sheet is thallus showing external features and apothecia of parmelia flavicens of foliose lichens.

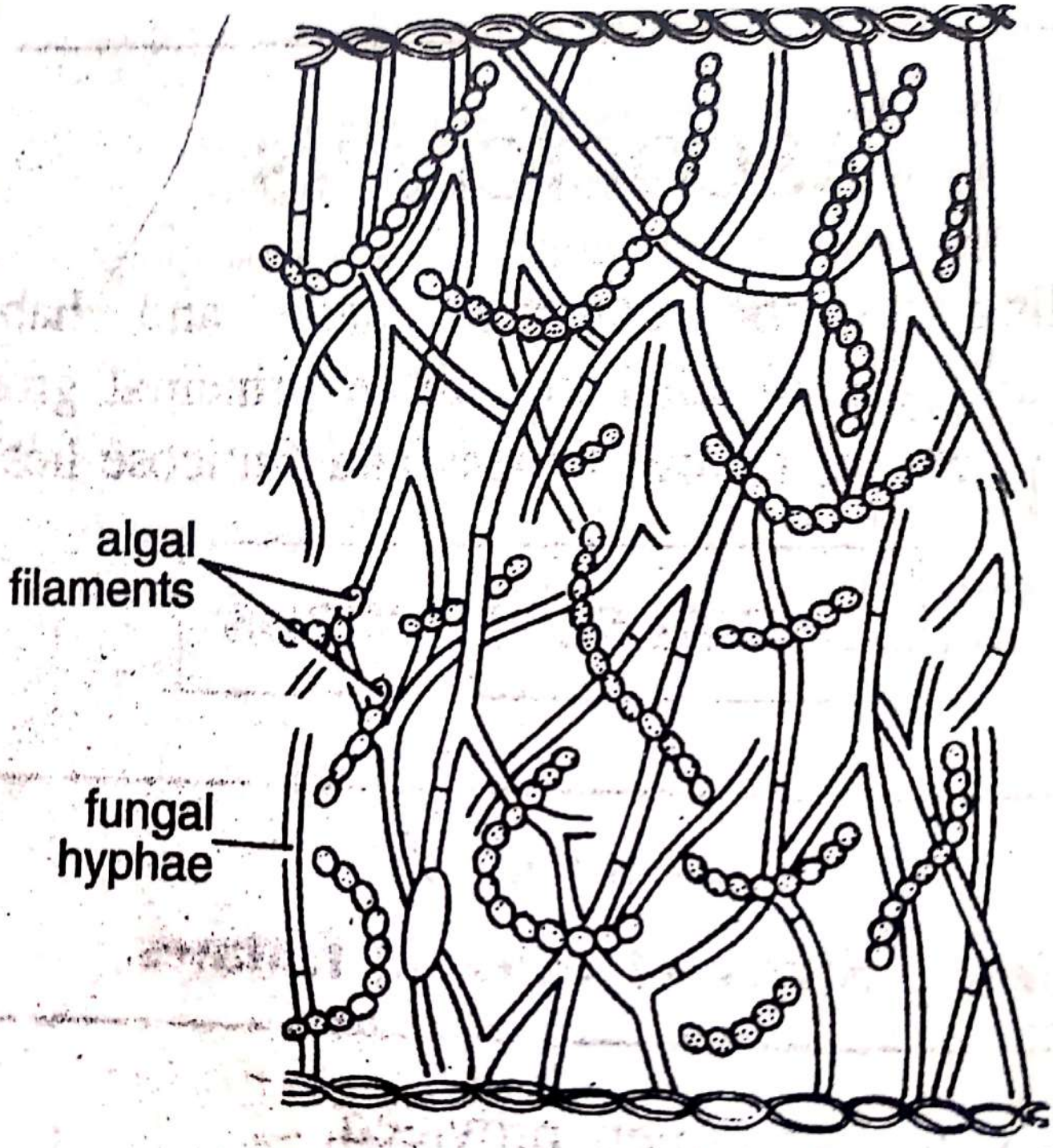


Fig. 3. ***Collema.*** **Homoiomerous thallus showing internal structure.**

Collema :-

* These type of thalli are not very common.
* Internal structure is not much differentiated.
* The algal cells are irregularly scattered throughout the fungal hyphae.
* Both algal cells and fungal hyphae are enveloped in a gelatinous matrix or the ground substance.

Identification:- By the above said reasons, the given sheet is homoiomerous thallus showing internal structure in of collema of foliose Lichens.

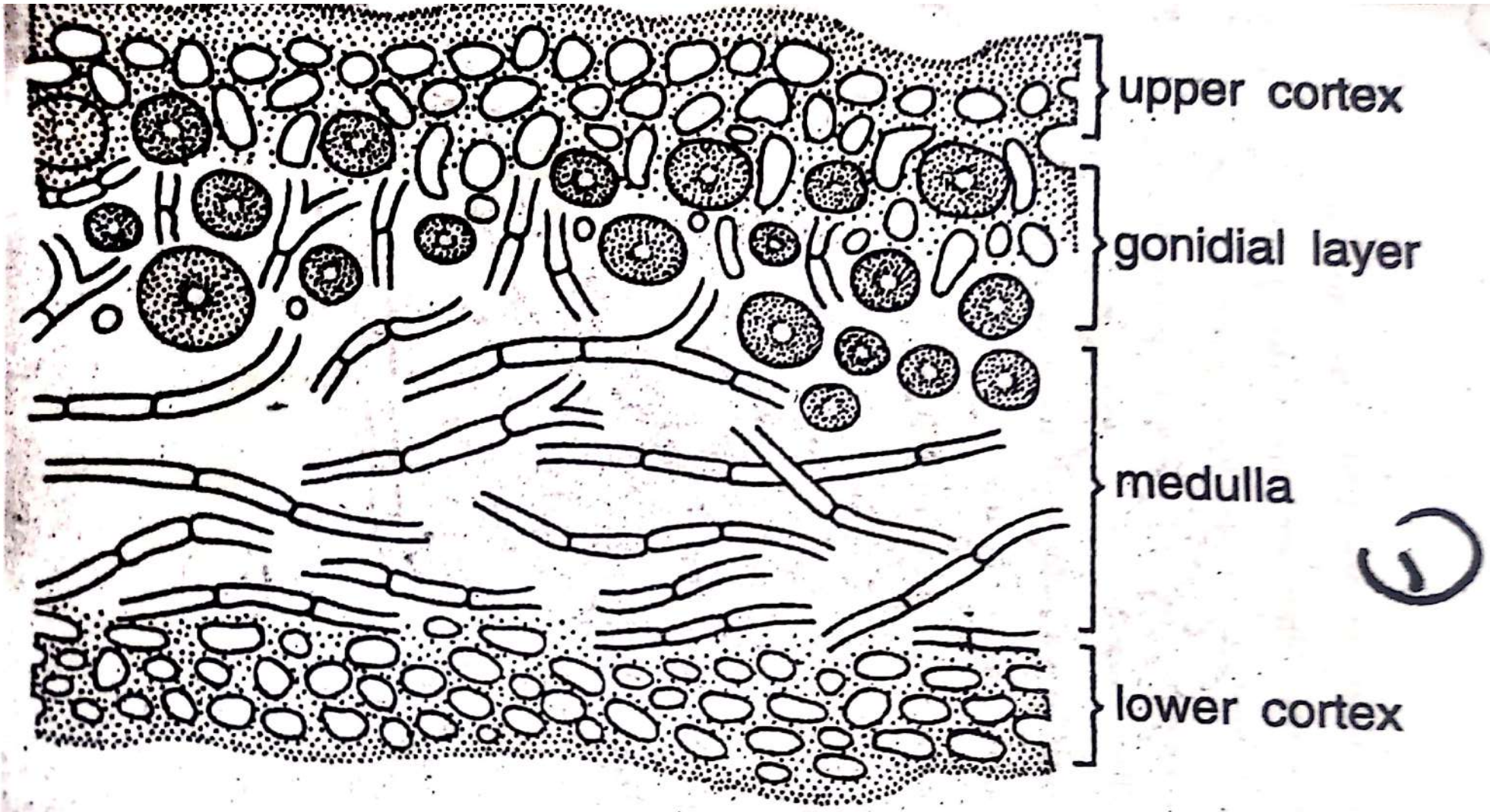


Fig. 4. *Physcia.* V.s. thallus to show heteromerous internal structure.

Physcia :-

* Internal structure of the thallus shows four distinct regions or zones. These are upper cortex, gonidial layer or algal layer, medulla and the lower cortex.
* Certain breathing pores may also be present in the epidermis. These help in gaseious exchange.
* Below the gonidial layer is the medulla made of very loosely interwoven hyphae.
* Cells of the lower cortex produce rhizines.

Identification:

By the above said reasons, the given shed is V.S of thallus to show heteromerous internal structure of physcia of foliose lichens.

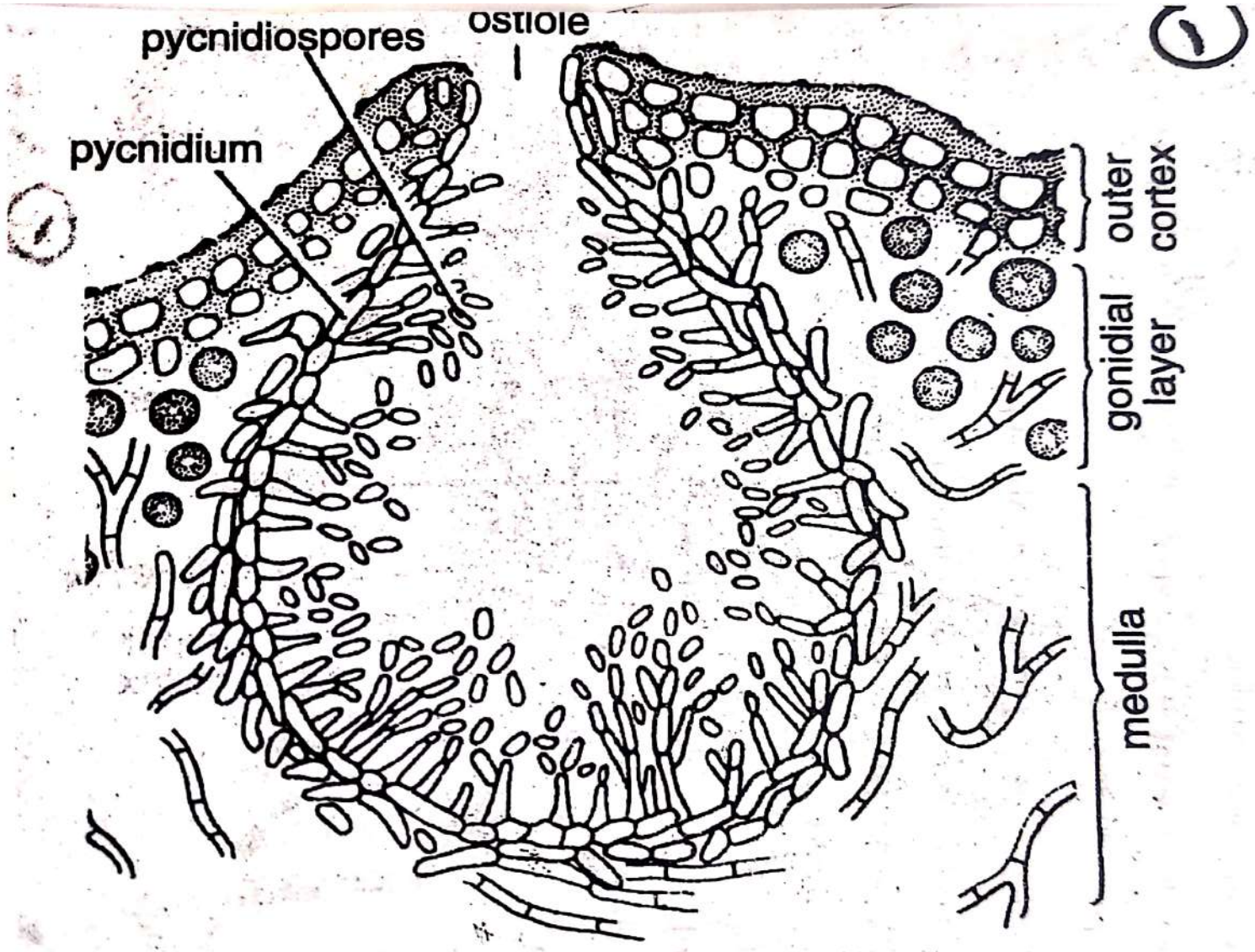


Fig. 5. ***Physcia.*** V.s. pycnidium to show pycniospores.

Physcia - pycnidium to show pycniospores :-

* Pycnidia or pycinidial cups are produced on the upper surface of the thallus.
* Pycnidium is a flask-shaped cavity with a small opening at its apex, an ostiole.
* Pycniospores are produced at the tip of these hyphae.
* Pycniospores are released through an ostiole and germinate to produce a lichen if it comes in contact with an alga.

Identification:-

By the above said reasons, the given sheet is V.S pycnidium to show pycniospores in physcia of foliose lichens.

