29 Anthoceros

Division	:	*Bryophyta*
Class	:	*Anthoceropsida*
Family	:	*Anthocerotaceae*
Genus	:	*Anthoceros*

Anthoceros is a ***Bryophyte***.
It is a ***horned liverwort***. It is included in the class ***Anthoceropsida***.
It is placed in the order ***Anthocerotales***.

Occurrence

Anthoceros is ***cosmopolitan*** in ***distribution***. It is found on ***moist soils*** and ***rocks***, overshadowed by ***dense vegetation***. They occur ***at high altitudes*** ranging from 6000 to 8000 ft.

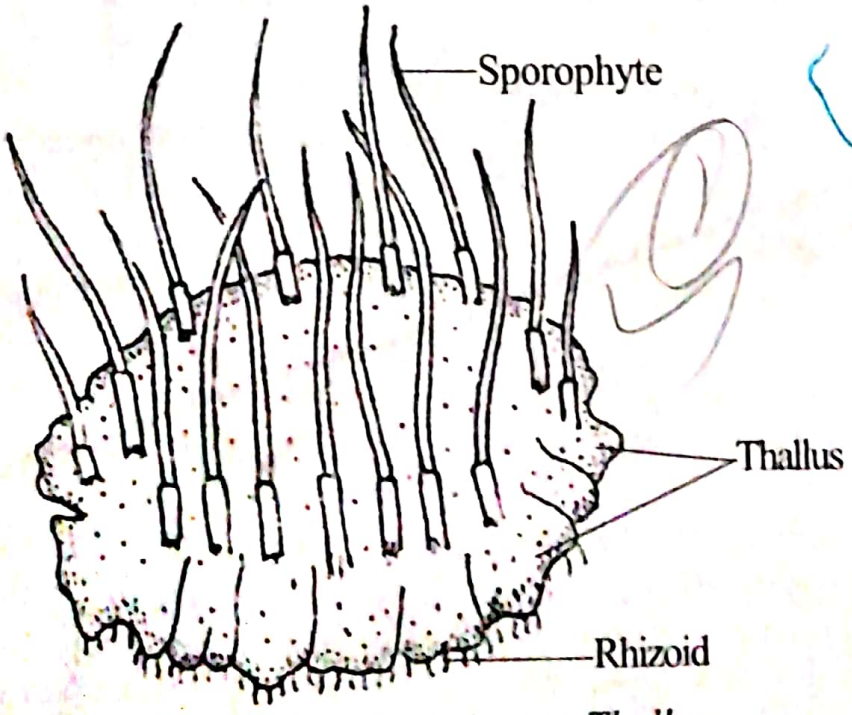


Fig. 29.1: Anthoceros crispus : Thallus.

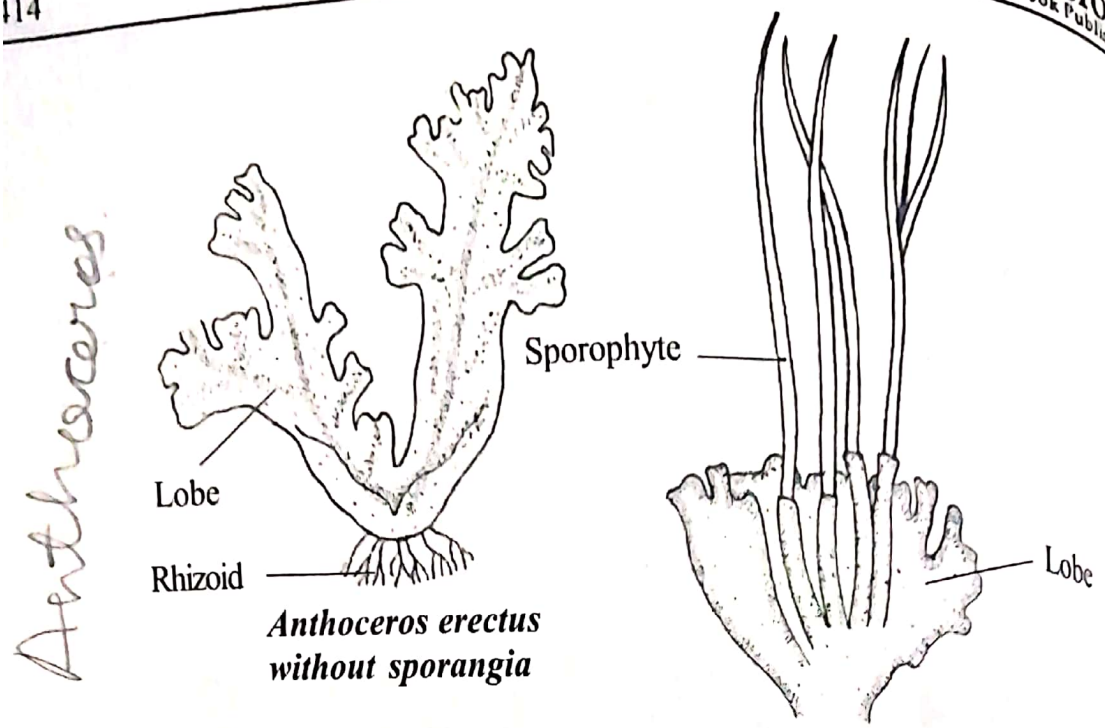


Fig. 29.2 : Some species of Anthoceros.

Anthoceros includes about ***200 species***. Of these, 25 species are found in India. They are found in the ***Himalayas, Punjab, Tamilnadu, Kerala, Karnataka***, etc.

The common Indian species of *Anthoceros* are-

Anthoceros himalayensis — *Anthoceros crispus*
Anthoceros chambenis — *Anthoceros dixii*

Thallus Structure (Gametophyte)

Anthoceros is a ***Bryophyte***.

It is a ***horned liverwort***.

It is placed in the class ***Anthoceropsida***.

It is ***cosmopolitan*** in distribution. It is found attached to ***moist soils*** or ***rocks*** at ***high altitudes***.

The plant is a ***haploid gametophyte (N)***.

The plant body is called a ***thallus***. It consists of ***lobes*** and ***rhizoids***.

The thallus is ***prostrate*** and ***lobed***.

The lobes of the thallus are ***thick*** and ***fleshy***.

The margins of the lobes are ***divided*** and ***overlapped.*** So the thallus appears like a small ***rosette***.

It is ***dark green*** in colour. It is ***dorsiventrally flattened***.

The ***midrib*** is absent. The dorsal surface of the thallus may be ***smooth*** or ***velvety*** or ***rough***.

The thallus is attached to the substratum by ***rhizoids***. The rhizoids are ***multicellular*** and ***smooth-walled***. They arise from the ventral surface of the thallus.

The mature gametophyte bears horn-like ***sporophytes*** on their dorsal surface.

The sporophyte grows ***vertically upwards***. It consists of a ***foot***, a ***seta*** and a ***capsule***

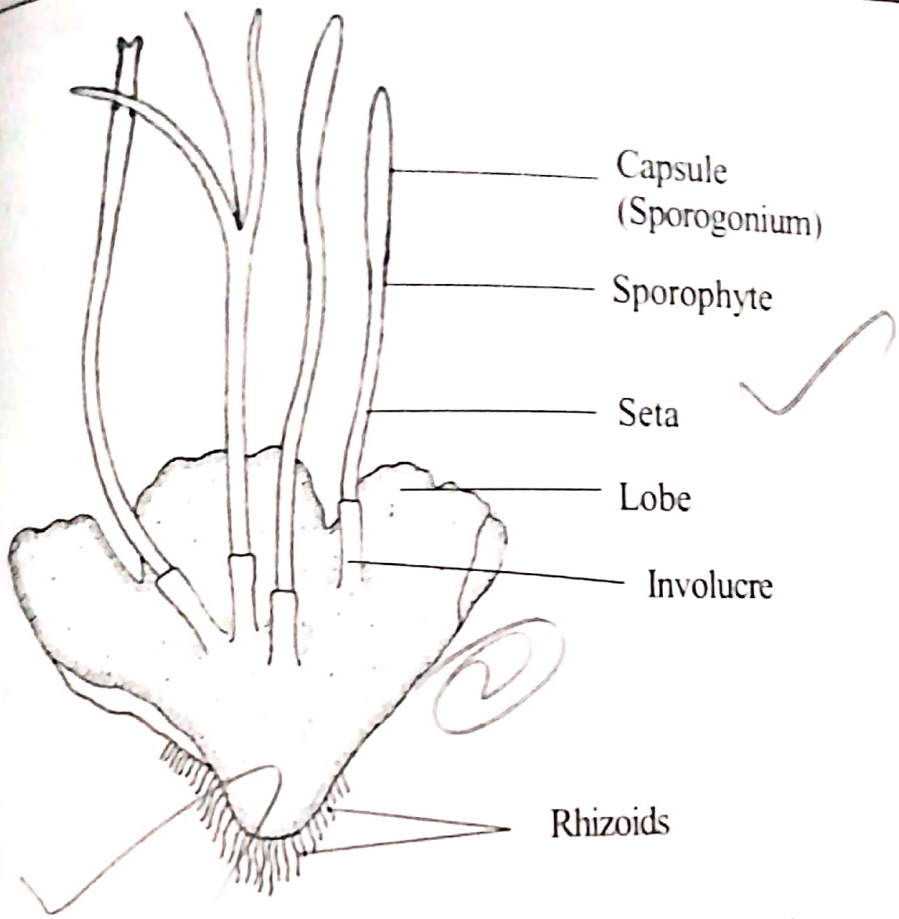


Fig. 29.3: Anthoceros – Thallus showing sporophytes.

The base of the seta is covered by a sheath called ***involucre***. The sporophytes reproduce ***xually*** by ***spores***.

The sporophyte is ***attached*** on the gametophyte. The ***gametophyte*** and ***sporophyte*** are ***rphologically dissimilar***. So they are ***heteromorphic***.

ternal Structure

The cross section of the thallus shows an ***upper epidermis***, a ***lower epidermis*** and a ***ddle parenchymatous tissue*** inbetween the two.

The upper epidermis is made up of compactly arranged ***thin-walled cells***. It has no ***mata***. Below the upper epidermis is a ***parenchymatous tissue***. It is ***4-38 cells*** in ***thick***.

The cells are ***compactly arranged*** without intercellular spaces.

Each cell has a big ***chloroplast*** and a ***pyrenoid***. Many ***round cavities*** are embedded in ***parenchyma tissue***. They are known as ***mucilage cavities***. They are filled with ***muci-ge***.

The mucilage cavities open in the lower epidermis by small pores called ***slime pores*** or ***me slits***.

The mucilage cavities contain ***colonies*** of the ***blue green alga***, *Nostoc*. *Nostoc* fixes the ***mospheric nitrogen*** for the thallus.

The ***mucilage cavities*** and *Nostoc* ***colonies*** are absent in *Anthoceros himalayensis*.

The ***mucilage cavities*** and *Nostoc* ***colonies*** are absent in *Anthoceros himalayensis*. ***ce***, many ***mucilage filled cells*** occur in the parenchyma tissue. These cells are called ***muci-ge cells***.

The mucilage cavities, therefore, are considered to be the ***reduced air chambers***.

The lower epidermis is ***similar*** to the upper epidermis. But it has ***small openings*** called

...me pores. Each slime pore is guarded by two ***guard cells***. Many ***rhizoids*** arise from the cells of the lower epidermis.

Each cell of *Anthoceros* has a ***large nucleus*** and a ***discoid chloroplast*** in the cyto-

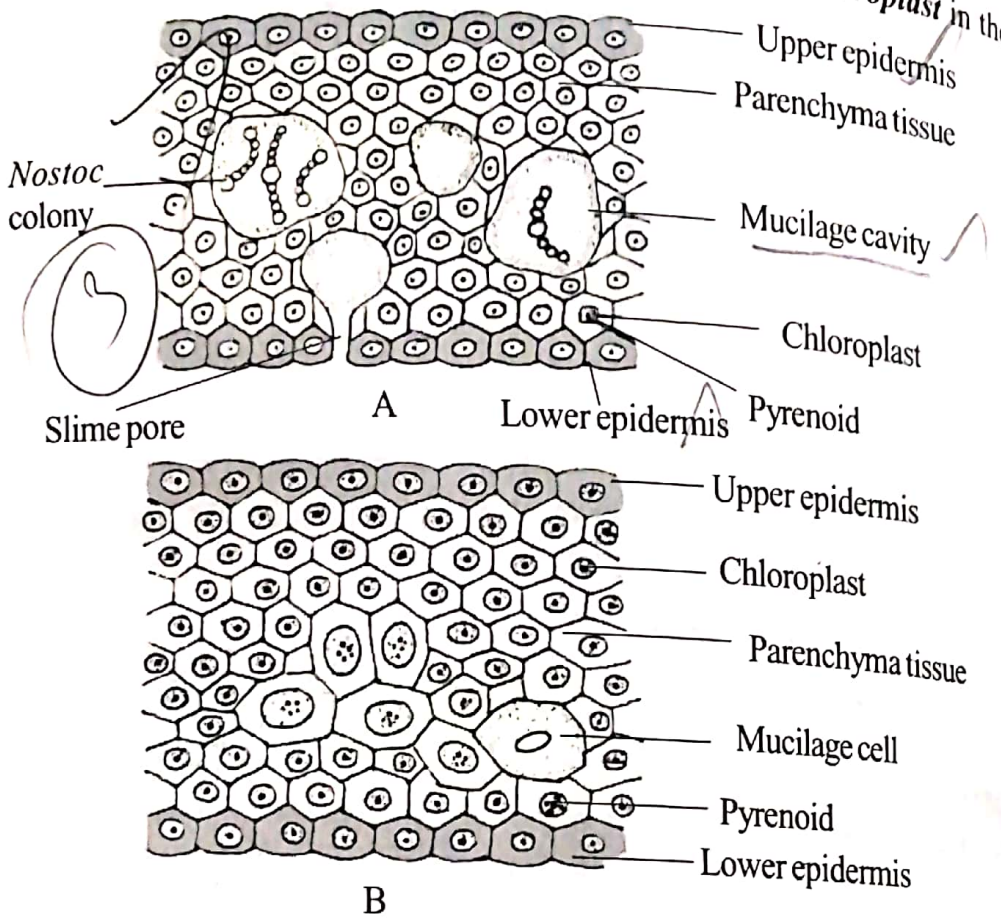


Fig. 29.4 : Anthoceros. A-C.S. of Anthoceros thallus; B-C.S. ofAnthoceros himalayensis showing mucilage cells.

plasm.