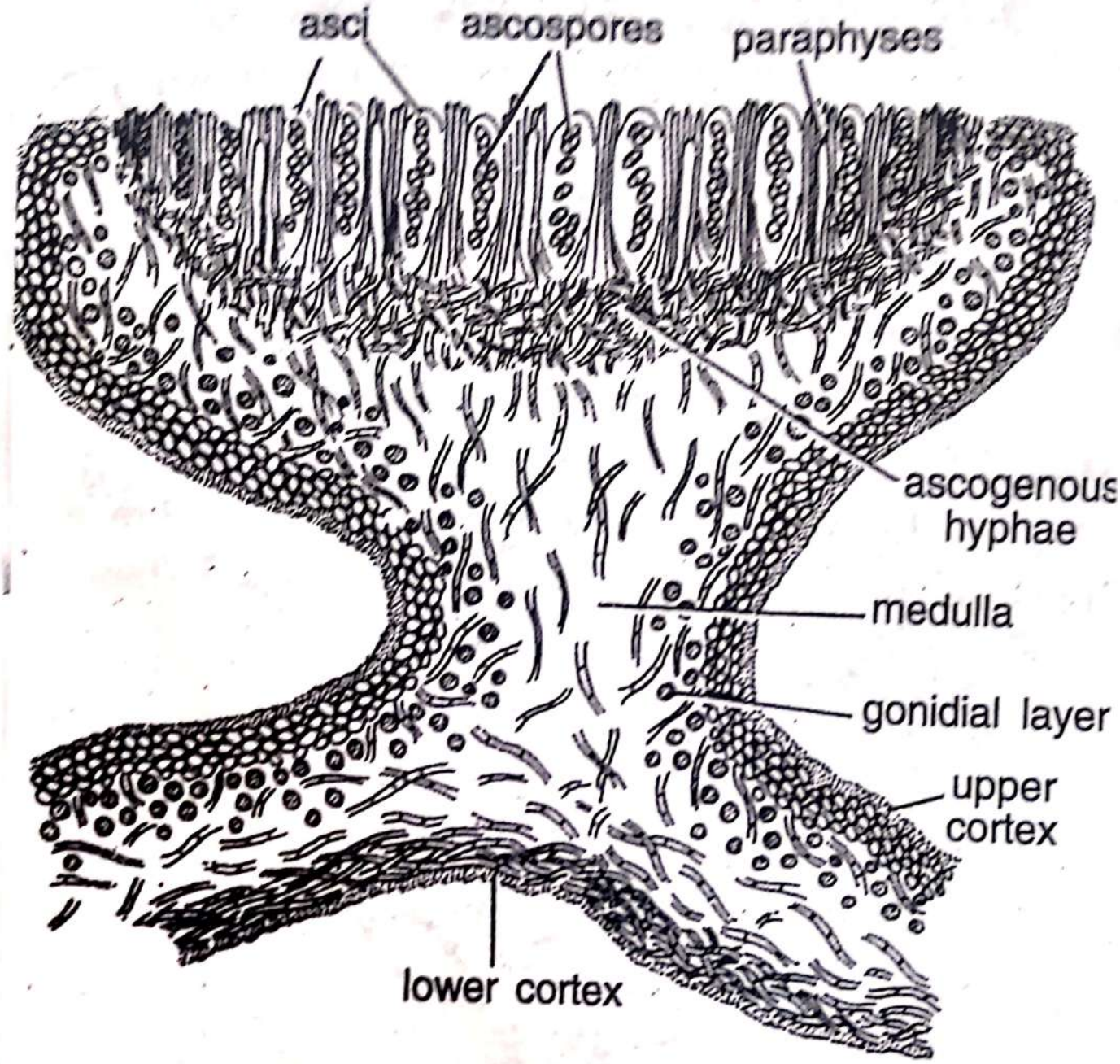


Fig. 7. *Physcia.* V.s apothecium for the study of ascospores.

Physcia :- apothecium for the study of ascospores :-

* Apothecia are saucer-shaped fruiting bodies.
* In some cases, perithecia, flask-shaped fruiting bodies are also formed.
* Each ascus usually contains eight ascospores but the number may vary from one to eight.
* Ascospores, when liberated, if come in contact with the suitable alga, produce the lichen thallus.

Identification :

By the above said reasons, the given sheet is apothecium for the study of ascospores of foliose lichens

Fruticose Lichens

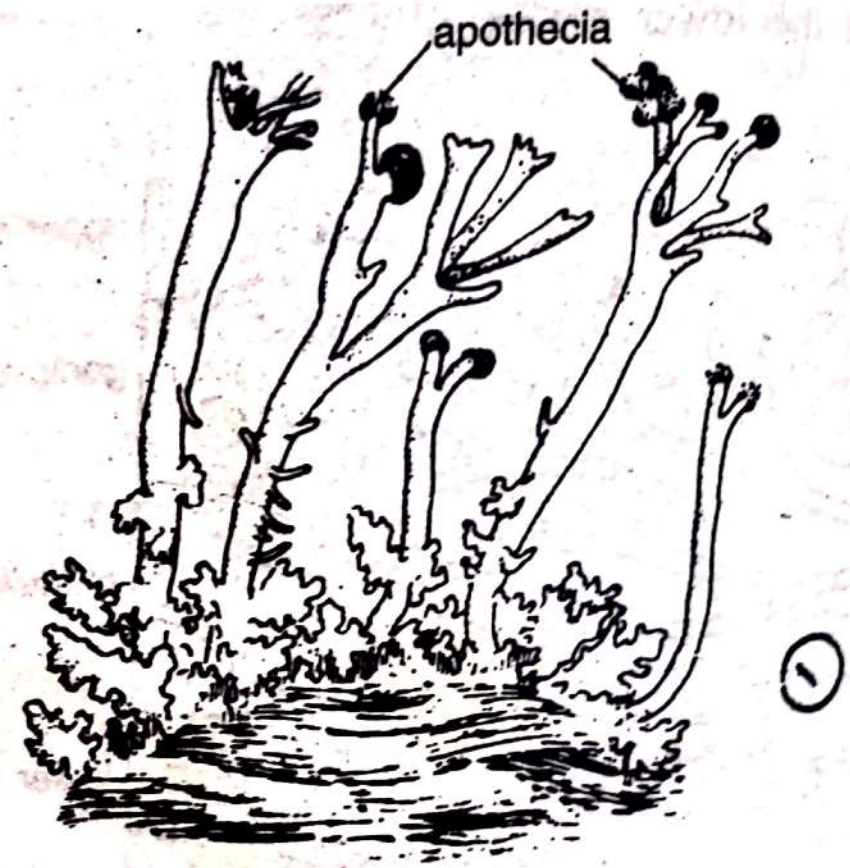


Fig. 8. ***Cladonia flabelliformis.*** **A fruticose ascolichen showing external features.**

Cladonia flabelli-formis :-

* These appear shrubby with cylindrical, flat or ribbon-like body.
* It is upright, generally branched and pendulous.
* It remains attached to the substratum by rhizoid-like structures forming a disc.

Identification :

By the above said reasons, the given sheet is External features of cladonia flabelliformis of fruticose Lichens.

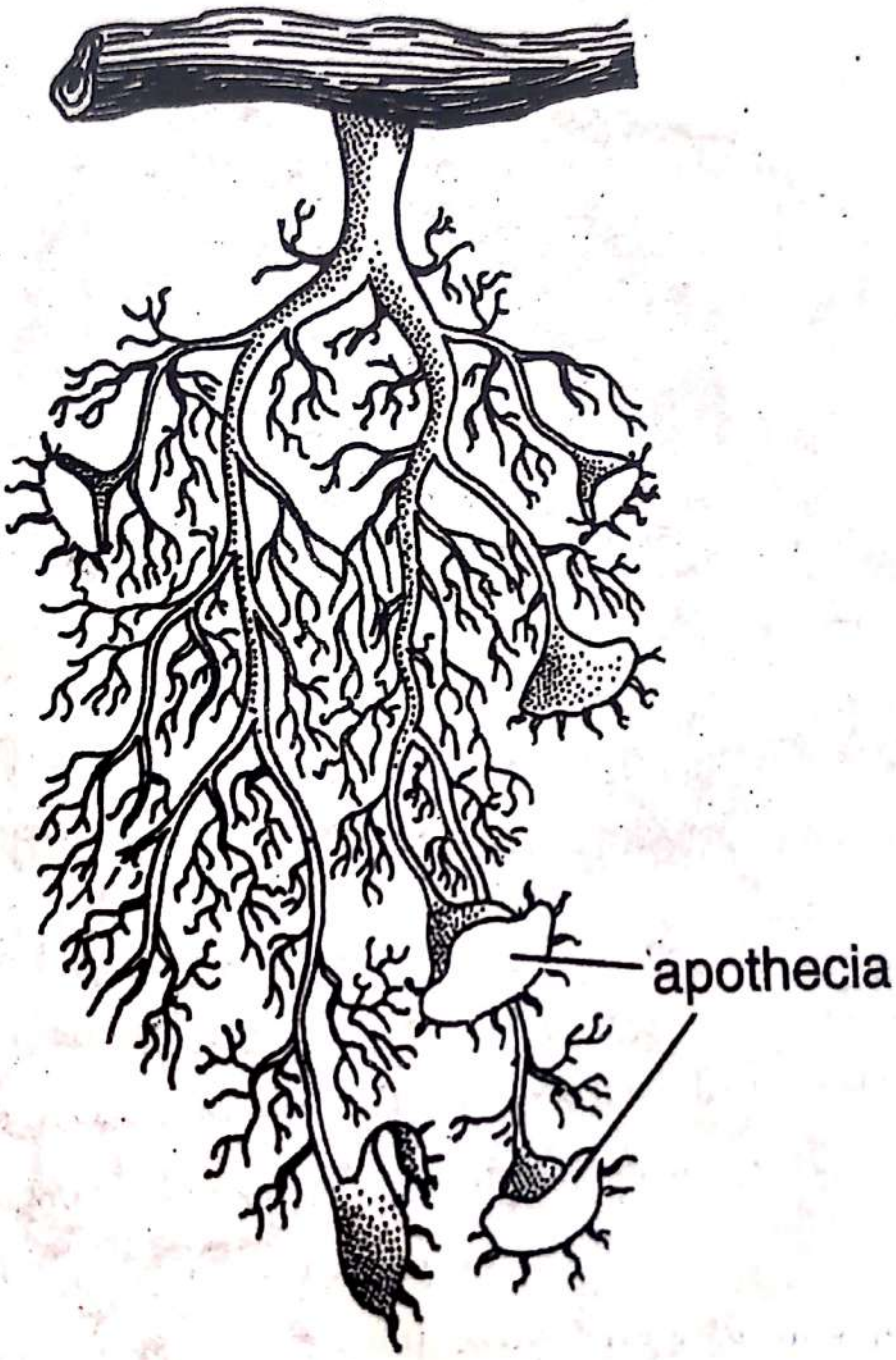


Fig. 9. ***Usnea*** **sp. A fruticose ascolichen to show external features.**

Usnea :-

* The transverse section appears almost circular.
* The internal structure shows four distinct regions, outermost cortex, the algal zone, medulla and the centrally located chondroid axis.
* Thallus structure is radially symmetrical.
* The cortex is made of closely packed and interwoven fungal hyphae. Intercellular spaces are absent.

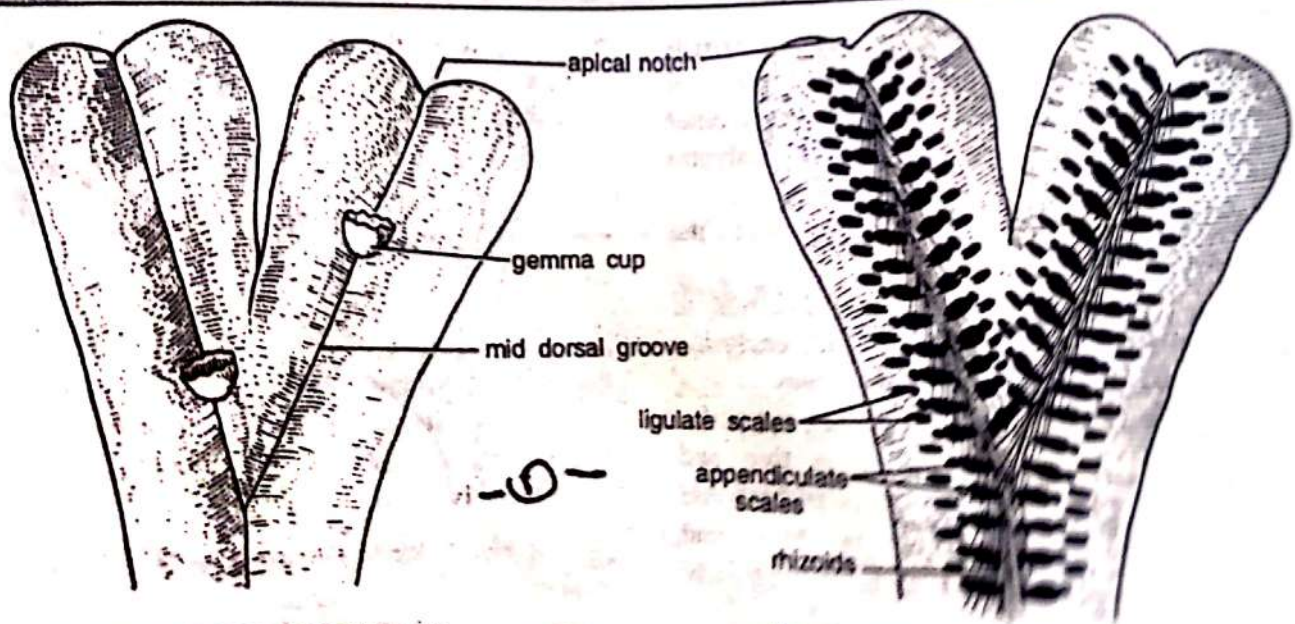
Identification:

By the above said reasons, the given sheet is external features of usnea sps of fruticose lichens.

Marchantia

Classification

Division	—	**Bryophyta**
Class	—	**Hepaticopsida**
Order	—	**Marchantiales**
Family	—	**Marchantiaceae**
Genus	—	***Marchantia***



DORSAL VIEW OF THE THALLUS

VENTRAL VIEW OF THE THALLUS

Marchantia - Thallus :- (Dorsal & Ventral view)

* Plants are thalloid, dorsi-ventral and prostrate
* Thallus is dichotomously branched and the apex of each branch is notched.
* The dorsal side has a conspicuous midrib and many polygonal areas.
* The ventral surface bears scales and rhizoids along the midrib.

Identification:

By the above said reasons, the given sheet is thallus of dorsal and ventral view of marchantia.

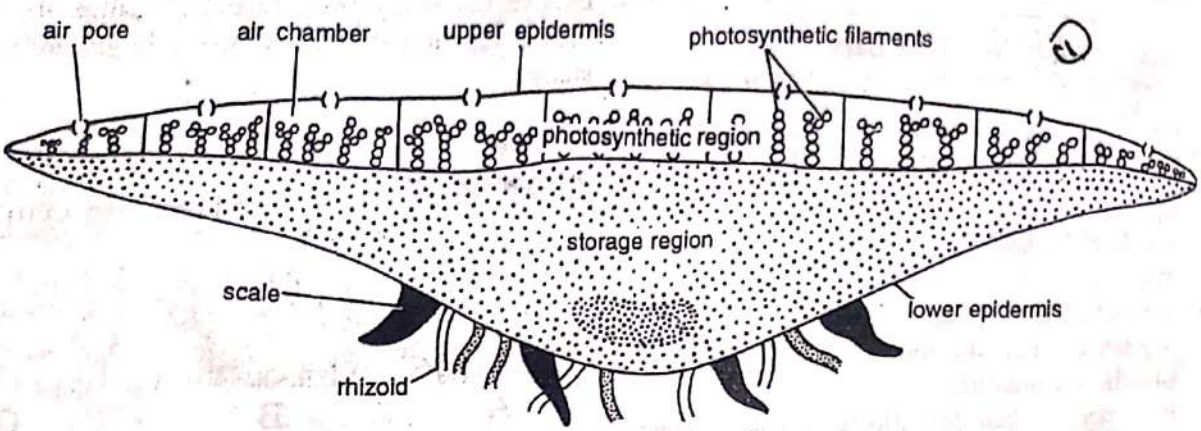


Fig. 2. *Marchantia.* V.t.s. thallus (diagrammatic).

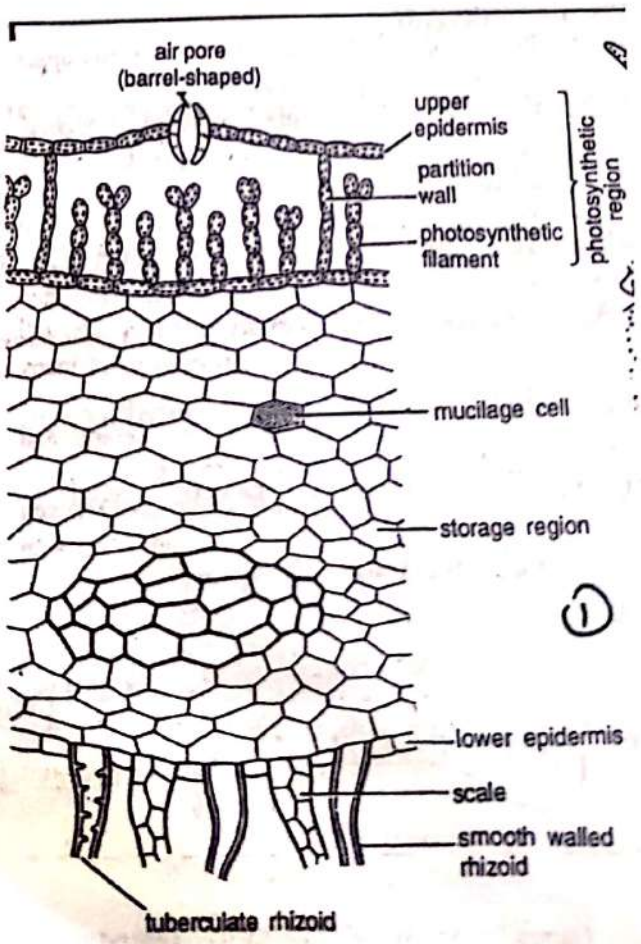


Fig. 4. *Marchantia.* V.t.s. thallus (a part cellular).

Marchantia - Thallus :-

* Thallus is dorsiventrally differentiated into an upper photosynthetic or assimilatory region and a lower storage region.
* Photosynthetic region is differentiated into upper epidemis and air chambers.
* Air pore is made of 4-8 superimposed tiers of cells.
* Each air chamber is filled with many branched assimilatory or photosynthetic filaments.

→ By the above said reasons, the given sheet is thallus of marchantia

Marchantia - Thallus :- (a part cellular) :-

* Storage region is thick in the centre and gradually narrows towards margins.
* Storage region consists of compactly arranged parenchymatous cells.
* The cells in the midrib or centre are slightly thickened to serve for ~~conditi~~ conduction.
* The lower surface of the thallus is bound by the lower epidermis, which bears scales and rhizoids in the middle region.

Identification-

→ By the above said reasons, the given sheet is thallus (a part cellular) of marchantia.

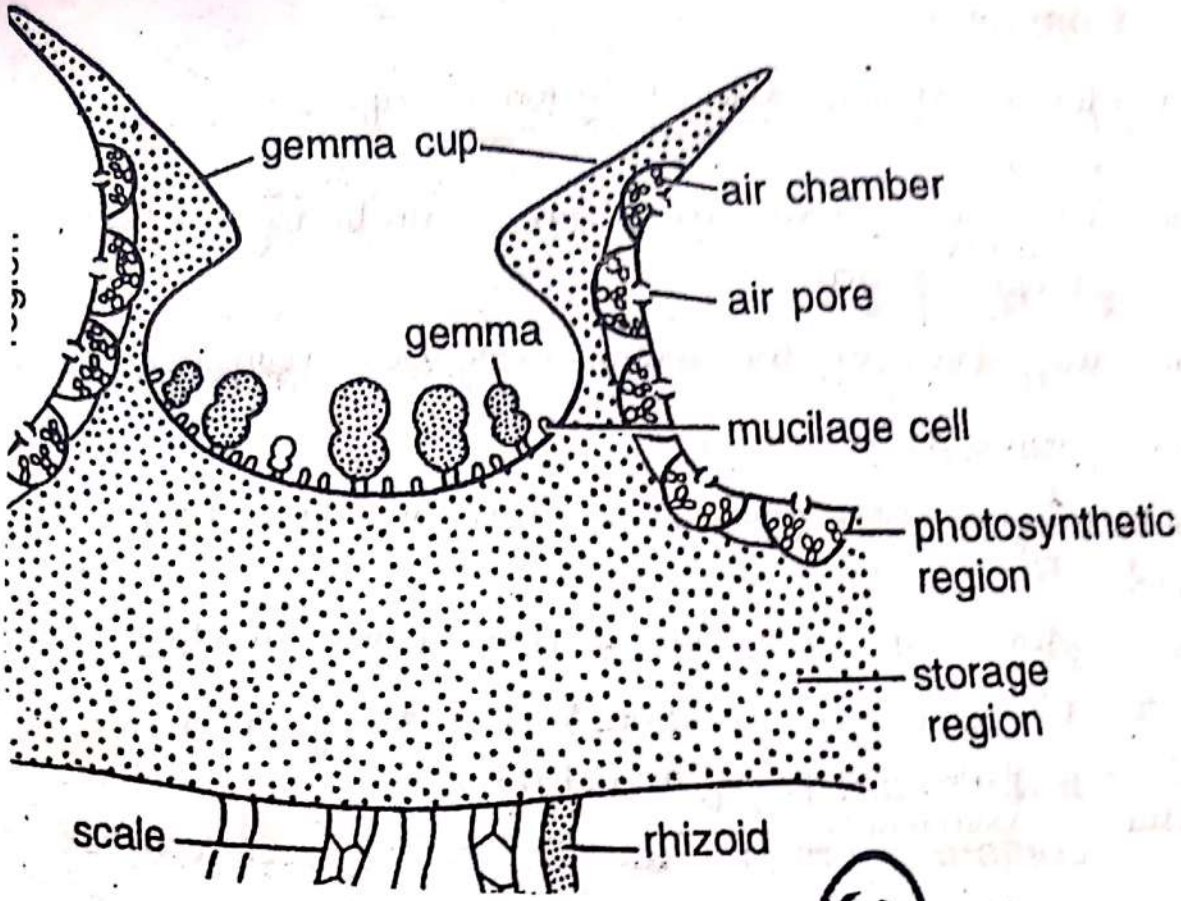


Fig. 6. ***Marchantia.*** V.t.s. of thallus through gemma cup.

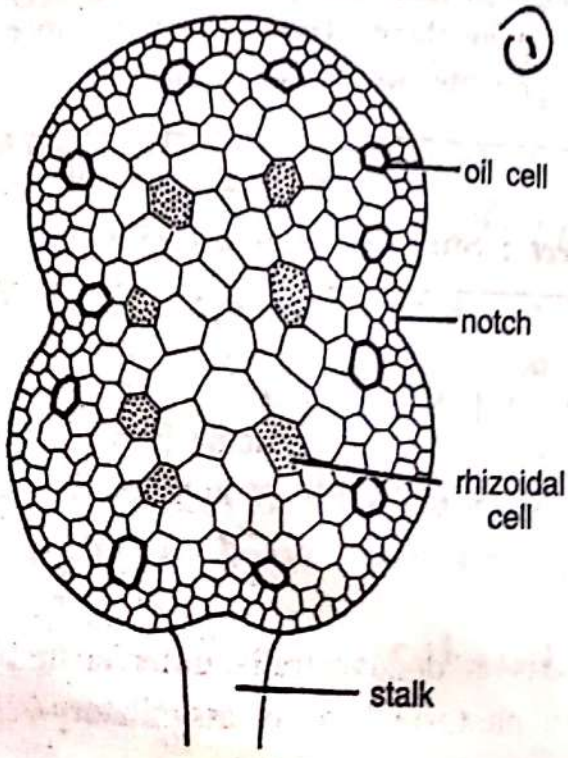


Fig. 7. ***Marchantia.*** A gemma.

Marchantia - thallus through gemma cup :-

* The outer wall shows outer photosynthetic region and inner storage region.
* From the floor of the central cavity arise numerous discoid gemmae.
* Intermingled with gemmae are many mucilage hairs or cells.
* The gemma cup arises as a part of the thallus.

Identification: By the above said reasons, the given sheet is thallus through gemma cups of marchantia.

Marchantia - Gemma :-

* Gemmae is one-celled, stalked structure. The stalk keeps gemma attached to the base of the gemma cup.
* The disciform gemma has two shallow notches on both the lateral sides.
* Towards the periphery of the gemma colourless oil cells are present.
* All the cells of gemma except oil cells and rhizoidal cells contain chloroplast.

Identification:

By the above said reasons, the given sheet is gemma of marchantia.

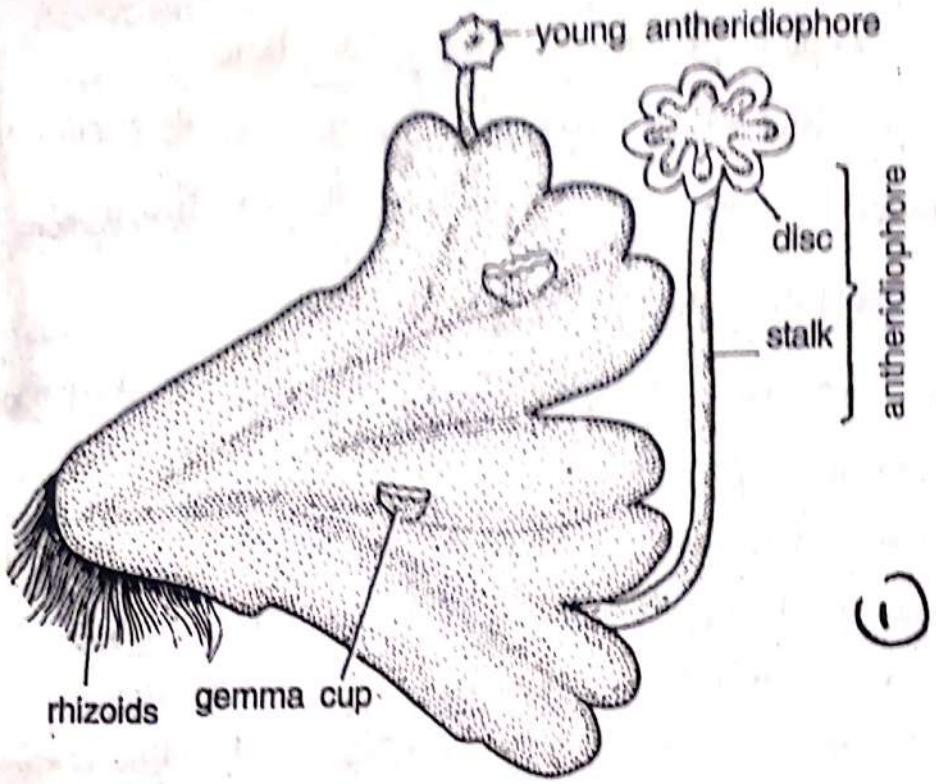


Fig. 9. ***Marchantia.*** Thallus bearing antheridiophore.