The nucleus is ***eukaryotic*** and ***haploid***. Each chloroplast contains a ***single pyrenoid*** surrounded by ***starch plates***. The chloroplast contains pigments like ***chlorophyll –a, chlorophyll –b***, ***carotenes*** and ***xanthophylls***.

Growth

The growth of *Anthoceros* takes place by a single ***apical cell*** at the growing tips of the lobes. The apical cell is ***pyramidal*** in shape.

Reproduction

Anthoceros reproduces by ***two methods***:

1. *Vegetative reproduction*
2. *Sexual reproduction*

Vegetative Reproduction

In *Anthoceros*, vegetative reproduction takes place by:

1. *Fragmentation*
2. *Gemmae*
3. *Tubers*

4. Persistent growing apices
5. Apospory

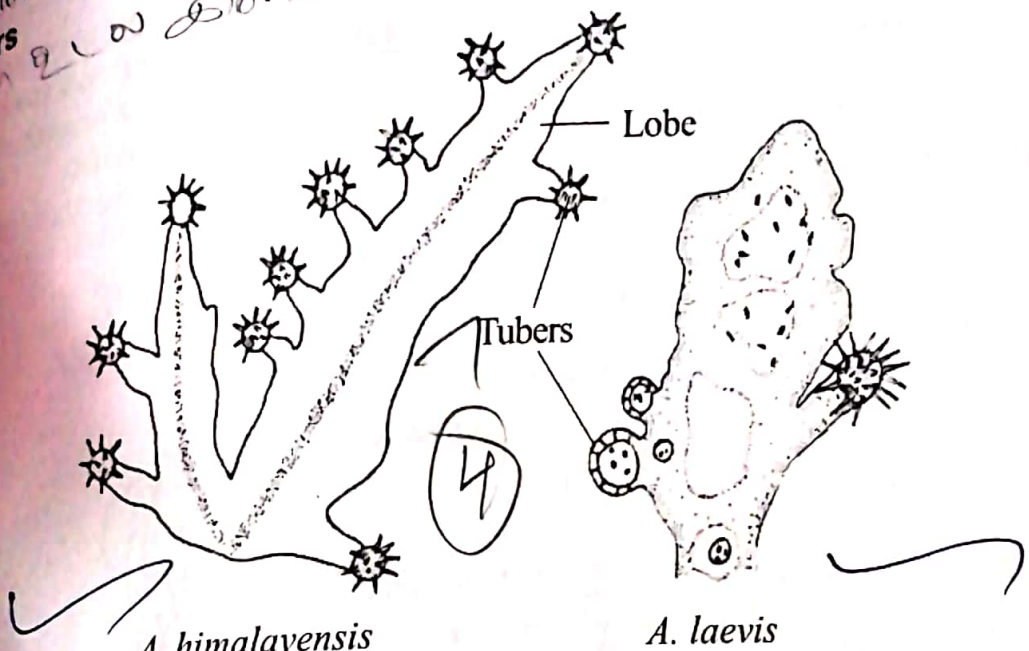
Fragmentation

Due to the ***progressive death*** and ***decay*** of old portions, the ***young lobes*** get detached from the ***parent plant***. These young lobes then grow into ***new plants***. This method of multiplication is called ***fragmentation***.

Gemmae

Gemmae are ***small, round structures***. They are found attached to the thallus by ***short stalks***. They are produced along the margin of the thallus. After detachment, each gemma grows into a new plant. This method is rare in *Anthoceros*. eg. *Anthoceros glandulosus*.

Tubers



A. himalayensis *A. laevis*

Fig. 29.5 : Anthoceros sp – vegetative reproduction.

Tubers are ***small, round structures*** produced along the margin of the thallus. They are composed of ***parenchymatous cells***. The cells are rich in ***reserve foods*** such as *starch, oils and proteins*. The tubers get detached from the thallus and grow into new plants. Eg. *A. himalayensis* and *A. laevis*.

Persistent Growing Apices

The major part of the thallus, except the ***growing apices***, dries during the summer. The ***growing apices*** grow into new plants in the favourable season. Eg. *Anthoceros fusiformis*.

Apospory

In some rare cases, some undifferentiated cells of ***sporogonium*** develop into ***gametophytic*** plants. This phenomenon is known as ***apospory***. These gametophytes are ***diploid*** and ***sterile***.

Sexual Reproduction

In *Anthoceros*, the sexual reproduction is ***oogamous type***. The plant is a ***haploid gametophyte***. Many species of *Anthoceros* are ***homothallic*** or ***monoecious***. They produce male and female sex organs in the ***same thallus***. Eg. *Anthoceros fusiformis* and *Anthoceros punctatus*.

The male sex organs are called ***antheridia*** and the female sex organs are called ***archegonia***. The ***antheridia mature before*** the archegonia.

A few species are ***heterothallic*** or ***dioecious***. Eg. *Anthoceros himalayensis*. Here, the antheridia are produced in one plant and the archegonia are produced in another plant.

Antheridia

Antheridia are the ***male sex organs***. They are produced inside ***small cavities*** called ***antheridial chambers***.

The antheridial chambers are ***slightly immersed*** in the upper part of the thallus.

The roof of the antheridial chamber is ***single layered***.

The mature antheridial chamber appears like a ***small orange-yellow spot*** on the dorsal surface of the thallus.

Each antheridial chamber has a cluster of ***7-22 antheridia*** depending upon the species.

The mature antheridium is a ***club-shaped structure***. It is produced on a ***stalk***.

The main body of the antheridium consists of an ***outer jacket layer*** or ***antheridial wall*** and an inner mass of ***androcytes***. The cells of the antheridial wall are ***sterile***.

Each cell contains a ***nucleus*** and a ***large chromoplast***. The androcytes have a large ***haploid nucleus*** and ***dense cytoplasm***.

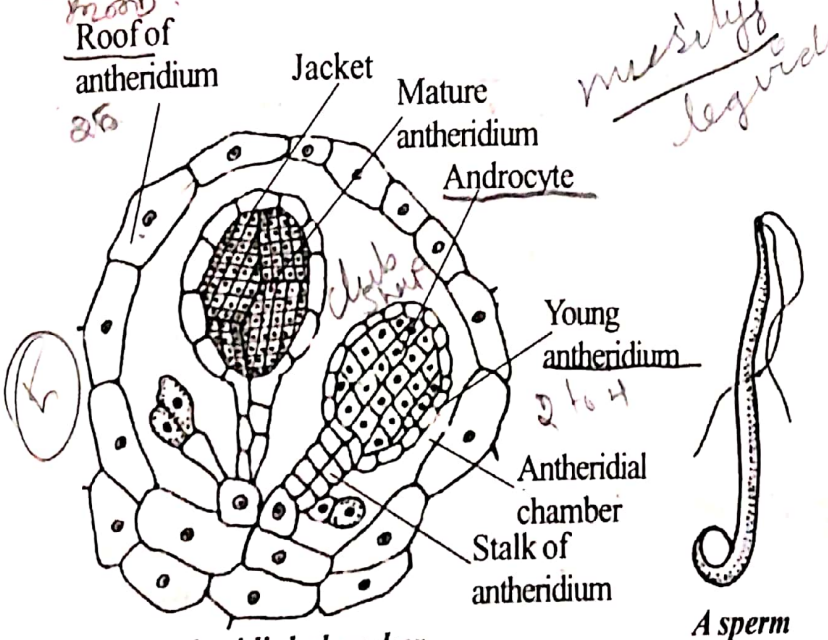


Fig. 29.6 : Anthoceros.

The ***roof*** of the ***antheridial chamber*** breaks irregularly. So the antheridia come in contact with ***water***.

The antheridial wall absorbs ***water*** and ***swells up***. This causes the separation of a few wall cells from the distal end of the antheridium to form an ***aperture***.

The liberated androcytes develop into ***biflagellate sperms*** or ***antherozoids***.

The mass of ***antherozoids*** is released through the aperture.

The antherozoid is a ***spindle-shaped*** cell with a ***curved posterior end***. The posterior half is slightly broader and the anterior half is narrow.

The antherozoid has a ***haploid nucleus***, ***dense cytoplasm*** and a ***blepharoplast granule***. There are ***two equal flagella*** at the anterior end of the antherzoid.

...chegonia

The archegonia are ***female sex organs***. They are deeply sunken in the upper portion of ...thallus.

They are produced ***singly*** along the ***margin*** of the thallus. They are produced in ***acro-...al succession***.

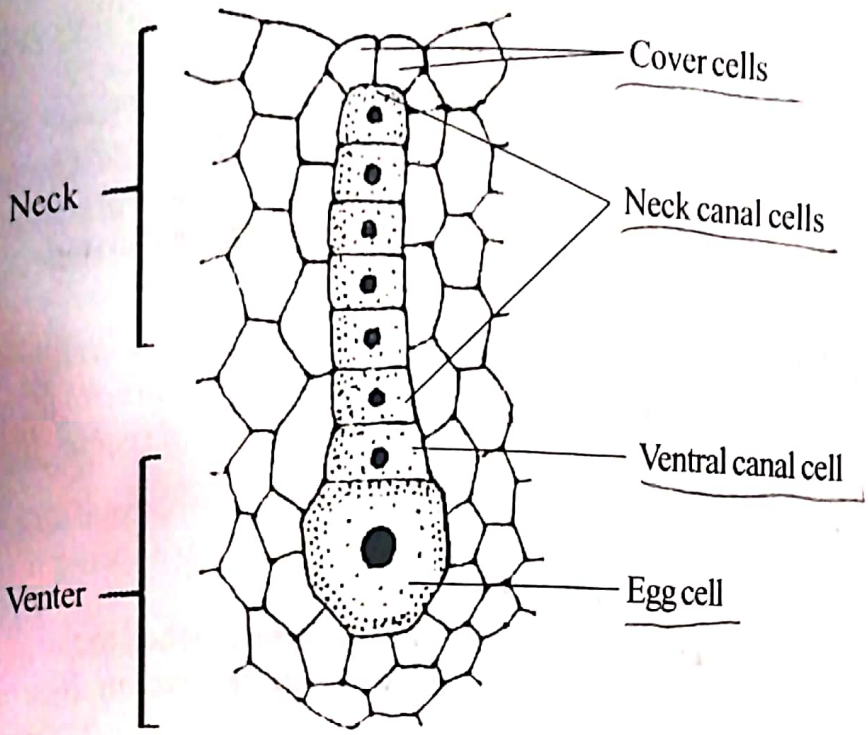
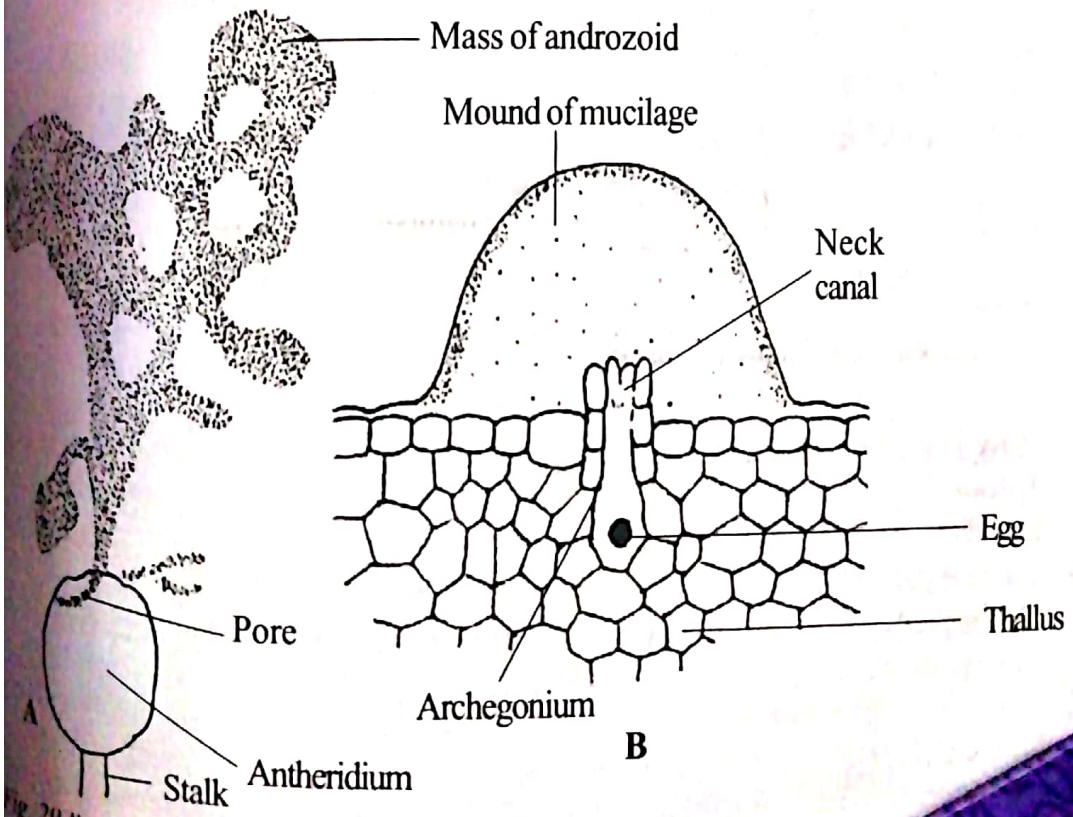


Fig. 29.7 : Anthoceros – An archegonium.



...g. 29.8 : A. laevis: A-Antheridium extruding a mass of androcyte... showing extrusion of neck canal cells and mucila...

That is, the mature archegonia lie at the middle of the lobes and the young archegonia lie near the margin.

The mature archegonium is a ***flask-shaped*** structure. It consists of a swollen ***venter*** and a narrow ***neck***. The venter consists of a large ***egg cell*** and a ***ventral canal cell***.

The neck consists of a vertical row of six ***neck canal cells***. The archegonia do not have sterile jacket cells.

The mouth of the neck is closed by ***4-5 cover cells***. The cover cells project above the dorsal surface of the thallus.

Towards maturity the ***ventral canal cell***, ***neck canal cells*** and ***cover cells*** disorganise and leave a narrow canal called ***neck canal***. The neck canal is filled with ***mucilage***. The mucilage oozes out through the mouth of archegonium and forms a ***mucilage mound***. The presence of ***mucilage mound*** on the thallus marks the mouth of mature archegonium.

Fertilization

The ***liberated antherozoids*** swim in water to reach the ***mature archegonia***.

They enter the venter cavity through the neck canal filled with ***mucilage***.

One of the antherozoids fuses with the egg to form a ***diploid zygote***. It develops into a ***sporophyte***.

Sporophyte

The sporophyte is a ***spore*** producing plant.

The sporophyte is ***diploid***. It is a ***horn-like structure*** attached to the ***gametophyte***.

The ***diploid zygote*** is the first cell of the ***sporophytic generation***. It develops into ***diploid sporophyte***.

The zygote undergoes repeated divisions to form a ***sporophyte***. The sporophyte o

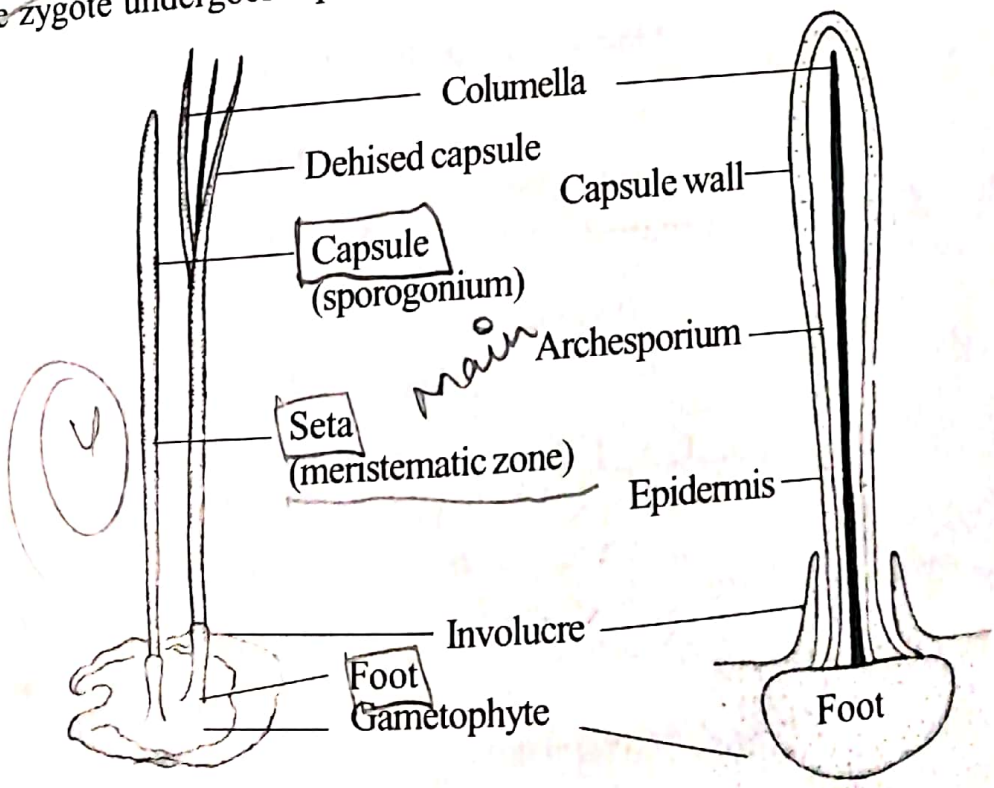


Fig. 29.9 : Anthoceros – Sporophyte.

Fig. 29.10 : Anthoceros – L.S. throu sporophyte.

...ros is *elongated* and *cylindrical*. It projects from the *dorsal surface* of the thallus. It grows for several centimeters. It is *green* in colour. The base of the sporophyte is ...nded by a collar like structure called *involucre*.

The sporophyte has three parts namely a basal *foot*, an intermediate *seta* and a terminal ...

...ule.

...d

The foot attaches the sporophyte on the gametophyte. It *absorbs food* and *water* from the ...tophyte.

Foot is a *round, bulbous* base of the *sporophyte*. It is deeply *immersed* in the dorsal ...n of the gametophyte. It is made up of thin-walled *parenchymatous* cells.

The peripheral portion acts as *placenta*. The peripheral cells often produce rhizoid – like ...owths called *haustoria*.

...ta

The seta is present inbetween the *foot* and *capsule*. The seta is also known as *interme-...te zone* or *intercalary zone* or *meristematic zone*. It is made up of *meristematic cells*.

New cells are continuously added to the base of the capsule by the activity of the *mer-...em*.

The products of the meristematic cells differentiate into various parts of the capsule such as ...*lumella*, *archesporial tissue* and *capsule wall*.

...psule

The capsule is a *long, slender*, *cylindrical structure*. It is also called *sporogonium*. It ...resent above the seta.

It grows upto *15 cms height*.

The *young capsule* is *green* and at maturity it becomes *brown*. The capsule is the *fertile* ...gion.

The capsule consists of *three parts* namely, an inner *columella*, a middle *archesporium* ...d an outer *capsule wall*.

Columella is a *central solid column* of *sterile cells*. It is *cylindrical*. It is present in the ...entre of the capsule. Columella is *endothelial* in origin.

Columella provides *mechanical support* to the capsule. It serves as a *conducting sys-...em* for young capsule. It helps in the *dispersal* of *spores*.

The *archesporium* is in the form of a *cylinder* between the *columella* and *capsule wall*. ...t develops from *amphithecium*. It is *single-layered* at the base of the capsule. Just above ...his, it is *two cells thick*.

The cells of the archesporium are known as *sporogenous cells*. The sporogenous cells ...how various *sporogenous stages* from the base to the apex. The sporogenous cells develop ...nto *spore mother cells* and *elater mother cells*. The spore mother cells are *larger* than the ...later mother cells. These cells are *loosely arranged*. The spore mother cells undergo *meiosis* ...nd form *haploid spores* called *meiospores*.

The meiospores are *tetrahedral*.

The elater mother cells divide *mitotically* to form *pseudo-elaters*.

The *meiospore tetrads* alternate with *pseudo-elaters*.

The pseudo-elaters are made up of 4 or more elongated, thick-walled cells.

The cell wall has no spiral thickenings. The cell wall is *smooth*.

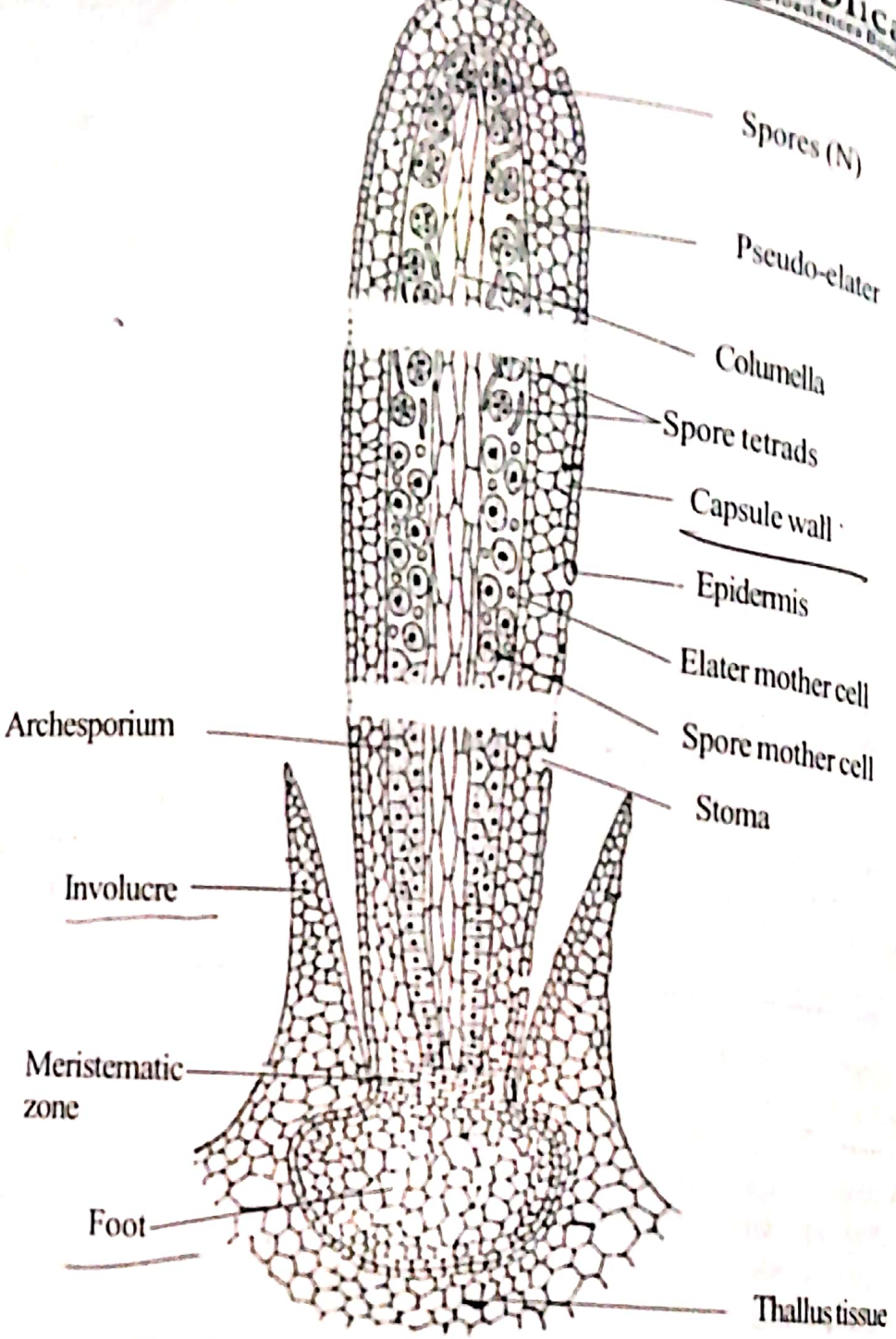


Fig. 29.11 : Anthoceros – L.S. of sporophyte.

The pseudo-elaters are ***irregular*** in shape.

They are ***nutritive*** in function. In later stages the pseudo elaters help in the ***dehiscence*** of ***sporogonium***.