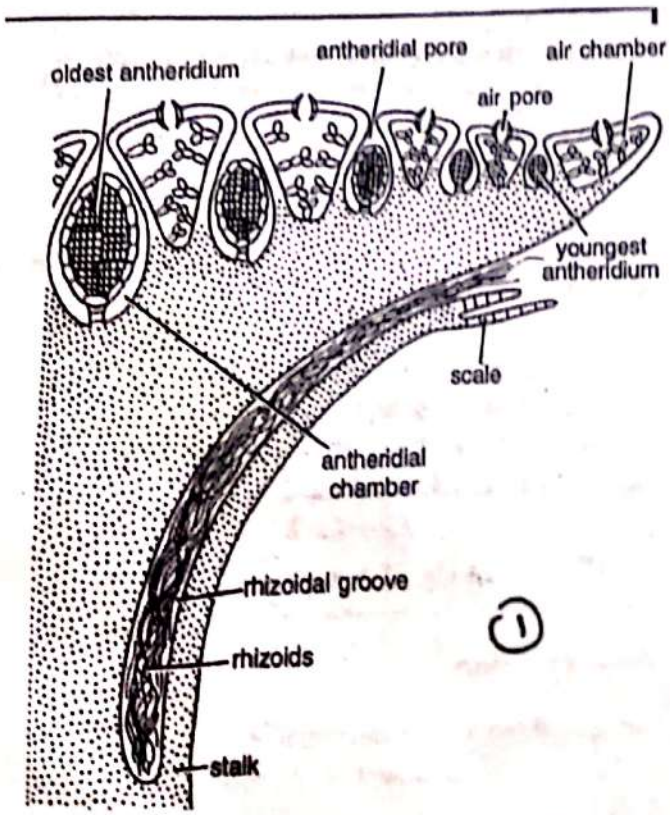


Fig. 10. ***Marchantia.*** A part of L.s. of antheridiophore.

Marchantia - thallus bearing antheridiophore :-

* The antheridiophore consists of 0.5 to 2.0 cms long stalk, bearing at its apex one eight lobed disc.
* The peltate disc is slightly convex.
* The internal structure resembles with that of the thallus.
* Epidermis is interrupted below by barrel-shaped air pores, each opening below, into an air chamber with branched assimilatory filaments.

By the above said reasons, the given sheet is thallus bearing antheridiophore of marchantia.

Marchantia - L.S of antheridiophore :-

* Alternating with air chambers, are antheridial cavities.
* Each antheridial cavity, that opens by an antheridial pore, has a single globular antheridium.
* It has a multicellular stalk attached to the base of the antheridial cavity.
* The globular body has a single sterile jacket layer.

Identification :-

By the above said reasons, the given sheet is L.S. of antheridiophore of marchantia.

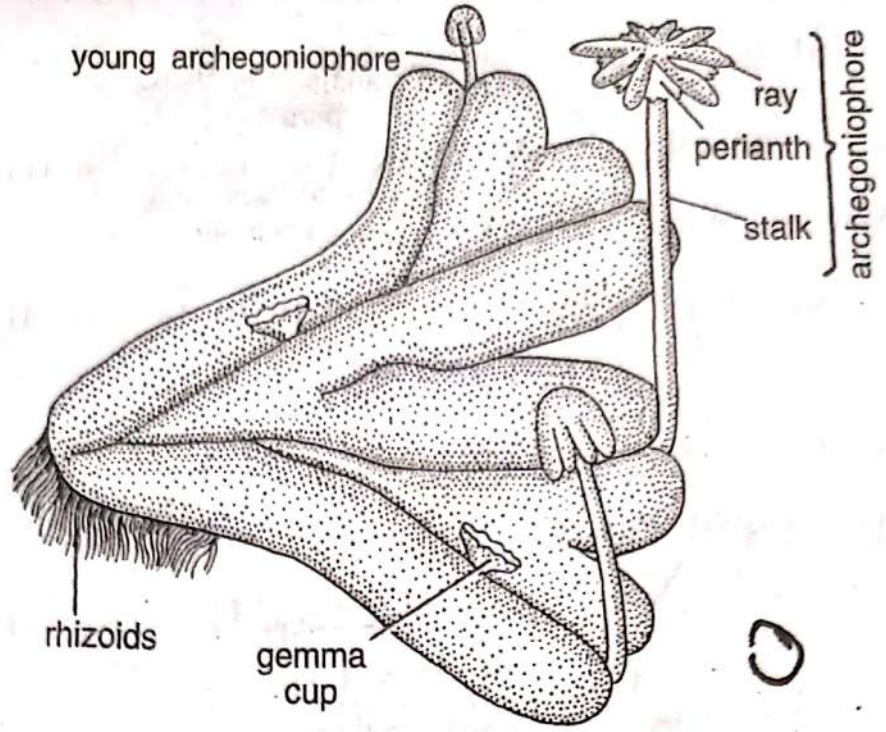


Fig. 12. ***Marchantia.*** Thallus with archegoniophores. *(B–14)*

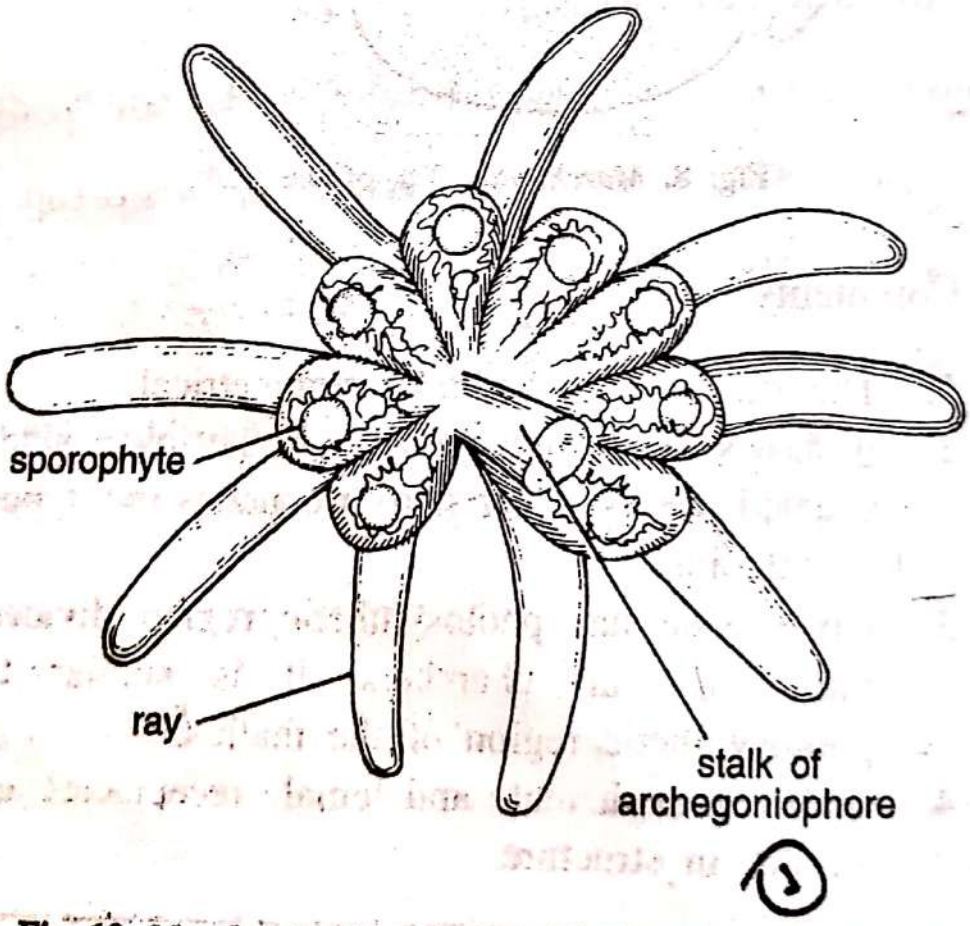


Fig. 13. ***Marchantia.*** **Disc of archegoniophore as seen from lower side.**

Marchantia - Thallus with archegoniophores :-

* It is a stalked structure passessing a nine-rayed stellate disc at the apex.
* Groups of archegonia are found in between the rays.
* In each archegonial group, the archegonia are borne in radial rows.

Identification: By the above said reasons, the given sheet is thallus with archegoniophores of marchantia.

Marchantia - Disc of archegoniophore :-

* After fertilization, sporophyte is formed in the same archegonium.
* The peltate disc is convex. The internal structure is similar to that of thallus.
* Outermost is the epidermis, interrupted by air pores.
* In young receptacle, archegonia are acropetally arranged on the upper side of the disc.

Identification:

By the above said reasons, the given sheet is disc of archegoniophore of marchantia.

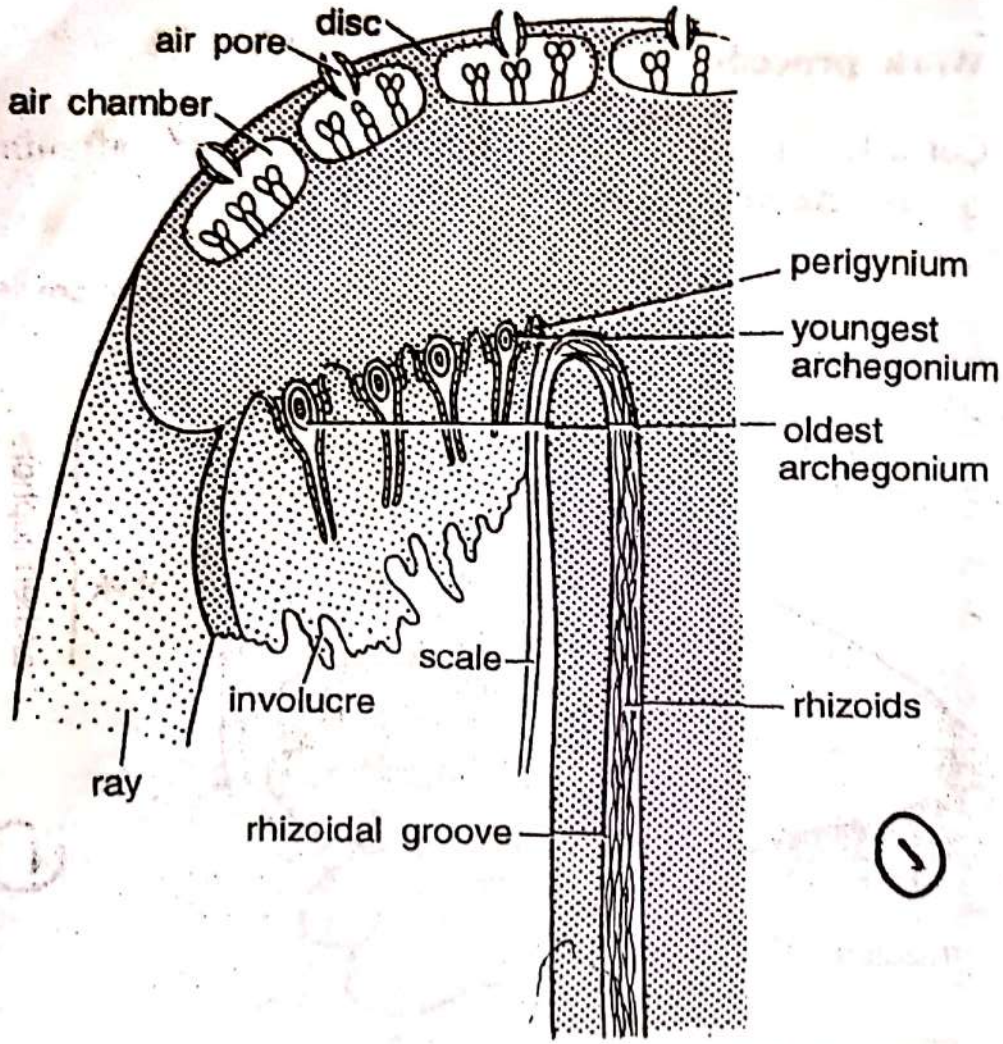


Fig. 14. ***Marchantia.*** A part of L.s. of archegoniophore.

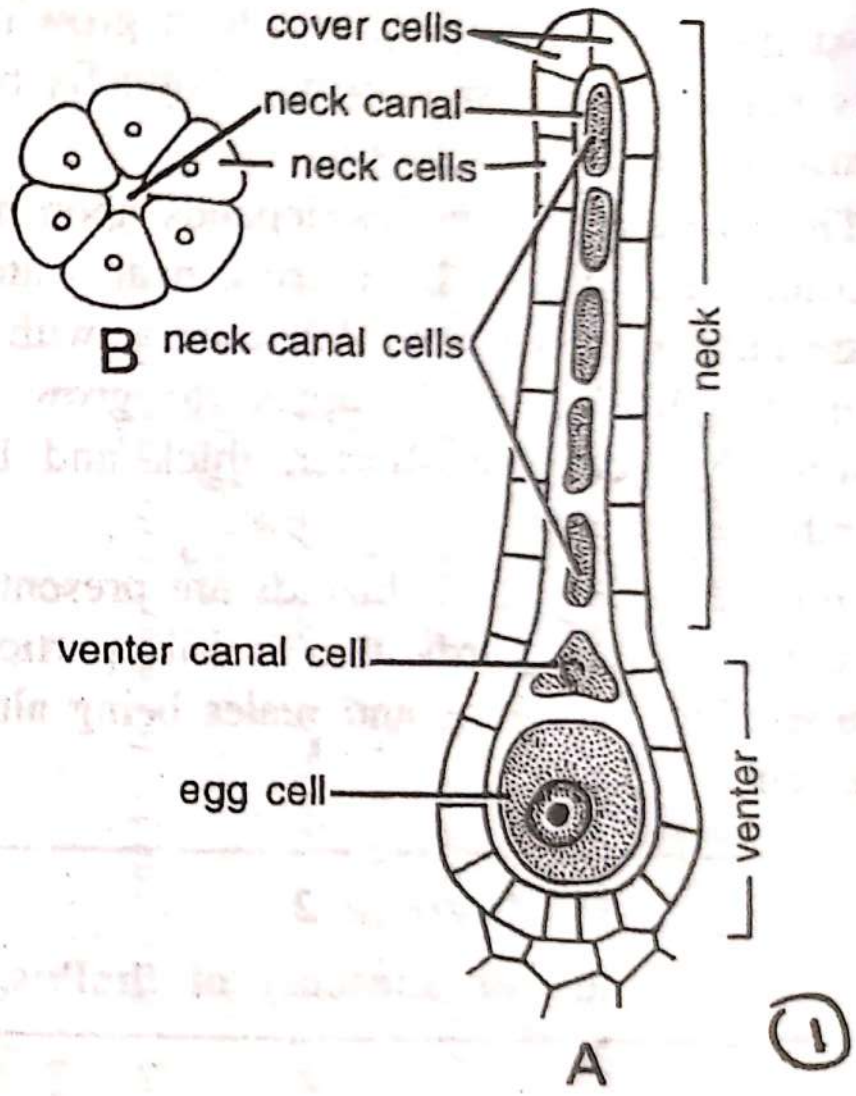


Fig. 15. ***Marchantia.*** **A.** An archegonium. **B.** T.s. through the neck.