The outer ***sterile envelope*** of the capsule is called ***capsule wall***. It surrounds the ***archesporium***. It is 4-6 cells in thickness.

The outer most layer of cell is called ***epidermis***. It is made up of vertically ***elongated cells***. The epidermal cells are ***chlorenchymatous***. The epidermis has ***many pores***, called ***stomata***.

Each stoma is guarded by two ***guard cells***. It opens in a ***sub-stomatal chamber***.

The other layers of the capsule wall are made up of ***parenchyma cells***.

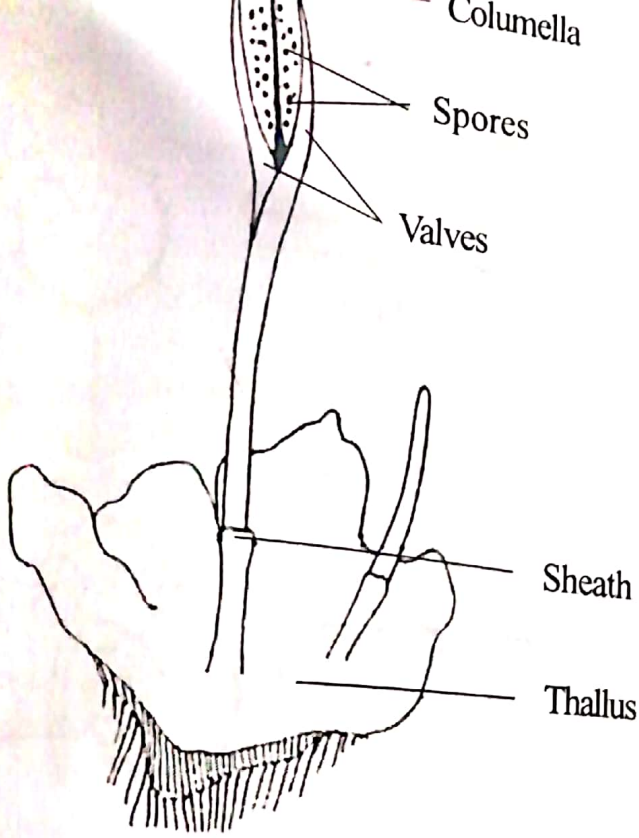


Fig. 29.12 : Anthoceros – A thallus with dehiscing sporophyte.

The capsule wall ***protects*** the sporogenous tissue from the environmental condition. It is ***photosynthetic***. However, the sporophyte depends on the gametophyte for ***water*** and ***minerals***.

The sporophyte, therefore, is considered as a ***partial parasite*** or ***semi-parasite***.

Dehiscence of Capsule

The mature capsule becomes ***yellow-brown***. The tip of the capsule dries up and ***dehisces*** into ***two valves***. The dehiscence begins at the tip and extends towards the base of the capsule. The valves arch away from one another. Therefore, the columella surrounded by spores is freely exposed to the air. The spores are dispersed by ***wind***.

Germination of Meiospore

Each spore is a ***rounded*** structure. It is ***haploid*** and known as ***meiospore***. It has a ***double-layered wall*** enclosing the ***cytoplasm***.

The outer wall is called ***exine*** or ***exospore*** and the inner wall is called ***intine*** or ***endospore***. The exine is ***thick*** and has ***reticulate thickenings***. The ***intine*** is ***thin*** and smooth. The cytoplasm contains a large ***haploid nucleus***, a colourless ***plastid***, ***oil droplets*** and ***starch***.

The ***meiospore*** is the first cell of the ***gametophytic generation***. It germinates into a ***haploid gametophyte***. The spore starts germination after a period of rest.

The ***exine*** ruptures and the intine protrudes out as a small ***germ tube***. The germ tube develops into a ***protonema***.

The protonema is ***green***. It develops ***rhizoids*** from its ***ventral surface***. The protonema grows into a new ***gametophytic*** plant.

Conclusion

Anthoceros shows ***alternation of generation*** in its life cycle. The ***haploid gametophyte*** alternates with the ***diploid sporophyte***. The life cycle is ***diplohaplontic***.

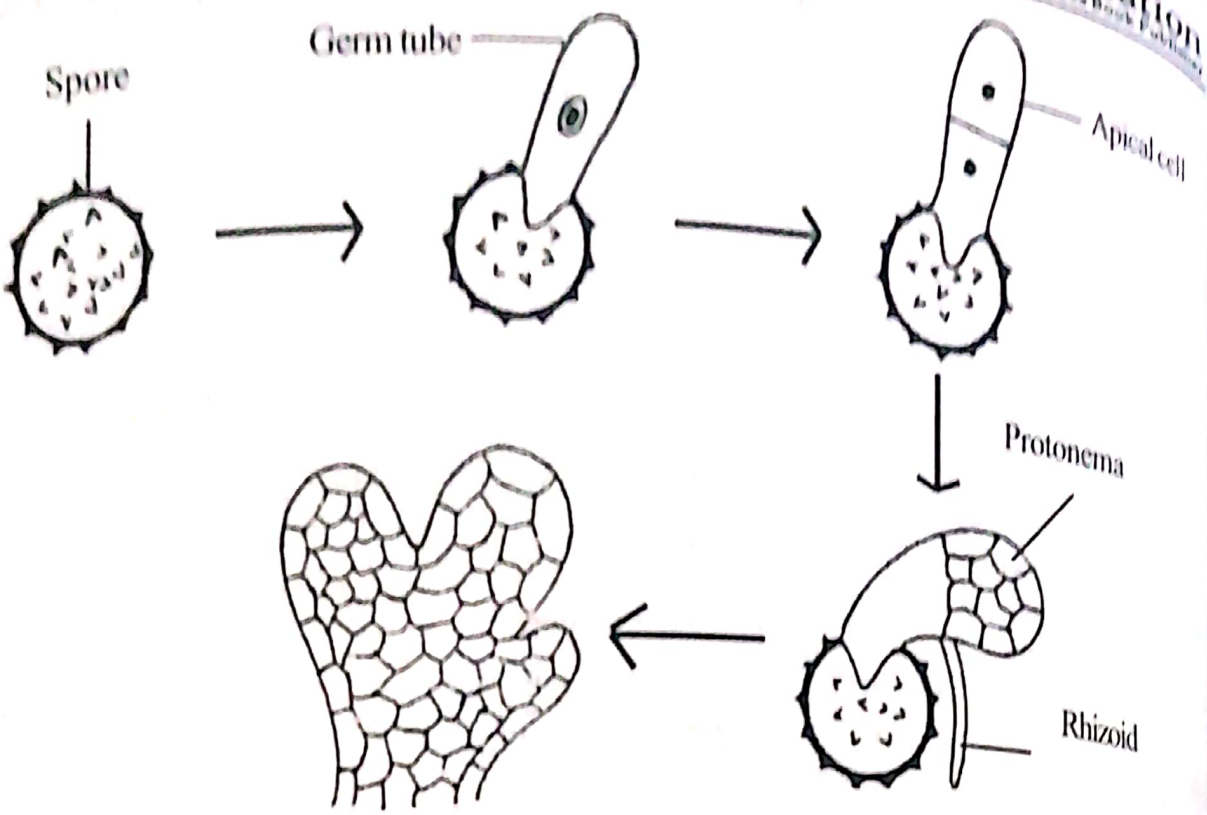


Fig. 29.13 : Anthoceros – Stages of germination of meiospore.

The vegetative thallus is a ***haploid gametophyte*** (N).

Vegetatively, it reproduces by ***fragments***, ***gemmae***, ***tubers*** and ***persistent growing apices***.

Sexual reproduction is ***oogamous*** type. The fusion of ***antherozoid*** with the ***egg*** forms a ***diploid zygote*** (2N).

The zygote develops into a ***diploid sporophyte*** (2N). The sporophyte is ***attached*** on the ***gametophyte***. By ***meiosis***, the sporophyte produces ***haploid meiospore tetrads***. The meiospores germinate into ***haploid gametophytic plants*** (N).

The gametophyte and sporophyte are ***morphologically different***. Hence the life cycle is ***heteromorphic type***.

Life Cycle of *Anthoceros*

Anthoceros is a ***Bryophyte***. It is a ***horned liverwort***. It is included in the class ***Anthoceropsida***. It is ***cosmopolitan*** in distribution. It is found on ***moist soils*** and ***moist rocks***. It occurs in high altitudes. It is a ***haploid gametophyte*** (N).

The ***thallus*** consists of ***lobes*** and ***rhizoids***. The lobes are ***dark-green*** in colour. It is ***prostrate*** and ***lobed***. The lobes of the thallus are ***thick*** and ***fleshy***. The margins of the lobes are ***divided*** and ***overlapped***. So the thallus appears like a small ***rosette***.

The thallus is attached to the substratum by ***rhizoids***. They arise from the ventral surface of the thallus. The mature thallus bears horn-like ***sporophytes*** on its dorsal surface.

The growth takes place by an ***apical cell***. The apical cell is ***pyramidal*** in shape.

Anthoceros reproduces by two methods:

1. Vegetative reproduction

2. Sexual reproduction.

vegetative reproduction takes place by

fragmentation

gemmae

tubers

Persistent growing apices

apospory

due to the progressive death and decay of old portions, the young lobes get detached from
ent plant. These *young lobes* grow into *new plants*. This method of reproduction is
fragmentation.

some species, *small round bodies* called *gemmae* are produced along the margin of
lus. The detached gemmae grow into new plants.

he tubers are *small* bud-like structures rich in *starch*. They are produced near the
When cut off, the tubers grow into new plants.

some cases, old portion of the thallus dries during the summer, but the apex remains
The apex grow into new plants in the next favourable season.

some rare cases, some undifferentiated cells of *sporogonium* develop into *gameto-*
plants. This phenomenon is known as *apospory*. These gametophytes are *diploid* and

he sexual reproduction in *Anthoceros* is *oogamous type*. The male sex organs are called
idia and the female sex organs are called *archegonia*. Many species are *homothallic*.
roduce *antheridia* and *archegonia* in the same plant. A few species are *heterothallic*.
roduce antheridia and archegonia in separate plants.

Antheridia are produced in clusters inside *small cavities* called *antheridial chambers*.
of the antheridial chamber is *single layered*. Each antheridial chamber has a cluster of
theridia.

The mature antheridium has a *stalk* and a *body*. The stalk is *multicellular*. The body of
idium consists of an outer *jacket layer* and an inner mass of *androcytes*. The cells of the
are *sterile*. The androcytes contain a *haploid nucleus* and *dense cytoplasm*.

The *roof* of the antheridial chamber ruptures. The antheridial wall *absorbs water* and
up. As a result, a few wall cells at the tip separate from the antheridium to form a *pore*.
ndrocytes develop into *biflagellate sperms* or *antherozoids*. The *antherozoids* are
ed through the pore.

The antherozoid is a *tiny, spindle-shaped structure* with a *curved posterior end*. The
ior end is slightly *broader* and the anterior end is narrow. The antherozoid contains a
id nucleus, *dense cytoplasm* and a *blepharoplast granule*. There are *two equal*
la at its anterior end.

Archegonia are deeply sunken in the upper portion of the thallus. They are produced *sin-*
ar the margin. They are *acropetal* in succession.

The archegonium is a *flask-shaped* structure. It consists of a swollen *venter* and a narrow
The venter consists of a large *egg* and a *ventral canal cell*.

The neck consists of a vertical row of *six neck canal cells*. The sterile jacket is absent.
rchegonium has 4-5 *cover cells*.

Towards maturity the ventral canal cell, neck canal cells and cover cells disorganise and
a narrow canal called *neck canal*. The neck canal is filled with *mucilage*.

The sperms swim in water and enter the ***venter cavity***. One of the sperms fuses with the egg to form a ***diploid zygote*** (2N).

The zygote undergoes repeated divisions to form a ***diploid sporophyte***. It is ***elongated*** and ***cylindrical***. It projects from the dorsal surface of the gametophyte. The base of the sporophyte is surrounded by a collar like structure called ***involucre***.

The sporophyte has three parts namely a basal ***foot,*** an intermediate ***meristematic zone*** and a terminal ***capsule***.

Foot is a ***round, bulbose base*** of the sporophyte. It consists of ***parenchyma*** cells. The peripheral cells form a ***placenta***. They produce ***haustoria***. The foot ***fixes*** the ***sporophyte*** to the gametophyte and absorbs ***minerals*** and ***water*** from the gametophyte.