Marchantia - L.S of archegoniophore, an archegonium :-

* The nearly mature archegonium has swollen venter and a long neck.
* The venter encloses an egg cell and a venter canal cell, while the neck has 4-8 neck canal cells surrounded by six vertical rows of jacket cells.
* The cover cells are not much distinct.
* After fertilization perianth and involucre are developed.

Identification :

By the above said reasons, the given sheet is L.S of archegoniophore and an archegonium of marchantia

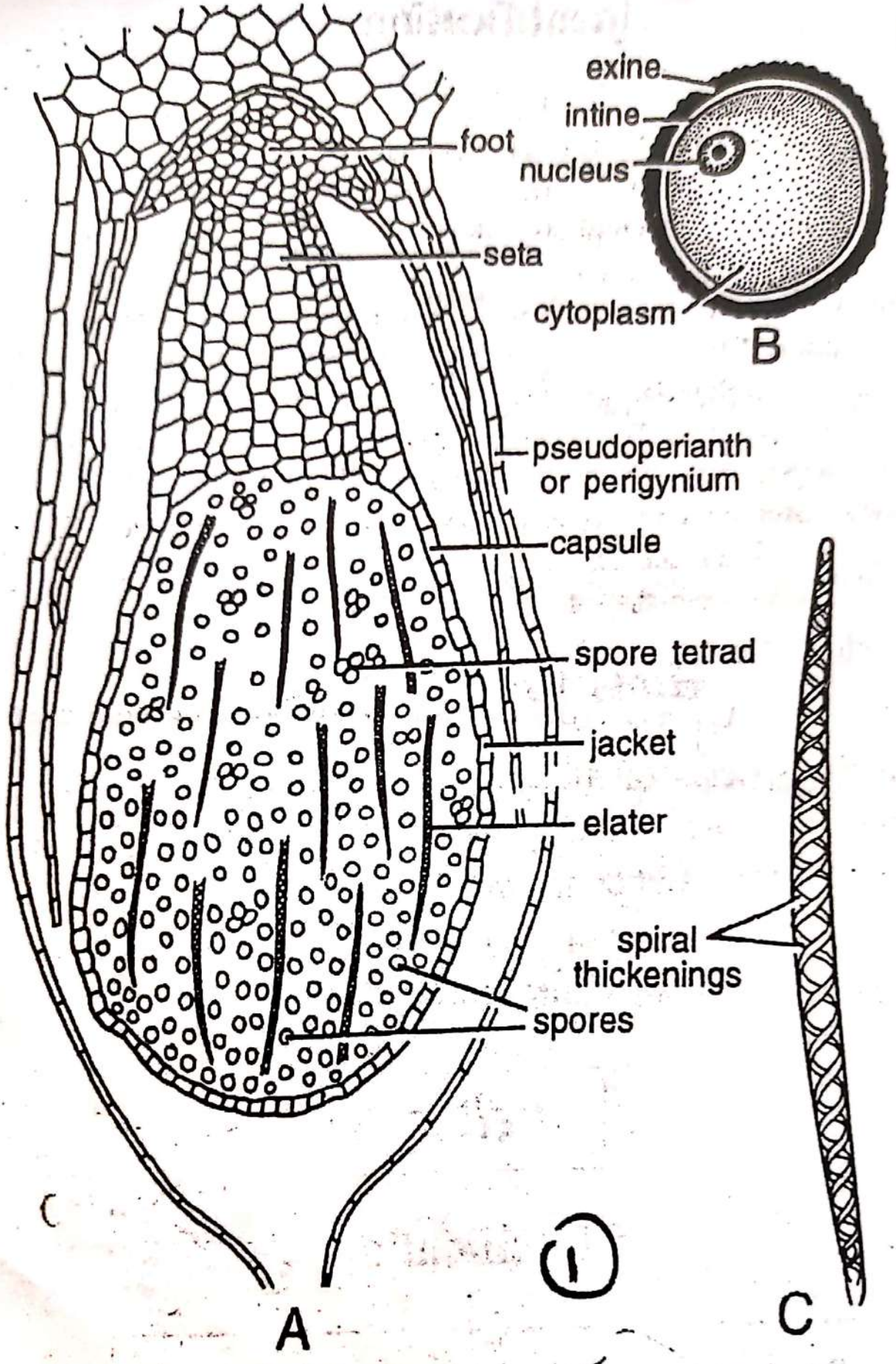


Fig. 16. ***Marchantia.*** **A. L.s. of nearly mature sporophyte. B. Spore. C. An elater.**

Marchantia - mature sporophyte :-

* Sporophyte develops in the same place as archegonium after its fertilization.
* Capsule has a single layered jacket, inside which lie many spores and elaters.
* A spore has an outer thick sculptured exine and a thin uniform intine.
* The spores are very small in size.

Identification:

By the above said reasons, the given sheet is mature sporophyte of marchantia.

Anthoceros (Horn Wort)

Classification

Division	—	**Bryophyta**
Class	—	**Anthocerotopsida**
Order	—	**Anthocerotales**
Family	—	**Anthocerotaceae**
Genus	—	***Anthoceros***

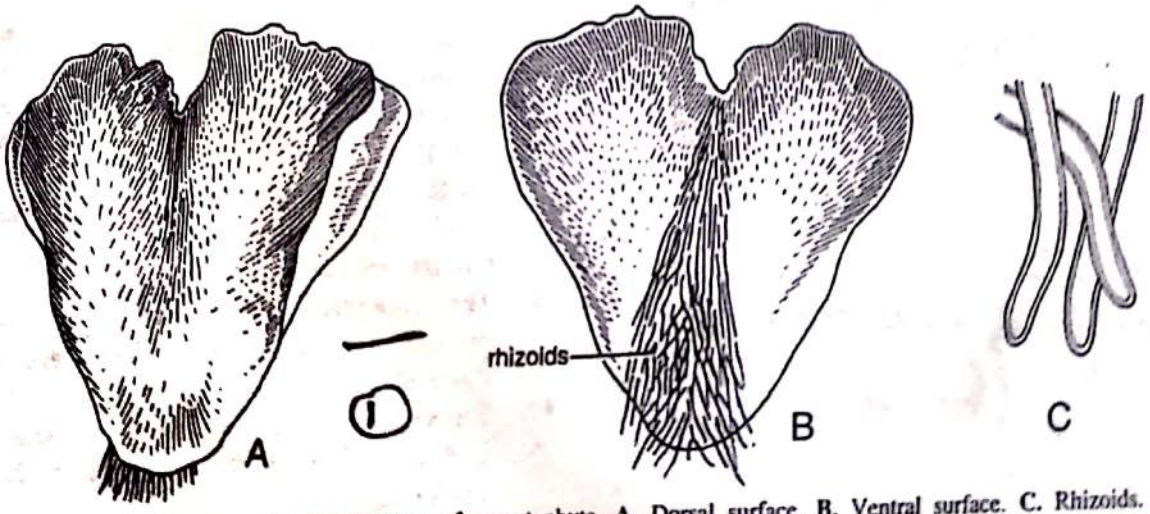


Fig. 1. *Anthoceros*. External features of gametophyte. A. Dorsal surface. B. Ventral surface. C. Rhizoids. *(B–14)*

Anthoceros :-

* Plant body is thalloid, somewhat lobed or radially dissected and generally suborbicular.
* The thallus is less often dichotomously branched and lack a definite midrib.
* The dorsal surface of the thallus is generally smooth, velvety or rough.
* Sex organs are situated on the dorsal side and are embedded in the tissue of the thallus.

Identification:

By the above said reasons, the given sheet is External features of gametophyte of Anthoceros.

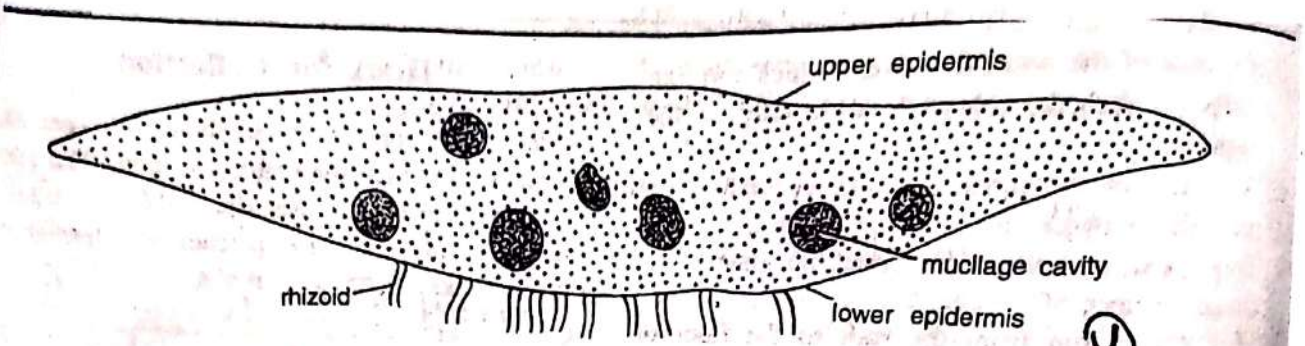


Fig. 2. *Anthoceros.* V.t.s. thallus (diagrammatic).

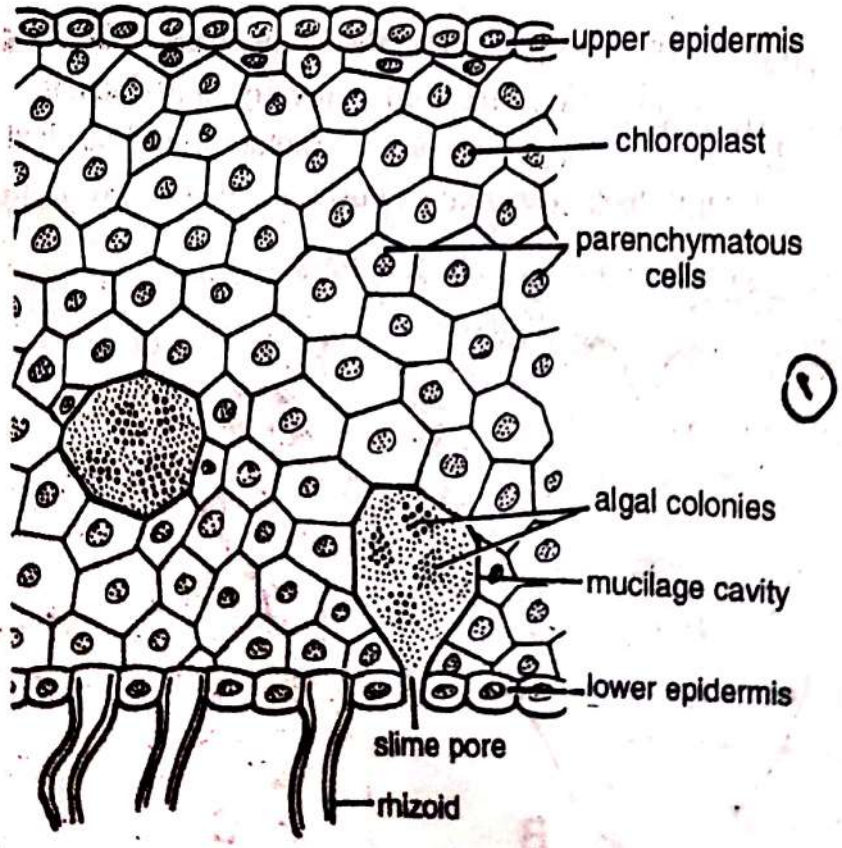


Fig. 3. *Anthoceros.* A part of V.t.s. of thallus (cellular).

Anthoceros - thallus :-

* Thallus is few cells in thickness in the middle and becomes thinner towards the margins.
* Internal structure is homogeneous.
* Air pores and air chambers are absent.
* On upper side is present upper epidermis and lower epidermis on the lower side.

→ By the above said reasons, the given sheet is thallus of Anthoceros.

Anthoceros - thallus (cellular) :-

* Parenchymatous tissue lies between these two layers.
* Each of the cells has a large chloroplast with a single pyrenoid except the cells of lower epidermis producing rhizoids.
* The endophytic algae present in he mucilage cavities, enter through these slime pores.
* Rhizoids are smooth-walled and arise in the middle region.

Identification :-

By the above said reasons, the given sheet is thallus (cellular) of Anthoceros.