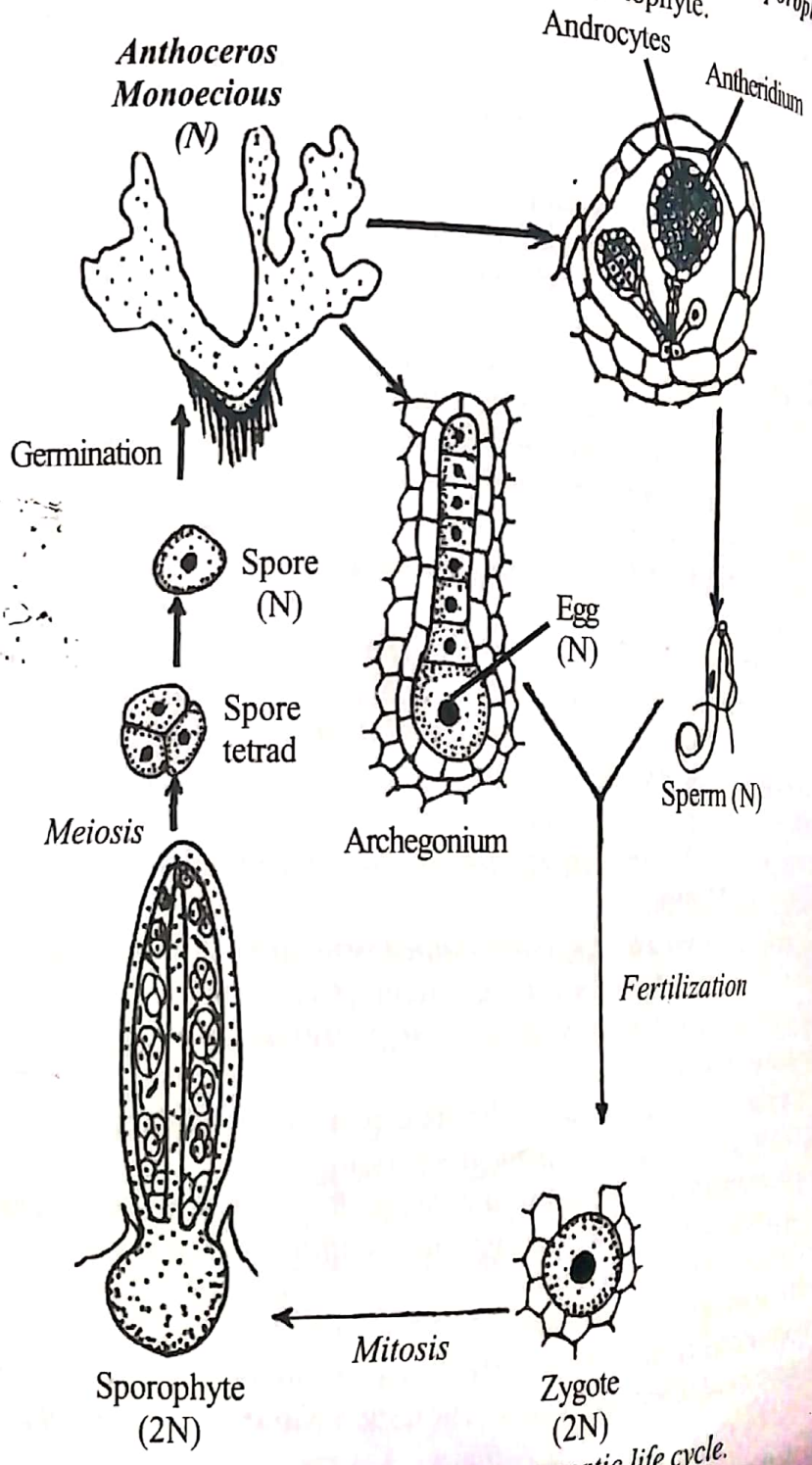


Fig. 29.14 : Anthoceros – Diagrammatic life cycle.

The meristematic zone is present above the foot. It is made up of ***meristematic cells***. It ...ces ***columella***, ***archesporium*** and ***capsule wall*** continuously. The growth of sporo- ...s is ***intercalary***.

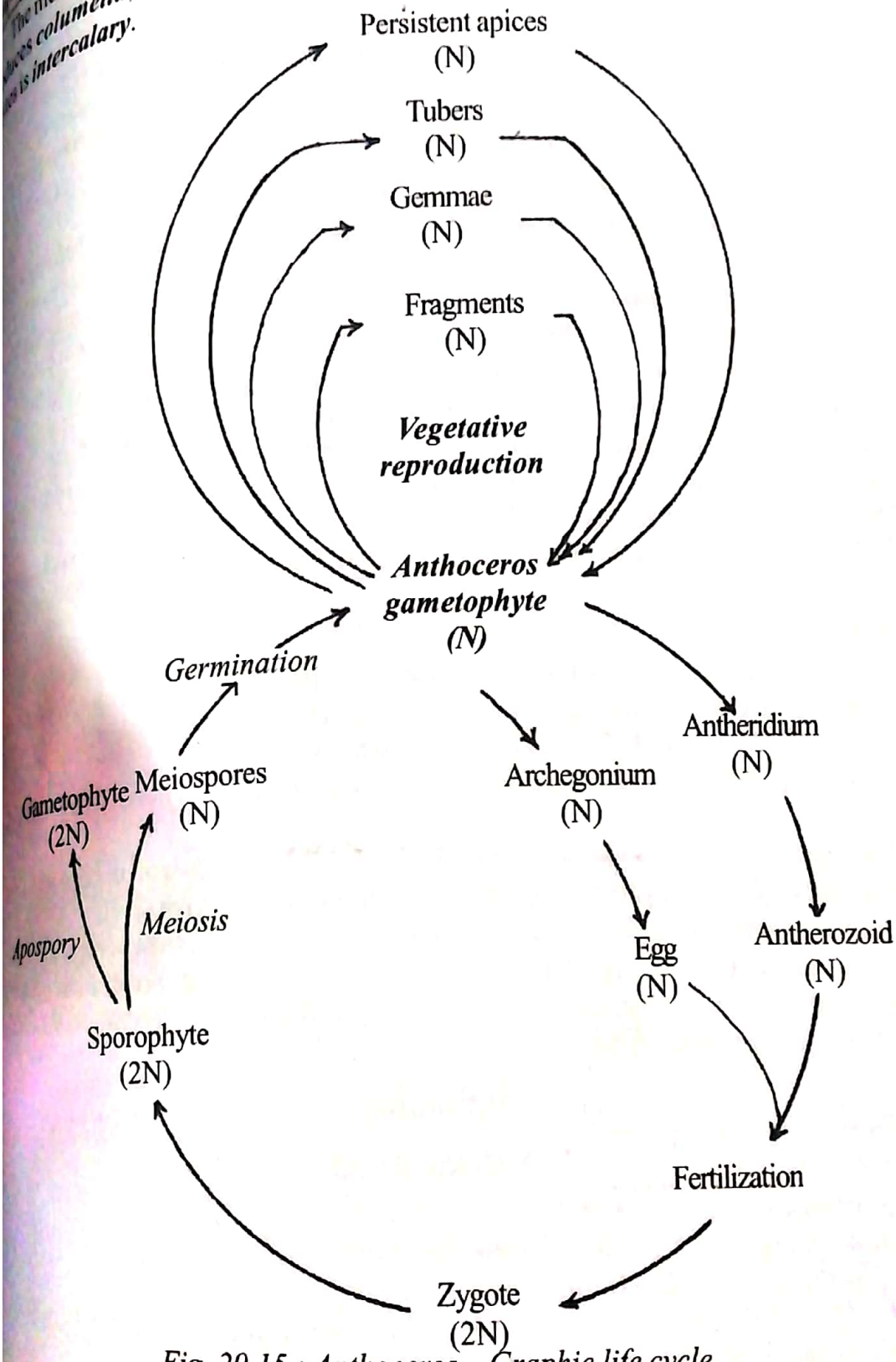


Fig. 29.15 : Anthoceros – Graphic life cycle.

The capsule is a ***long, slender, cylindrical*** structure. It is present above the ***meristem-...c zone***. The young capsule is ***green*** and at maturity it becomes ***brown***. The capsule is ...erentiated into ***three parts*** namely, an inner ***columella***, a middle ***archesporium*** and an ...er ***capsule wall***.

The columella is a ***solid column of sterile cells***. It is ***cylindrical***. It is present in the centre of the capsule. It is ***4-16 cells*** in thickness. It is made of ***thick-walled cells***. It provides ***mechanical support*** to the capsule. It helps conduction of ***water*** and ***minerals*** and the dehiscence of the capsule.

The archesporium is present around the ***columella***. It forms a ***cylinder*** of ***3-4 cells*** between the columella and capsule wall. It exhibits ***sporogenesis*** from base to the apex.

The archesporium is ***single-layered*** at the base. The archesporial cells are called sporogenous cells.

The sporogenous cells divide ***mitotically*** into ***spore mother cells*** and ***elater mother cells***. The middle of the capsule has loosely arranged spore mother cells and elater mother cells. The spore mother cells undergo ***meiosis*** and form ***haploid meiospores***. The meiospores are ***tetrahedral***. The elater mother cells form ***pseudo-elaters***. They are ***nutritive*** in function.

The capsule wall is a ***sterile envelop*** around the archesporium. It is 4-6 cells thick. The outer layer is the ***epidermis***. It is made up of ***elongated cells***. It has many ***stomata***. The capsule wall is ***photosynthetic***. The sporophyte is ***attached*** on the ***gametophyte***.

The tip of the capsule ***dries*** and ***dehisces*** into ***two valves***. So the columella surrounded by the meiospores is exposed to the air. The spores are dispersed by ***wind***.

The meiospores are ***tetrahedral***. The spore wall is differentiated into an outer ***exine*** and inner ***intine***. It contains a ***haploid nucleus*** and ***dense cytoplasm***. It germinates into a ***haploid gametophytic plant*** (N).

Conclusion

Anthoceros shows ***alternation of generation*** in its life cycle. The ***haploid gametophyte*** alternates with the ***diploid sporophyte***. The life cycle is ***diplohaplontic***.

The vegetative thallus is a ***haploid gametophyte*** (N).

Vegetatively, it reproduces by ***fragments***, ***gemmae***, ***tubers*** and ***persistent growing apices***.

Sexual reproduction is ***oogamous*** type. The ***antherozoid*** fuses with the ***egg*** and forms a ***diploid zygote*** (2N). The zygote develops into a ***diploid sporophyte*** (2N).

The ***sporophyte*** is ***attached*** on the gametophyte. By ***meiosis***, the sporophyte produces ***haploid meiospores*** (N). The meiospores germinate into ***haploid gametophytic plants*** (N). Here the gametophytes and the sporophytes are ***morphologically different***. So the life cycle is known as ***heteromorphic type***.

Highlights

Anthoceros

- *Anthoceros* is a ***Bryophyte***.
- It is included in the class ***Anthoceropsida***.
- It is commonly called ***horned liverwort***.
- It is found on ***moist soils*** or ***rocks*** at high ***altitudes***.
- The plant is a ***haploid gametophyte (N).***
- The life cycle is ***diplohaplontic***.
- The plant body is called a ***thallus***.
- The thallus consists of ***lobes*** and ***rhizoids***.
- The lobes are ***prostrate*** and ***lobed***.

31 Polytrichum

Division	:	*Bryophyta*
Class	:	*Bryopsida*
Sub-class	:	*Eubrya*
Order	:	*Polytrichales*
Family	:	*Polytrichaceae*
Genus	:	*Polytrichum*

Polytrichum is a ***Bryophyte***. It is commonly called ***hairy cup moss*** because of the luzzy **calyptra** enclosing the ***mature capsule***. It is one of the ***highly evolved*** mosses. It is included in the class ***Bryopsida***. It is placed in the order *Polytrichales*.

Occurrence

Polytrichum is ***cosmopolitan*** in distribution. It is mainly found in cool ***temperate*** and **tropical** regions. It is also found in ***cool*** and ***shady*** places. It is found growing in bogs, on rocks and cliffs, swamps and as ***epiphytes*** on tree trunks.

Polytrichum includes about ***100 species***. In ***India, four species*** of *Polytrichum* are reported from ***Himalayas***.

Polytrichum juniperinum
Polytrichum densifolium
Polytrichum xanthopilum
Polytrichum aplinum.

Thallus Structure (Gametophyte)

Polytrichum is a ***Bryophyte***. It is a ***hairy cup moss***. It is placed in the class ***Bryopsida***. It is ***cosmopolitan*** in distribution. It grows well in ***moist*** and ***shady*** places. It is found attached to moist soils or rocks at high altitudes.

The plant is a ***haploid gametophyte (N)***. The gametophyte is also known as ***gametophore***.

The mature gametophyte consists of two parts, the *rhizome* and the *leafy shoot*.

The *rhizome* is *horizontal* and grows *underground*. It bears three rows of colourless *leaves* called *'scale leaves'*. They are *brown* in colour.

The rhizome bears many *rhizoids*.

The rhizoids are long *multicellular* and *branched structures*.

The cells are rich in *protoplasm* and *oil globules*.

The *septa* are *oblique*.

Many rhizoids twist around one another to form a rope-like *rhizoidal strand*.

In the rhizoidal strand, *gemmae*, the *vegetative bodies* are produced.

The rhizoids provide *mechanical support* to the thallus to stand erect. They serve as *absorptive organs* and absorb *water* and *minerals*. They act as organs for external *capillary conduction*.

Rhizoids help in *vegetative reproduction*.

The leafy shoot is an *erect* axis, arising from the horizontal rhizome. It is the most conspicuous part of the plant.

The height of the leafy shoot varies from species to species depending on *environmental conditions*.

Polytrichum commune grows upto 45 cm in *height*.

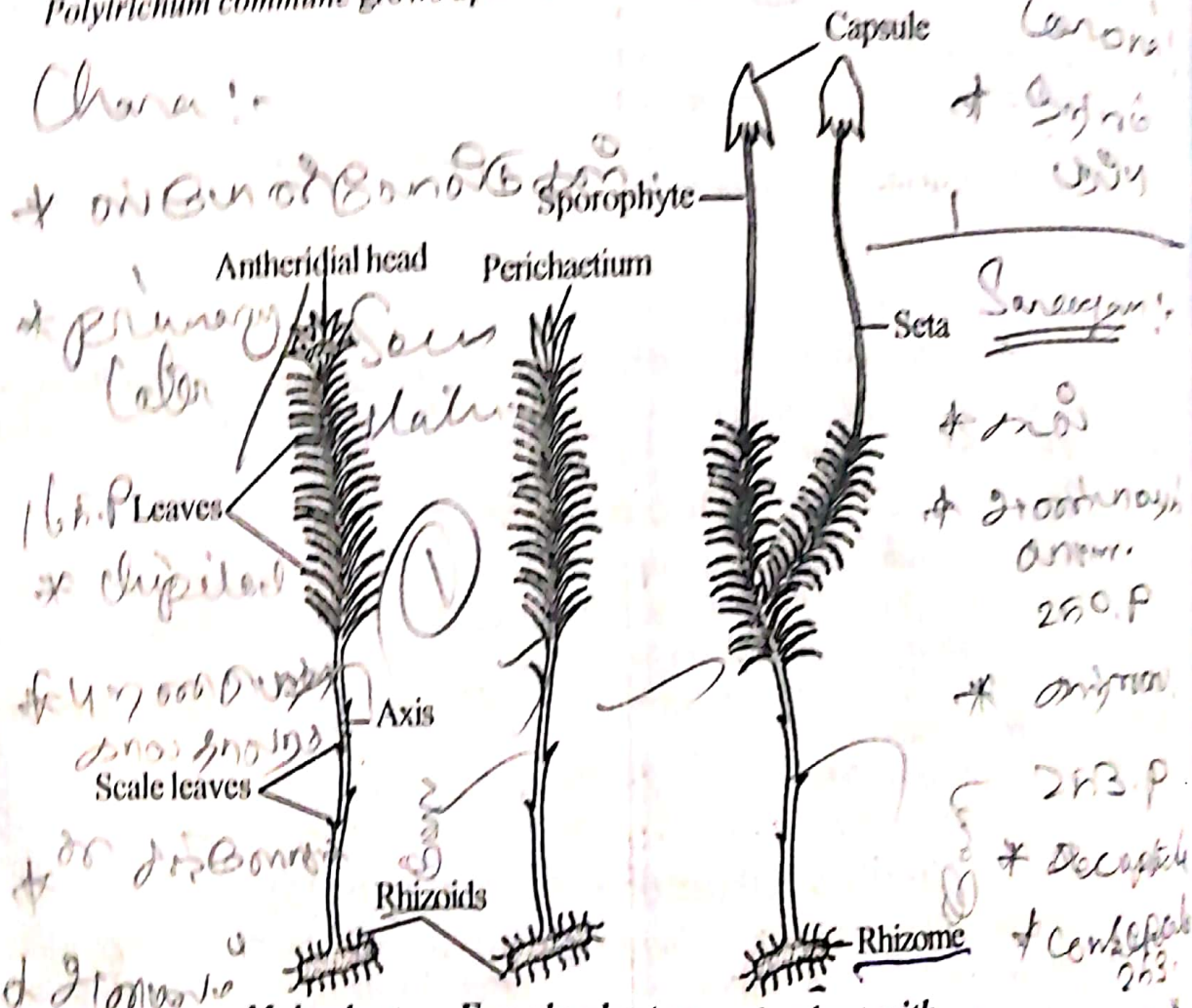


Fig. 31.1 : Polytrichum.

Each *leafy shoot* consists of a ***central axis*** called ***stem*** and many lateral expansions *leaves*.

Typically the erect leafy axis is ***unbranched***. Rarely, it is ***branched***.

The stem bears ***two kinds*** of ***leaves***, the ***scale leaves*** and ***foliage leaves***.

The ***scale leaves*** are ***small, brown*** and ***non-photosynthetic*** in function. They are produced on the lower portion of the ***stem*** or ***transition zone***.

The ***foliage leaves*** are large and are produced on the ***upper portion*** of the stem.

The leaves are ***green.*** They are arranged ***spirally*** on the stem.

Each leaf consists of ***two parts***, a broad colourless ***sheathing base*** and a narrow ***limb*** or *blade*.

The limb is ***linear***.

The ***sheathing*** base is ***membranous*** and it closely clasps a portion of the stem. It is one cell in thickness. It is traversed by a ***narrow midrib*** and is ***devoid*** of ***lamella***.

The limb is traversed by a broad ***multicellular midrib.*** The margin of the limb may be *entire* or ***toothed***.

The ***most significant*** and the ***unique*** feature of *Polytrichum* leaf is ***occurrence*** of ***photosynthetic tissue*** in the leaf. It is found in the form of ***thin***, ***closely set*** and vertical ***plates*** of ***green cells*** known as the ***photosynthetic lamellae***.

Each lamella is ***one cell*** in ***thickness*** and 5-8 cells in ***height***.

The lamellae are separated from one another by a ***narrow space***.

The leaf lamellae are usually restricted to the midrib region only. They compensate for the ***poor development*** of the ***lamina region***.

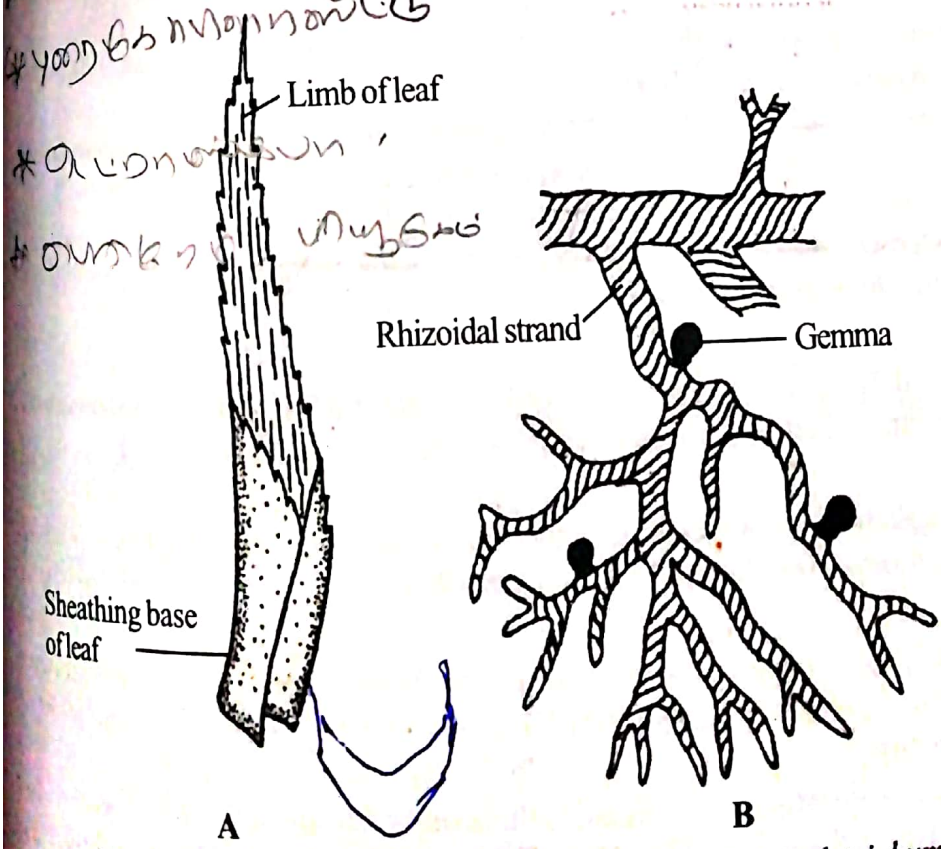


Fig. 31.2 : A Polytrichum commune-foliage leaf. B-Polytrichum sp.-rhizoidal strand bearing gemmae.

Polytrichum is ***heterothallic***. There are separate ***male*** and ***female plants***.
The male plant bears a cluster of antheridia at its tip called ***antheridial head***.
The female plant bears a cluster of archegonia at its tip called ***archegonial head***.
The mature female plant bears the ***sporophyte***. The sporophyte consists of a ***foot***, a ***seta*** and a ***capsule***.
The sporophytes reproduce ***asexually*** by ***spores***.

Internal Structure

The internal structure of *Polytrichum* is more complex.

1.Anatomy of Rhizome

The cross section of rhizome is ***triangular*** in outline. It shows the following structures:

Epidermis
Cortex
Pericycle
Leptoids
Amylom
Central cylinder

Epidermis

Epidermis is the outermost layer enclosing the cortex. The epidermal cells are thick-walled due to the deposition of ***suberin***. Rhizoids arise directly from the ***epidermal cells***.

Cortex

Inner to the epidermis is the ***cortex***. It consists of 3-4 layers of ***thin-walled parenchyma cells***.
The cortex is divided into ***three parts*** by ***three radial strands***. These strands are made up of ***sclerenchymatous cells***.
Each strand extends ***inward*** from the ***hypodermal layer*** to the arc of the ***central cylinder***. This strand is also known as ***hypodermal strand***.
The innermost layer of cortex is compared to the endodermis of plants.
The endodermal cells are larger in size. Their radial and horizontal walls are ***suberised***. It is broken by three ***hypodermal strands***.

Pericycle

It consists of 3-4 layers of cells. The cells are ***thin-walled*** and ***parenchymatous***. It surrounds the central cylinder. It is broken by protruding hypodermal strands.

Leptoids

Inside each ***furrow*** of central cylinder, there is a mass of cells called ***leptoids***. The cells are elongated and ***sieve-like***. Leptoids are ***thin - walled*** cells with ***oblique*** end walls.

Amylom

The ***leptoid*** is surrounded by a ***single*** layer of cells rich in ***starch***. This layer is known as ***amylom***. Amylom separates the ***leptoid*** from the central cylinder.

Central Cylinder

It is a compact mass of cells. It is found in the ***centre*** of the rhizome. It has ***three radiating*** lobes. It consists of thick-walled ***stereids*** and thin-walled ***hydroids***. The ***stereide cells*** are known as ***stereom***. The ***hydroids*** are known as ***hydrome***.

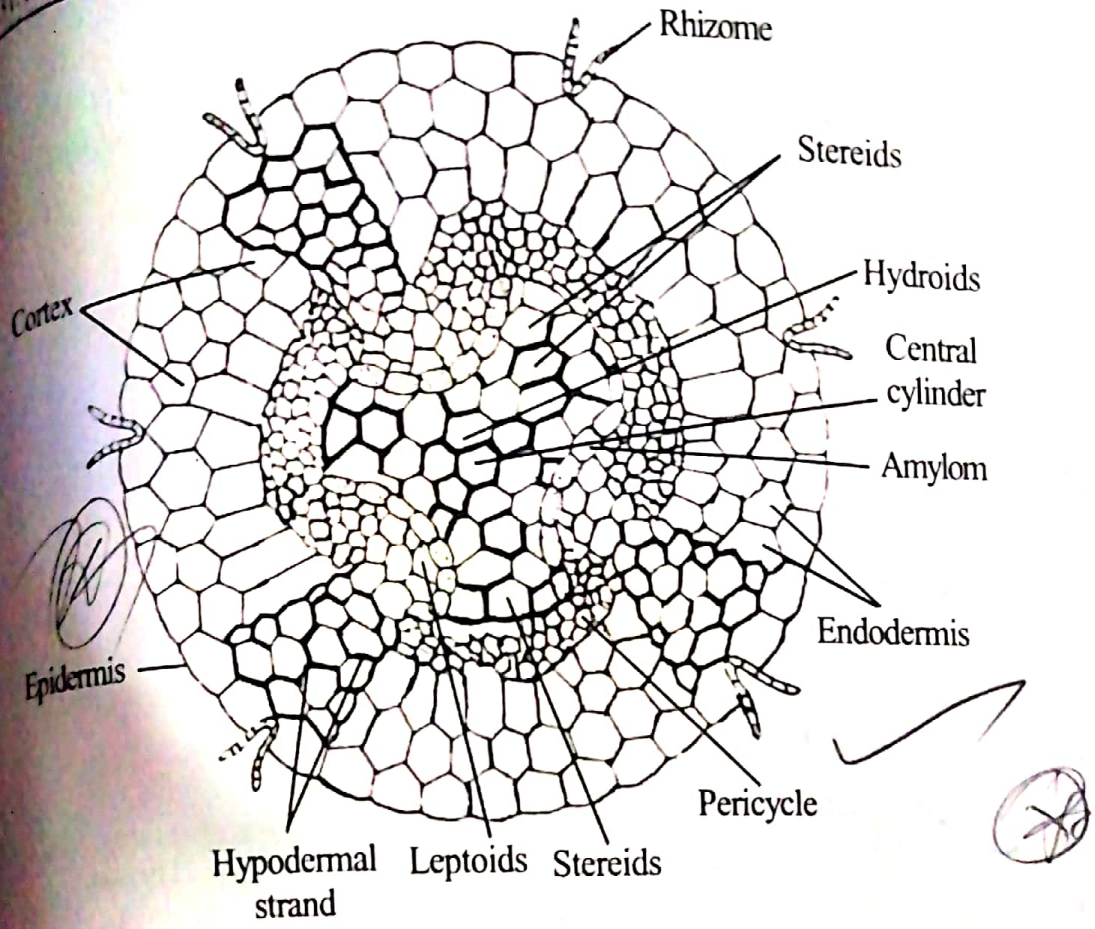


Fig. 31.3 : T.S. of rhizome of Polytrichum.