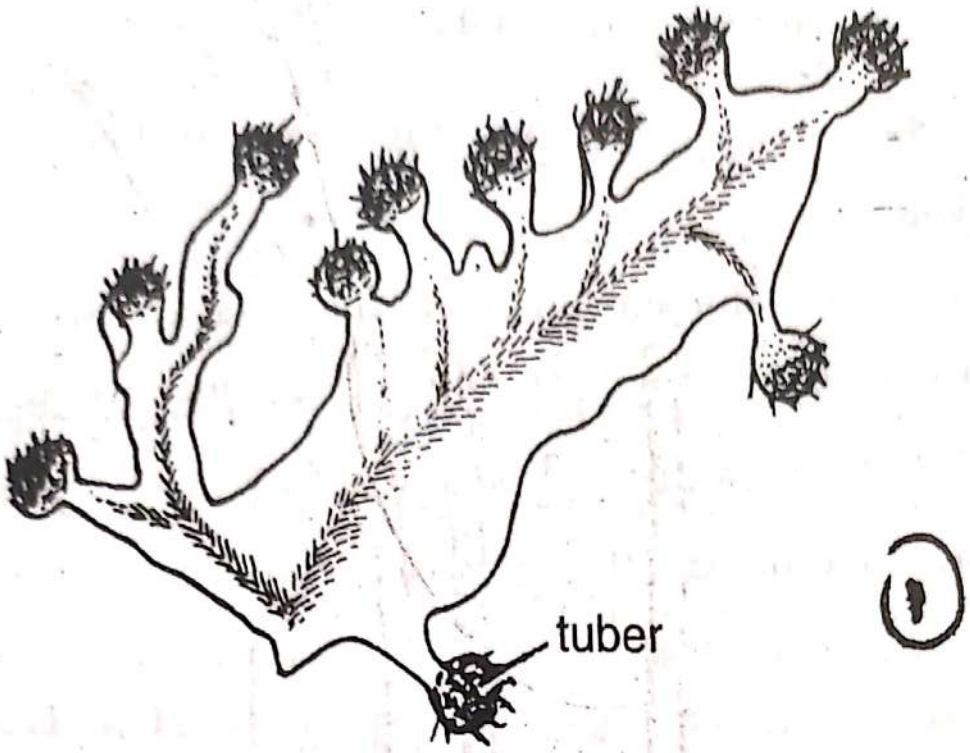


Fig. 5. ***Anthoceros.*** Thallus showing tubers.

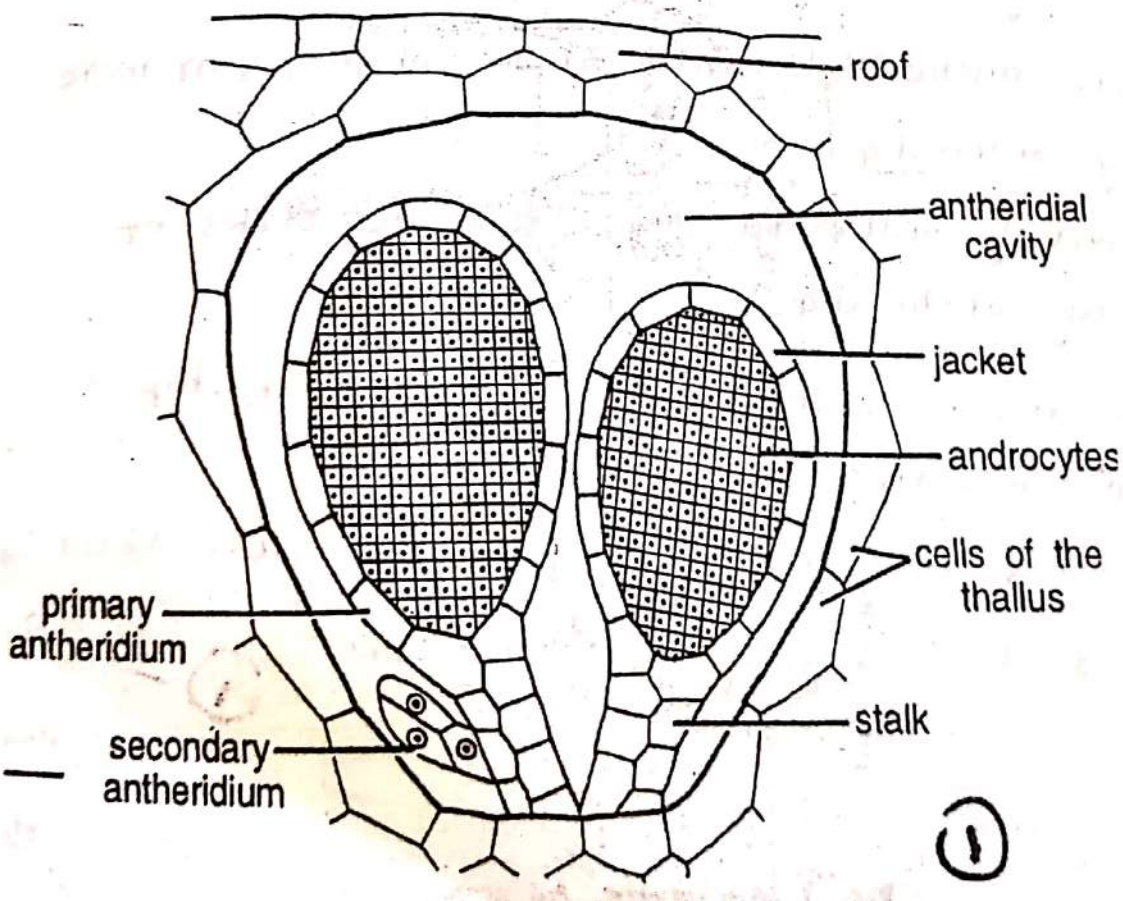


Fig. 6. ***Anthoceros.*** Antheridial cavity with primary and secondary antheridia.

Anthoceros - thallus showing tubers :-

* The tubers are the vegetative reproductive structures.
* Tubers are formed under unfavourable conditions, on the dorsal side along the margins of the thallus.
* A tuber in section shows outer 2-3 corky layers.
* On return of the favourable conditions, tubers develop into new thalli

By the above said reasons, the given sheet is thallus showing tubers of anthoceros.

Anthoceros - Antheridial cavity :-

* The antheridia are present in the antheridial cavity or antheridial chamber with a sterile roof of 2-3 layers.
* Each antheridial cavity contains about 1-4 or more primary antheridia.
* secondary antheridia arise from the stalks of primary antheridia.
* The mature antheridium is a stalked, club-shaped structure with single layered jacket.

By the above said reasons, the given sheet is Antheridial cavity of Anthoceros.

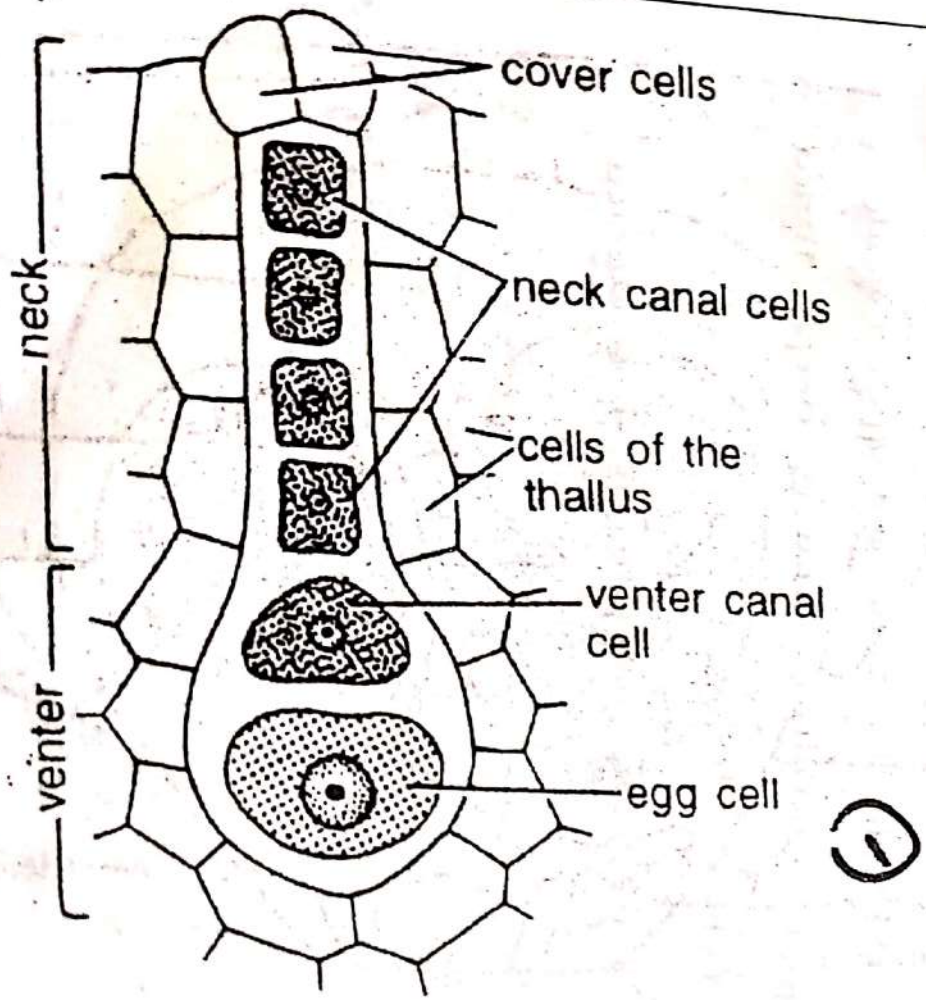


Fig. 7. ***Anthoceros.*** An archegonium.

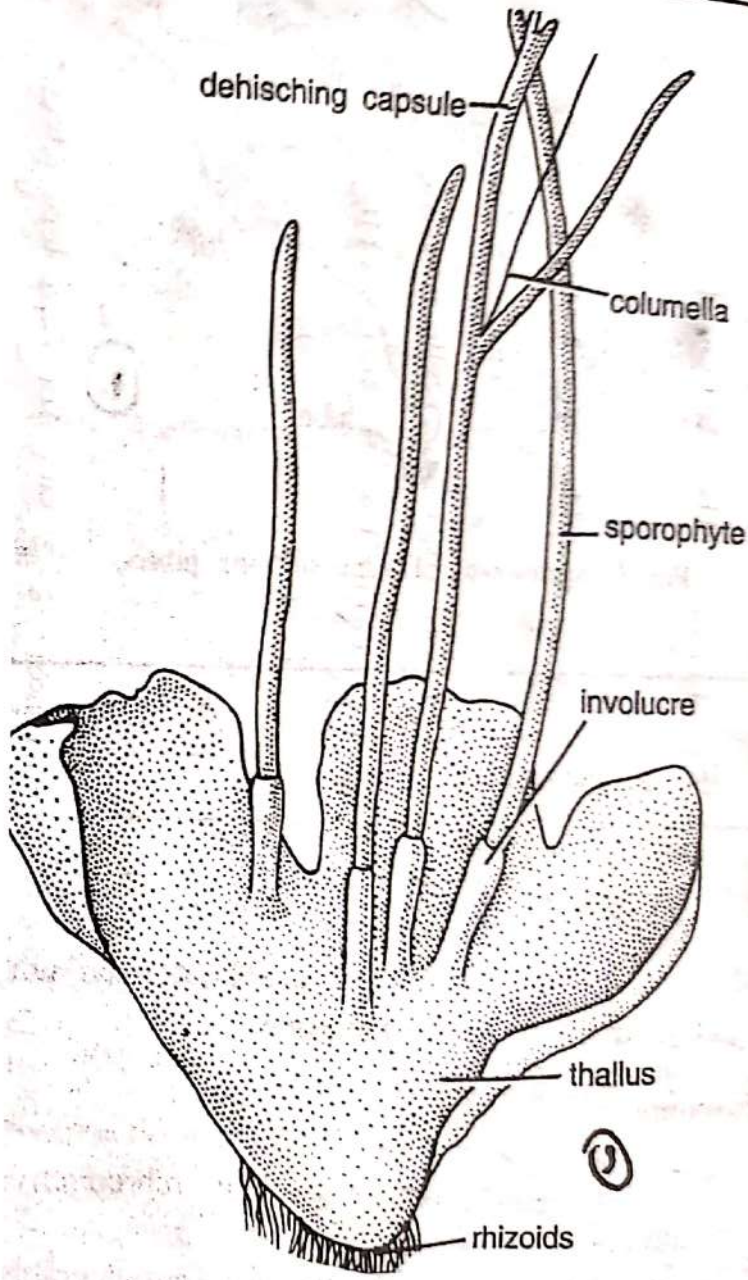


Fig. 8. ***Anthoceros.*** Gametophytic thallus bearing sporophytes.

Anthoceros - An archegonium :-

* The archegonia are embedded in the thallus and only the cover cells project beyond the general surface of the thallus.
* They are in direct contact with the vegetative cells, lateral to them.
* Archegonium consists of a neck and a swollen venter.
* The nearly mature archegonium has 4 cover cells.

Identification - By the above said reasons, the given sheet is archegonium of Anthoceros.

Anthoceros - Gametophytic :-

* The sporophytes are linear, 2-3 cms long, elongated structures.
* The mature sporophyte is made of a lower foot, middle meristematic zone and upper capsule.
* The foot is bulbous and is deeply rooted in the gametophytic tissues.
* The wall of the capsule is 4-6 layered.

Identification:-

By the above said reasons, the given sheet is gametophytic thallus bearing sporophytes of Anthoceros.