2.Anatomy of Stem

The stem is ***circular*** in cross section. The T.S. of stem shows the following structures:

Epidermis
Middle cortex
Central cylinder.

Epidermis

Epidermis is the outermost layer of cells. It is ***inconspicuous***.

Cortex

Below the epidermis is the ***cortex***.

The cortex is differentiated into ***two portions***, namely outer ***thick-walled cortex*** and inner ***thin-walled cortex***.

Small ***leaf traces*** are present in the cortex.

The leaf traces arise from the ***central cylinder*** and extend upto the tip of the leaves.

Inside the inner cortex there is a ***rudimentary pericycle***.

Central Cylinder

The central ***core*** is surrounded by the cortex is the ***central cylinder***. It consists of a compact ***mass*** of ***thick-walled*** cells constituting the ***hydrom cylinder*** and a ***peripheral zone*** called ***leptom*** mantle.

The hydrom cylinder consists of two kinds of cells, namely ***stereids*** and ***hydroids***.

The ***stereids*** are thick-walled ***supporting cells***.

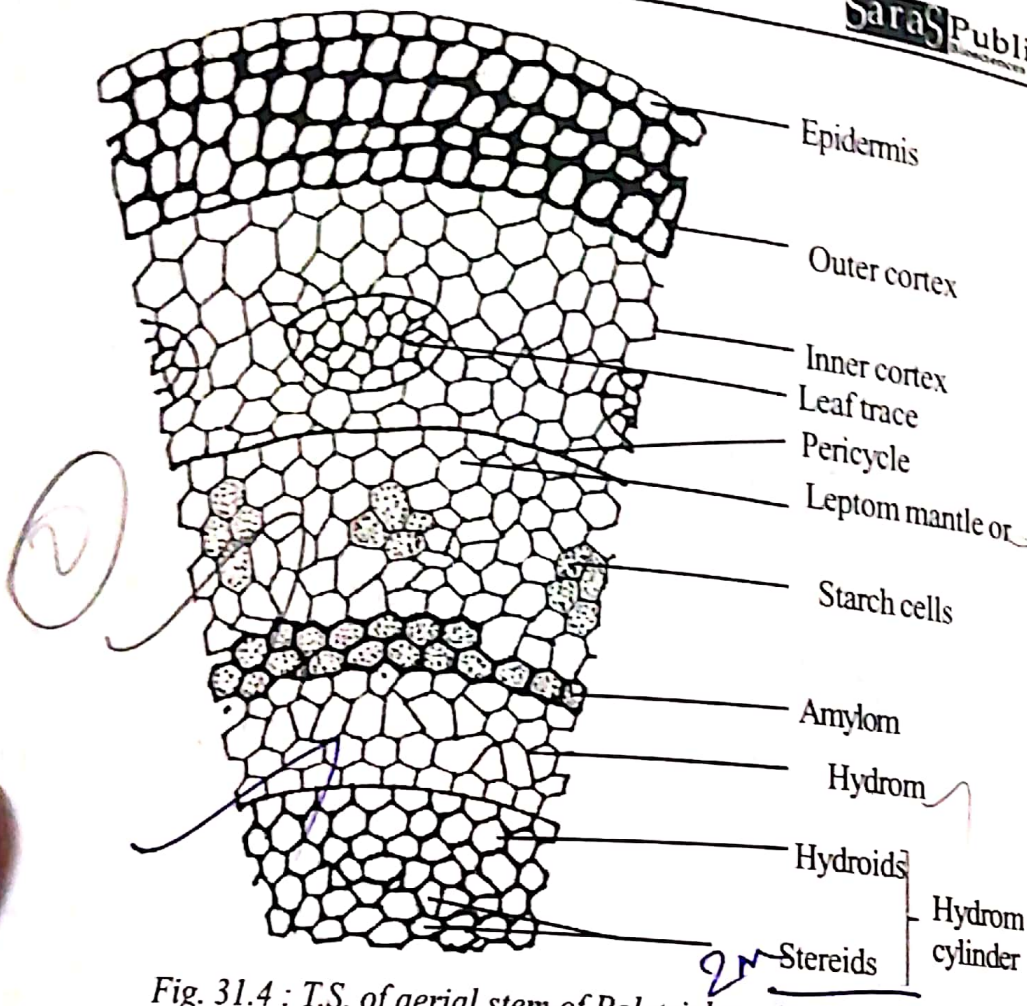


Fig. 31.4 : T.S. of aerial stem of Polytrichum (a portion enlarged)

They constitute the major parts of the ***hydrom*** cylinder.

The ***hydroids*** are elongated and thin - walled empty cells. The ***hydroids*** are concerned with ***water conduction***. The ***hydrom cylinder*** plays an important role in the conduction of water. The tissue is equivalent to ***xylem*** of ***higher plants***.

This ***hydrom*** cylinder is surrounded by 2-3 layers of thin-walled cells called ***hydrom mantle***.

External to the ***hydrom mantle*** there is a ***single*** layer of cells called ***hydrom sheath*** or ***amylom layer***. The cells of amylom layer have ***suberised*** walls and they contain ***starch***.

The ***peripheral*** zone of central cylinder is irregular called ***leptom mantle***.

The cells of ***leptom mantle*** are ***thin-walled*** and sieve-tube like. They contain ***starch***. So they are also known as ***starchy sheath***.

The ***leptom mantle*** is similar to the ***phloem*** of ***higher plants***.

3. Anatomy of Leaf

Structurally *Polytrichum* leaf is the ***most complex*** of all the ***mosses***.

The cross section of the leaf shows a ***broad midrib*** flanked by a narrow ***wing*** or ***lamina*** and thin vertical plates of cells known as ***lamellae***.

The ***midrib*** is several cells thick in the centre and gradually thins towards the margins forming a thin ***lamina***.

The cells of the midrib are ***parenchymatous***. Some thick - walled cells are also present and are called ***sclerides***.

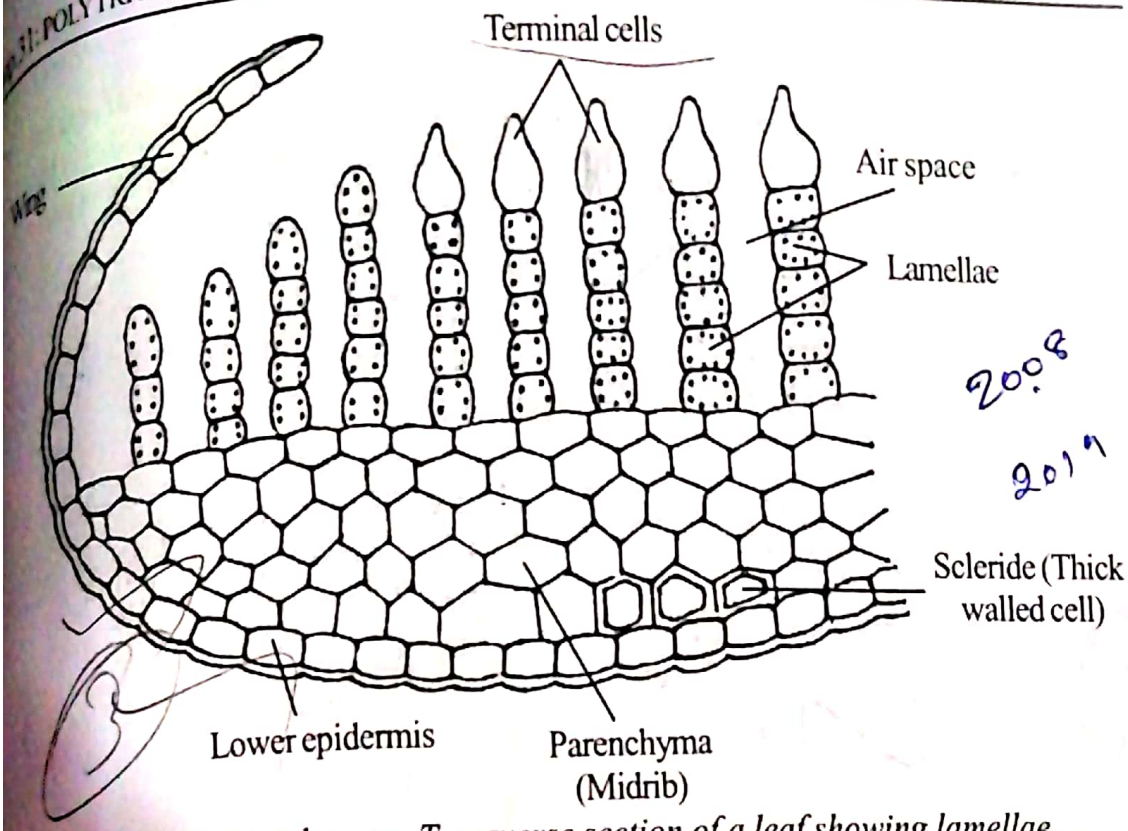


Fig. 31.5 : Polytrichum sp. Transverse section of a leaf showing lamellae.

On the lower surface, the midrib region has ***lower epidermis***.

The upper surface is composed of ***vertical plates*** of cells called ***lamellae***.

The cells of lamellae are ***thin-walled***.

The lamellae are ***one cell*** in thickness and 5-8 cells in ***height***. They are separated by a ***narrow space***. The cells have ***chloroplasts***.

The terminal cell of the lamella is different from the ***normal*** cells and is ***devoid*** of ***chloroplasts***.

The lamellae are absent in the ***margin*** of the leaves. The lamellae of the midrib are the main ***assimilatory*** tissue of the leaf.

Reproduction

In *Polytrichum*, reproduction takes place by three methods:

1. *Vegetative reproduction*
2. *Sexual reproduction*
3. *Asexual reproduction*

1. Vegetative Reproduction

In *Polytrichum* vegetative reproduction takes place by,

- *Fragmentation*
- *Bulbils*
- *Secondary protonema.*

Fragmentation

The rhizome of *Polytrichum* is horizontal. It gives rise to ***erect leafy shoots***. Death or breaking of the intervening portion results in the ***separation*** of ***erect*** branches. The ***erect*** branches become independent and grow as new plants.

Bulbils

Bulbils are ***vegetative*** buds. They are produced on rope-like ***rhizoidal strands***. The bulbils are small masses of ***parenchyma*** cells, rich in ***starch***. When these bulbils get separated off from the rhizoid, they germinate into new individuals. The bulbils are known as ***gemmae***.

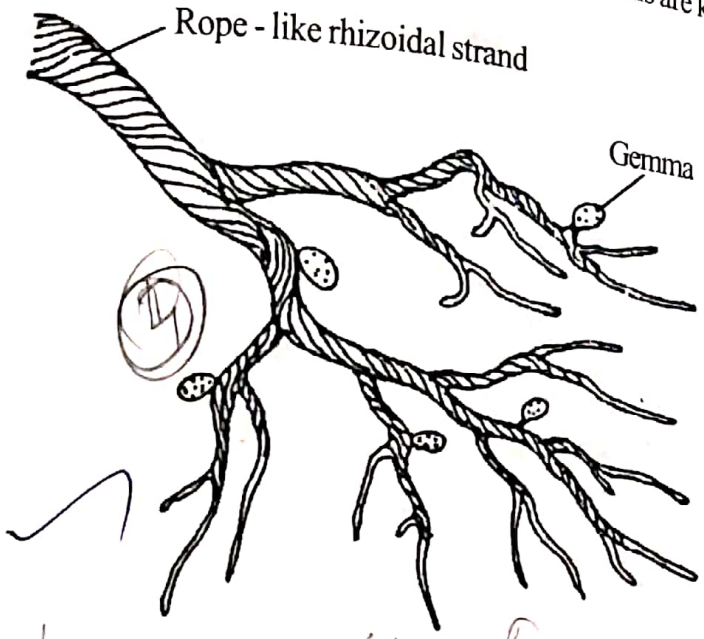


Fig. 31.6 : Gemmae of Polytrichum.