Funaria
(Cord Moss)

Classification

Division	—	**Bryophyta**
Class	—	**Bryopsida**
Sub-class	—	**Bryidae**
Order	—	**Funariales**
Family	—	**Funariaceae**
Genus	—	***Funaria***

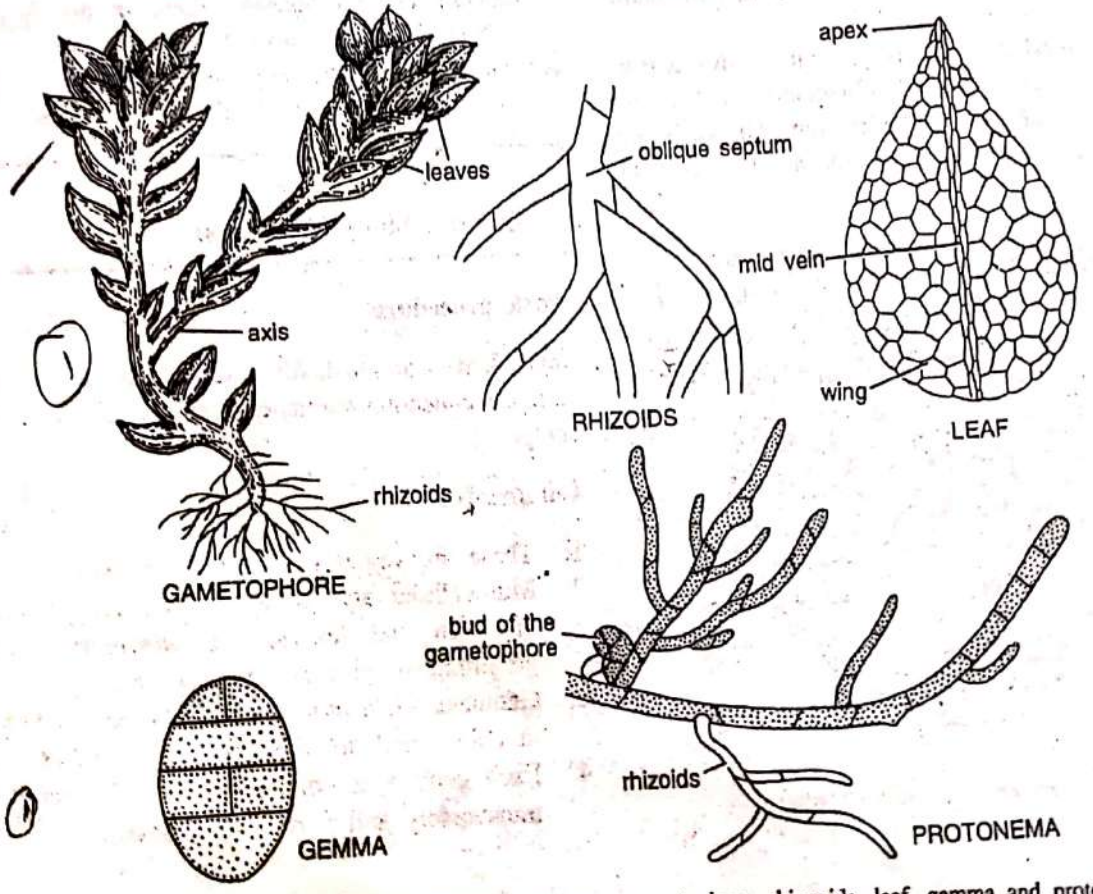


Fig. 1. ***Funaria.*** External features of the gametophyte : gametophore, rhizoids, leaf, gemma and protonema.

Funaria :-

* The gametophyte shows a prostrate underground protonema and an erect leafy gametophore.
* Many rhizoids are present at the base.
* The stem and branches are covered with small, simple, sessile and spirally arranged leaves with 3/8 phyllotaxy.
* Sex organs are borne at the apices of the axis.

Identification :

By the above said reasons, the given sheet is External features of the gametophyte of Funaria.

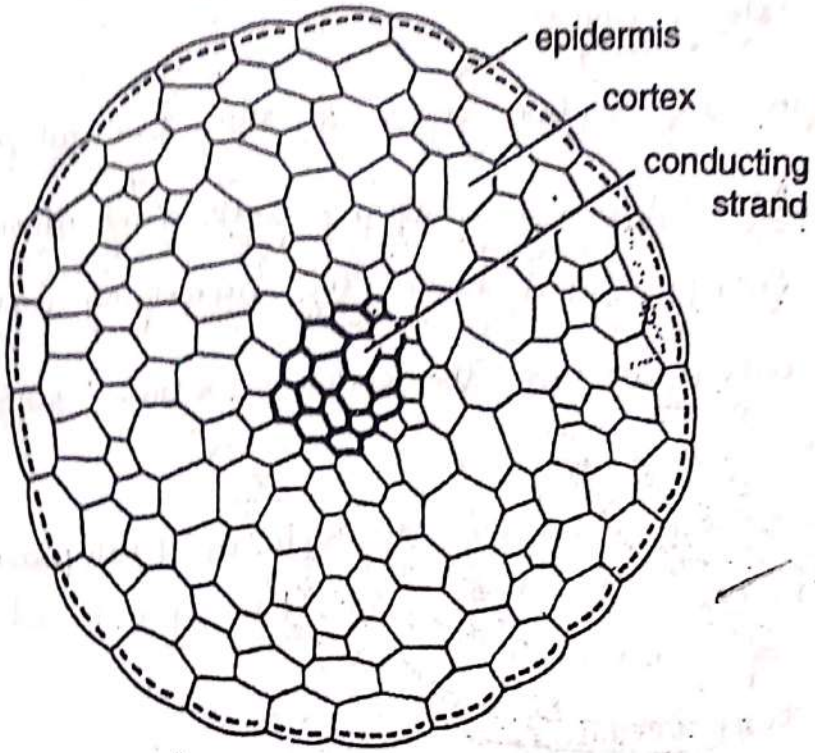


Fig. 2. *Funaria.* T.s. axis (cellular).

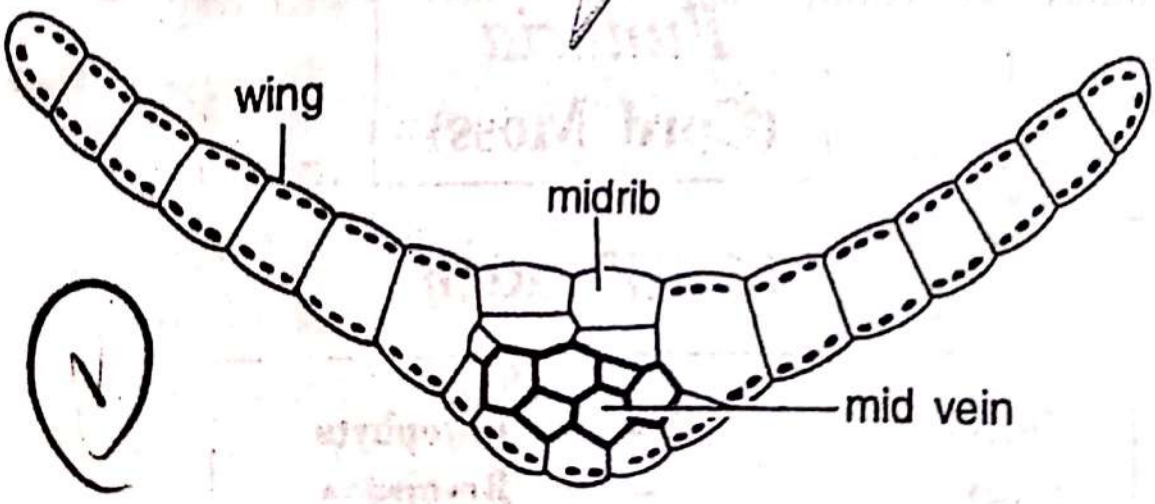


Fig. 3. *Funaria.* T.s. leaf (cellular).

takes part in the conduction of water and food materials.

Funaria - axis (Cellular) :-

* The transverse section shows an almost circular outline.
* The single-layered epidermis, with tangentially elongated cells has chloroplasts and bounds the underlying cortex.
* The outer cells of the cortex sometimes contain the chloroplasts.
* The cells are dead due to lack of protoplasm.

By the above said reasons, the given sheet is T.S axis (Cellular) of funaria.

Funaria - leaf (Cellular) :-

* The leaf consists of a single layer of cells containing chloroplasts except in the middle where it forms a distinct midrib.
* The centre of the midrib is occupied by a small strand of narrow and slightly thick-walled cells.

By the above said reasons, the given sheet is T.S leaf (Cellular) of funaria.

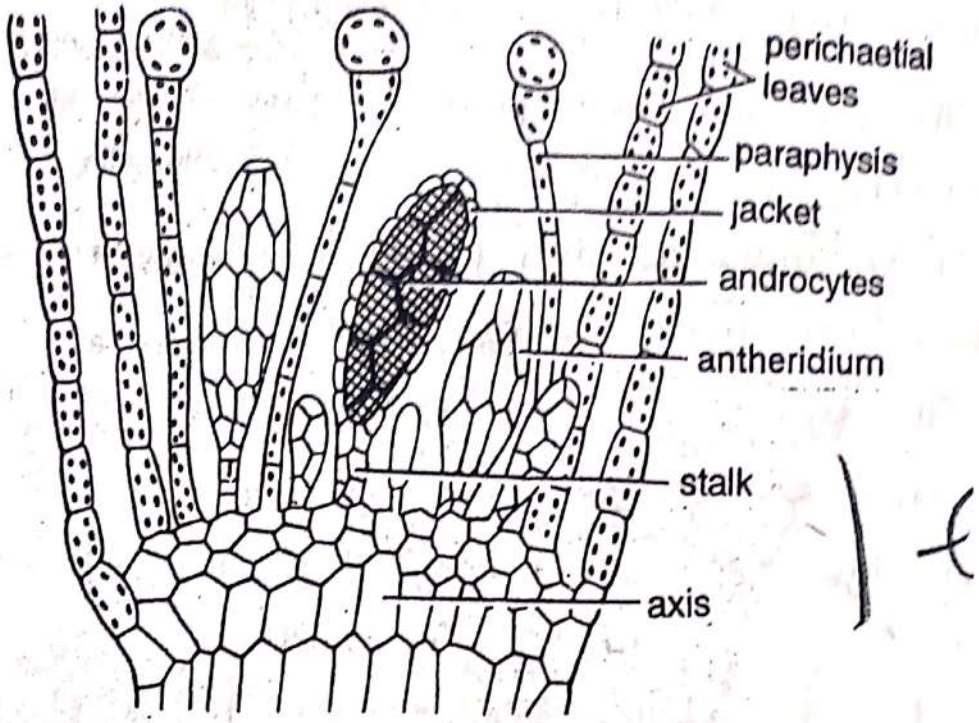


Fig. 4. ***Funaria.*** L.s. apex of the male branch showing antheridia.

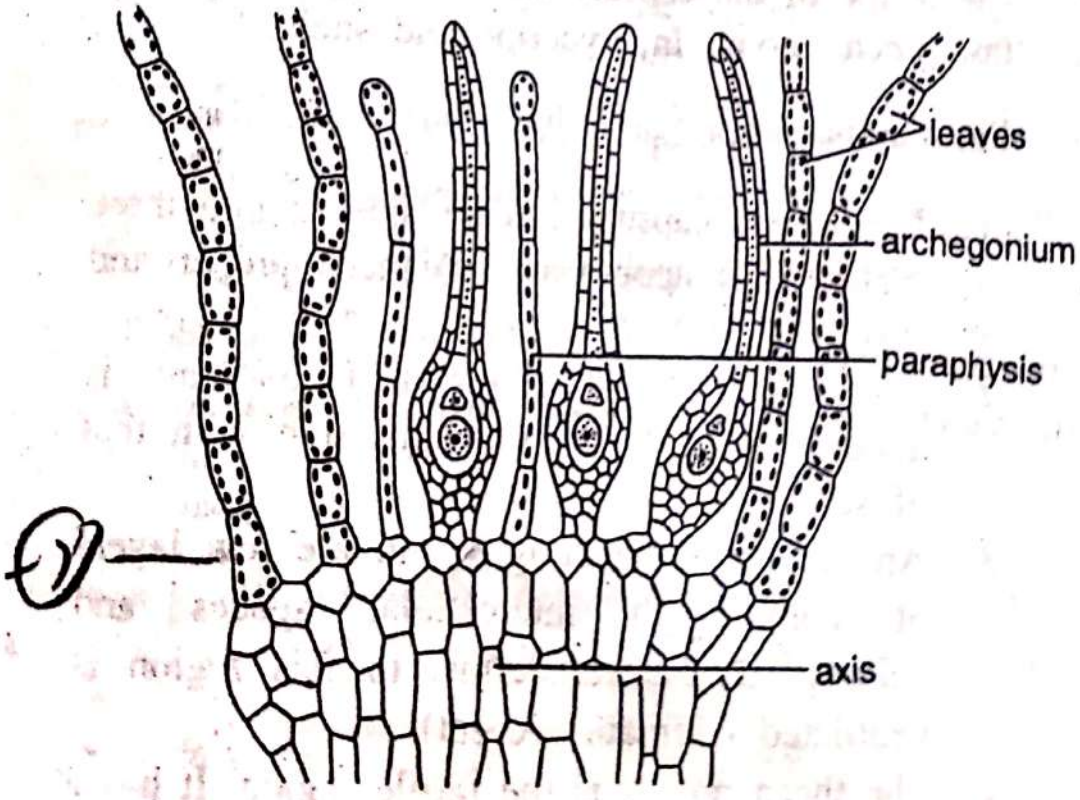


Fig. 5. ***Funaria.*** **L.s. apex of the female branch showing archegonia.**

Funaria - male branch :-

* The sex organs are present at the apices of branches.
* Both antheridia and paraphyses are surrounded by large leaves, known as perichaetial leaves.
* The body has a single layered outer jacket, the cells of which contain chloroplasts.
* A dense central mass of androcytes lies within the jacket.

By the above said reasons, the given sheet is L.S apex of male branch showing antheridia of funaria.

Funaria - female branch :-

* The archegonia also arise in clusters at the apex of the archegonial branch.
* All the archegonia of this cluster are almost of the same age and developmental stage.
* The wall of the venter is double layered,
* In the neck there are six or more neck canal cells and the venter has one venter canal cell and one egg cell.

Identification- By the above said reasons, the given sheet is L.S apex of female branch showing archegonia of funaria.

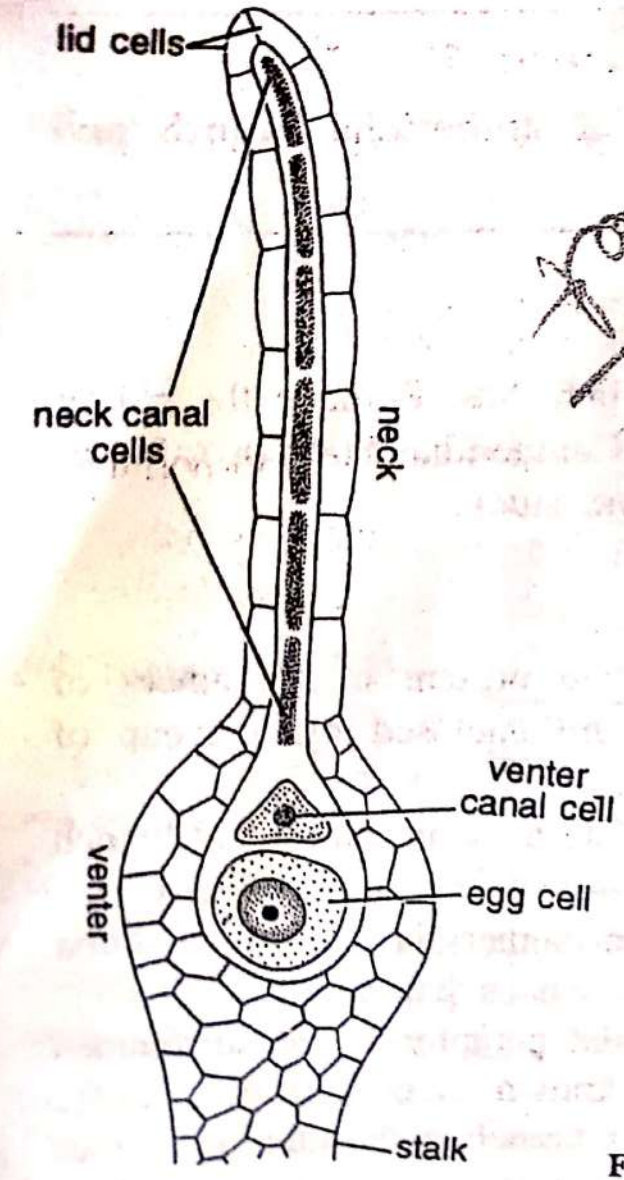


Fig. 6. *Funaria.* An archegonium.

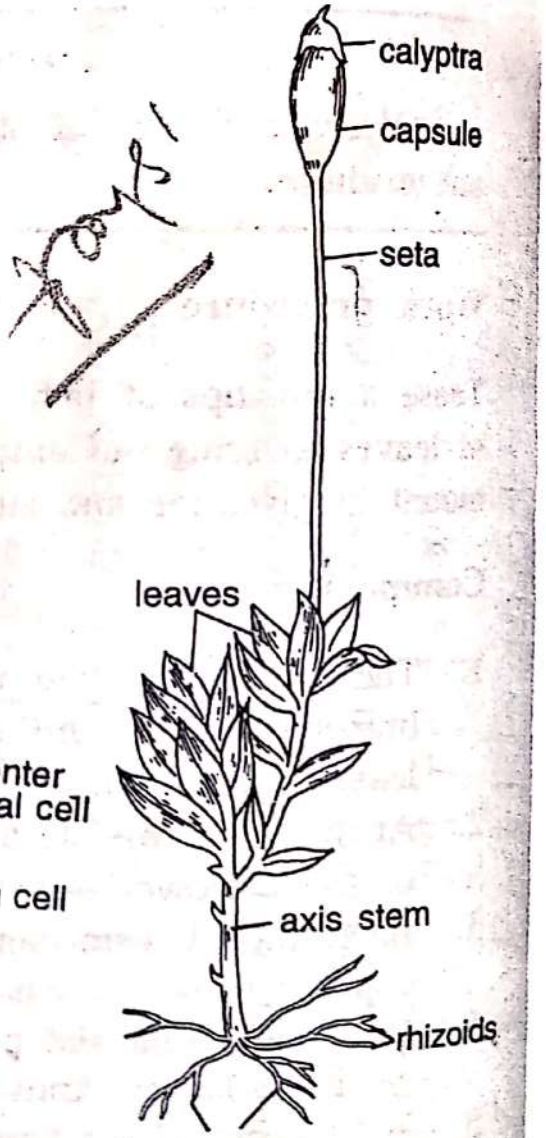


Fig. 7. *Funaria.* A gametophyte with sporophyte.

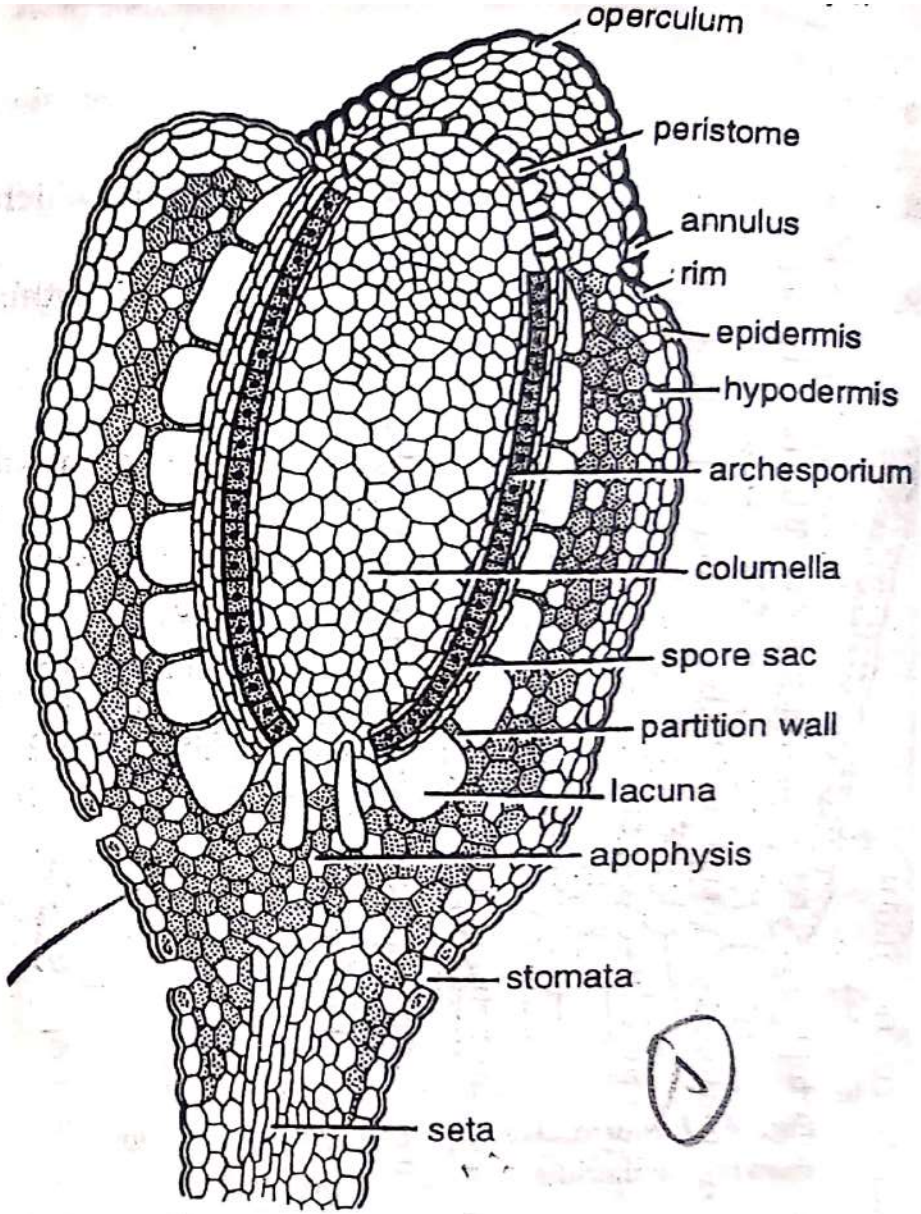


Fig. 8. *Funaria.* L.s. capsule.

Funaria - archegonium :-

* A gametophyte shows a sporophyte attached to it.
* A mature sporophyte shows three parts (i) foot, (ii) seta and (iii) capsule.
* Seta is long, slender and twisted. It bears a capsule at the top.
* The sporophyte is developed at the apex of the archegonial branch.

Identification - By the above said reasons, the given sheet is an archegonium of funaria.

Funaria - capsule :-

* L.S of capsule can be divided into three regions - i) apophysis, ii) theca proper and iii) upper region.
* Apophysis is the basal region.
* The epidermis in this region is ventilated.
* The theca proper is the fertile region.

Identification -

By the above said reason, the given sheet is L.S of capsule of funaria.

1 Demonstration of culture and cultivation of Chlorella

Chlorella is a type of green algae that is often cultivated for its nutritional benefits, including high protein content, vitamins, and minerals.

Materials Needed:

1. Chlorella starter culture
2. Cultivation vessels (such as glass or plastic containers)
3. Growth medium (water, nutrients)
4. Light source (natural sunlight or artificial light)
5. Aeration system (optional, but beneficial)
6. Ph testing kit

Steps:

1. Prepare Cultivation Vessels:

Clean and sterilize the cultivation vessels to prevent contamination. Choose a transparent container to allow light penetration.

2. Prepare Growth Medium:

Mix water with appropriate nutrients. Chlorella typically requires nutrients like nitrogen, phosphorus, potassium, and trace elements. Adjust the pH of the medium to the optimal range for Chlorella growth (typically pH 6-8).

3. Inoculate with Chlorella Starter Culture:

Add a small amount of Chlorella starter culture to the prepared growth medium. This can be obtained from a reliable source or a previous Chlorella culture.

4. Provide Light:

Place the cultivation vessels in an area with sufficient light. If using artificial light, ensure it provides the necessary spectrum for photosynthesis. Maintain a light-dark cycle (e.g., 12 hours light, 12 hours dark).

5. Maintain Temperature:

Chlorella grows optimally at temperatures between 20-30°C (68-86°F). Keep the cultivation vessels in this temperature range.

6. Aeration (Optional):

If possible, use an aeration system to provide additional oxygen to the culture. This can enhance Chlorella growth.

7. Monitor and Adjust:

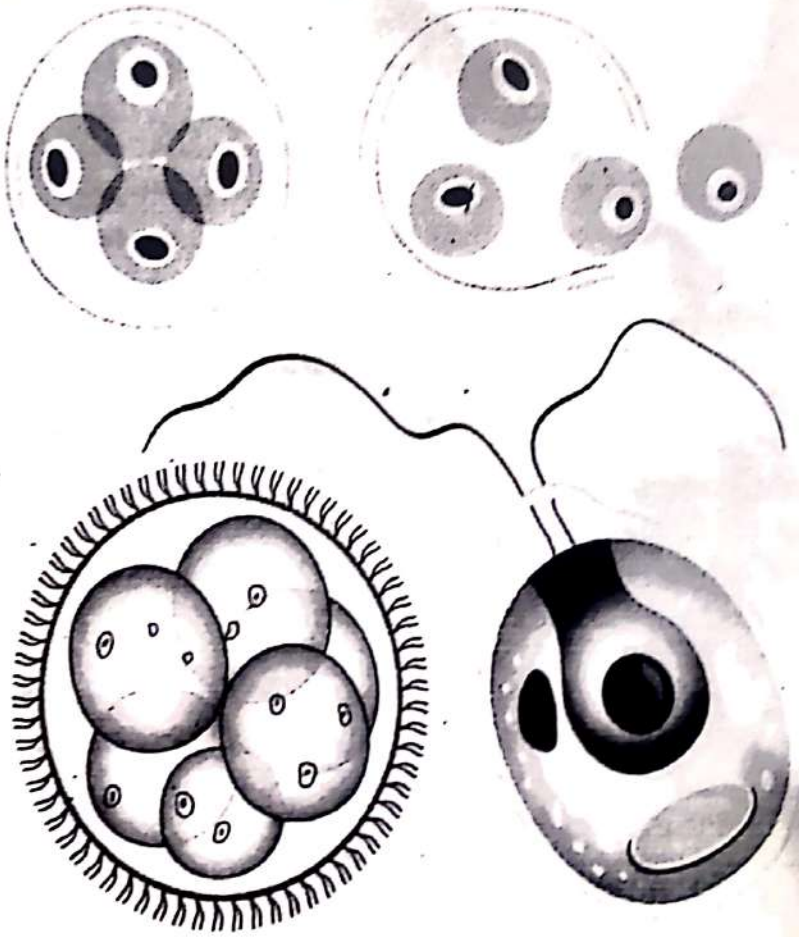
Regularly check the pH of the growth medium and adjust if needed. Observe the color and density of the culture. Green color indicates healthy Chlorella.

8. Harvesting:

Harvest Chlorella when the culture reaches the desired density. This can be done by filtration or centrifugation.

9. Drying and Processing:

Dry the harvested Chlorella to reduce moisture content. This can be done using low-temperature drying methods. Process the dried Chlorella into various forms, such as powder or tablets.



Q.1 Identification of some algal products available in local market.

Ans. Identifying algal products in the local market involves a combination of visual observation, reading product labels, and sometimes conducting additional tests. Identification procedure is as follows:

1. Read Product Labels:

Check the labels on packaged products for information on ingredients. Algal products may include seaweed, algae extracts, or algal-based ingredients. Look for terms like "seaweed," "algae," or specific algal species names.