Secondary Protonema

The leaves of *Polytrichum* produce filamentous structure called secondary protonema. The filaments grow into new ***gametophytes***.

2. Sexual Reproduction

In *Polytrichum,* the ***sexual reproduction*** is ***oogamous type***.

The plant is a ***haploid gametophyte*** (N). *Polytrichum* is ***heterothallic*** or ***dioecious***. i.e., the male and female sex organs are produced on separate plants.

Antheridial Head

The male sex organs are called ***antheridia***. The gametophyte that produces antheridia is called ***male gametophyte*** or ***male plant.***

The sex organs are produced in clusters at the tips of leafy shoots (gametophores).

The cluster of antheridia is called ***antheridial cluster*** or ***antheridial head***.

Antheridial head is produced at the tip of leafy shoot of ***male gametophyte***. It consists of ***axillary clusters*** of ***antheridia*** intermingled with ***paraphyses*** and ***perigonial leaves***. These leaves are different from the ordinary ***vegetative leaves***. They have broad ***sheathing leaf base*** and short bristle-like terminal portion.

The ***perigonial leaves*** are ***bright red*** or ***orange*** in colour.

The ***perigonial*** leaves give the antheridial cluster a small cup-like structure resembling a small flower.

In the cup, perigonial leaves are arranged ***spirally*** around the growing apex and a single cluster of ***antheridia is found in the axil of each perigonial leaf***. Hence each antheridial cluster is considered as a ***modified axillary branch***.

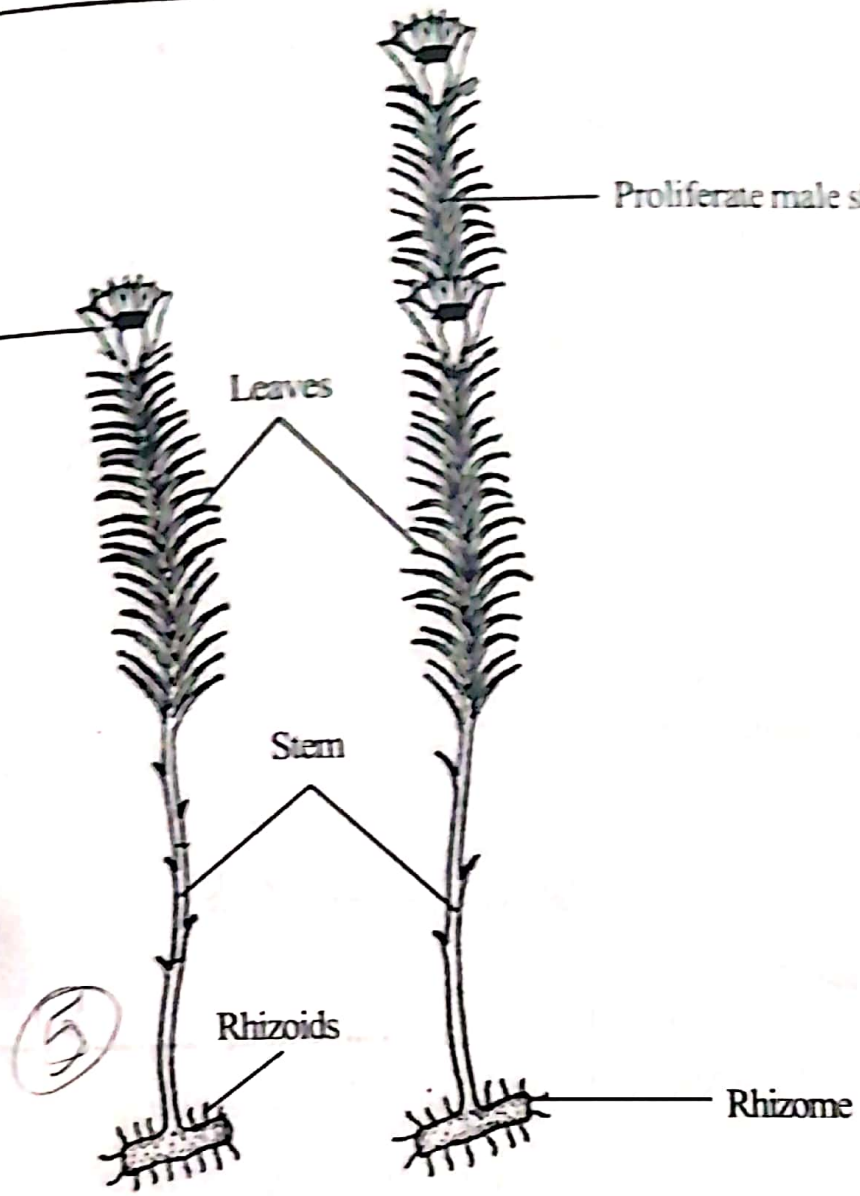


Fig. 31.7 : A-Polytrichum sp. Male plan with antheridial head. B-Male plant with proliferate male shoot and terminal antheridial head.

The antheridial clusters are ***intermingled*** with ***paraphyses***. Paraphyses are of two types. Some paraphyses consist of ***uniseriate*** row of cells. They are known as ***simple paraphyses***. Some are ***spathe-like*** and are known as ***spathulated paraphyses***.

The apex of the stem occurs as a ***small bud*** in the middle of the ***antheridial head***. This bud after the development of antheridia may grow out in the following year and produce a fresh shoot, at the apex of which more antheridia may be produced. This proliferation through the ***antheridial head*** may be repeated several times.

The mature ***antheridium*** is ***club-shaped***. It has a short ***stalk*** and a ***body***. The body is club-shaped and is surrounded by a single layered jacket. ***Androcyte mother cells*** are present inside the jacket.

Each androcyte mother cell divides into ***two biflagellate sperms*** or ***antherozoids***.

At the distal end, the jacket layer has one or a few large cells called ***operculum***.

The cells of the jacket layer contain coloured ***pigments***. Intermingled with antheridia, there are ***multicellular*** hair- like ***paraphyses***. The paraphyses may be ***simple*** or ***spathulated***.

Water is essential for the ***dehiscence*** of antheridium.

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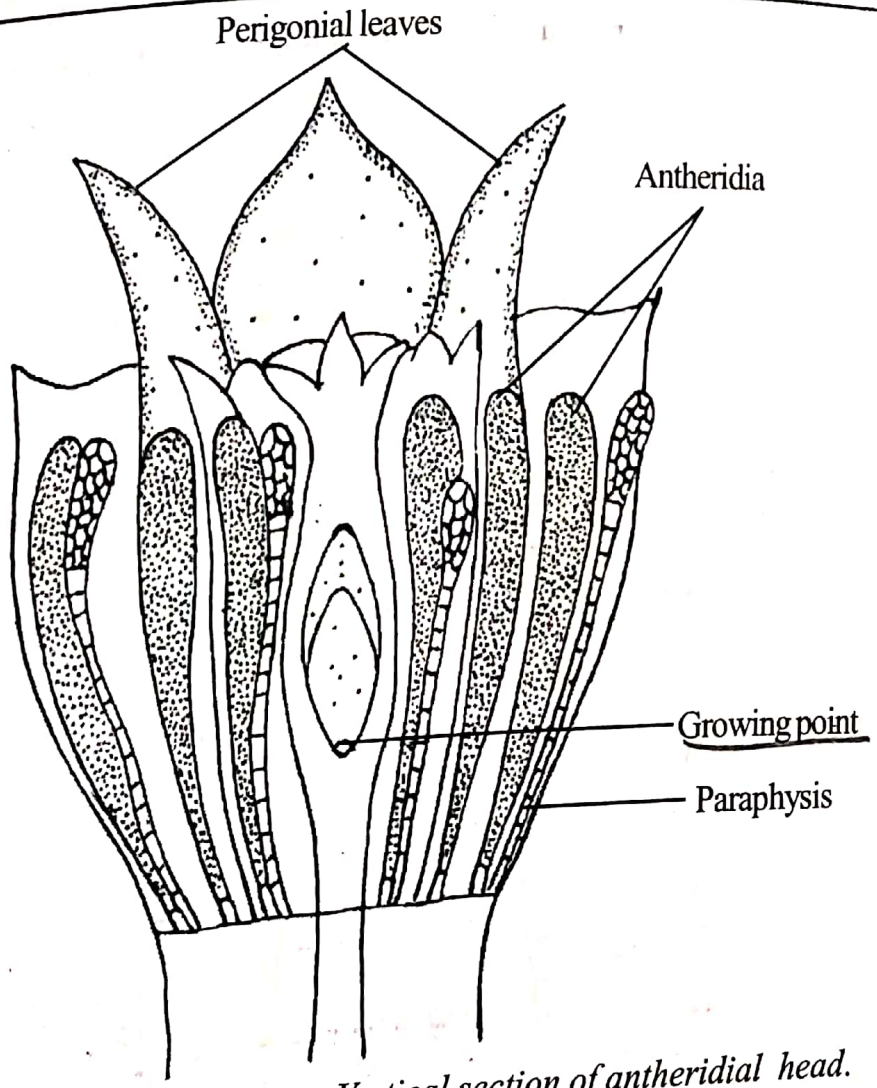

Fig.3 7.8 : Polytrichum : Vertical section of antheridial head.

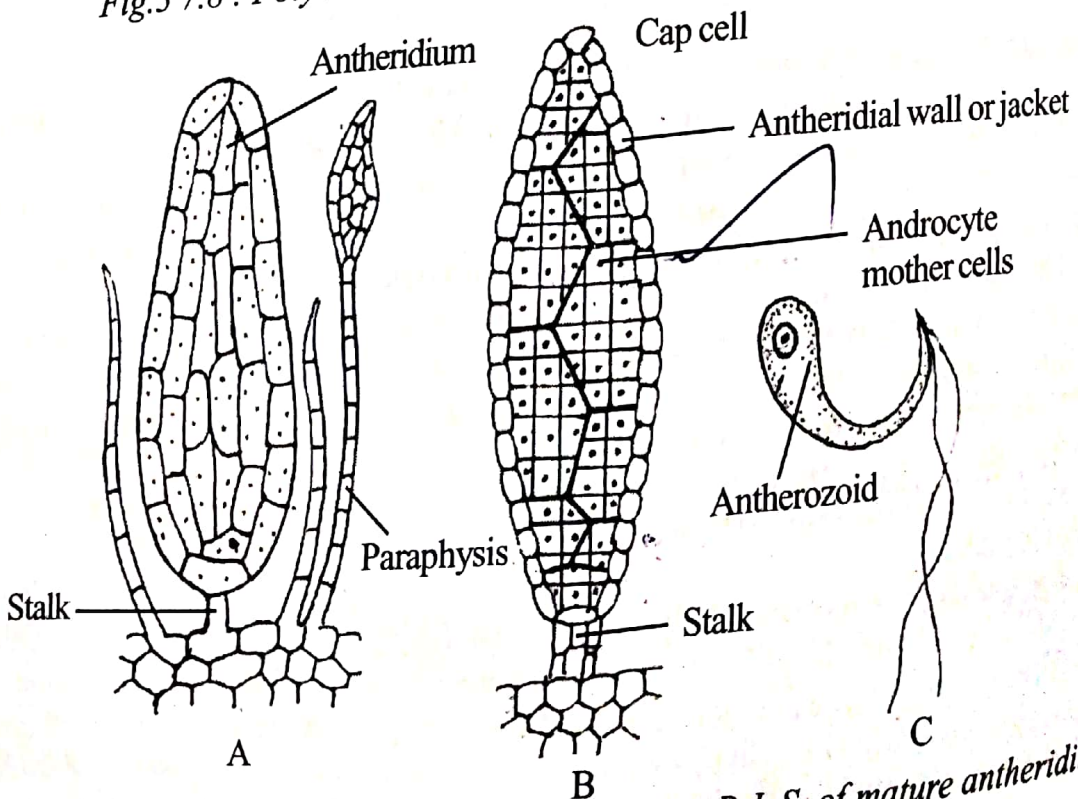

Fig. 31.9 : A-Antheidium with two types of paraphyses. B-L.S. of mature antheridium. C-Sperm or antherozoids with two flagella.

When water enters the antheridial head, the sterile cells of the jacket absorb water and ell. This swelling causes some pressure to throw off the operculum and a pore is formed at the ex.

The sperms present inside the antheridium come out with mucilage. The sperms present on e antheridial cluster is splashed to the archegonial cluster by ***rain drops***.

rchegonial Head

The female sex organs are called ***archegonia***.

The gametophyte that produces archegonia is called ***female gametophyte***.

The archegonia are produced in clusters.

The cluster of archegonia is called ***archegonial head***.

Archegonial head is produced at the tip of the stem of ***female gametophyte***.

Each archegonial head consists of a single row of ***perichaetial leaves*** enclosing a cluster 3-6 ***archegonia*** intermingled with ***paraphyses***. Usually 3 archegonia are found in an archegonial head. The overlapping ***perichaetial leaves*** give the head a bud like appearance.

Spathulate paraphyses are absent.

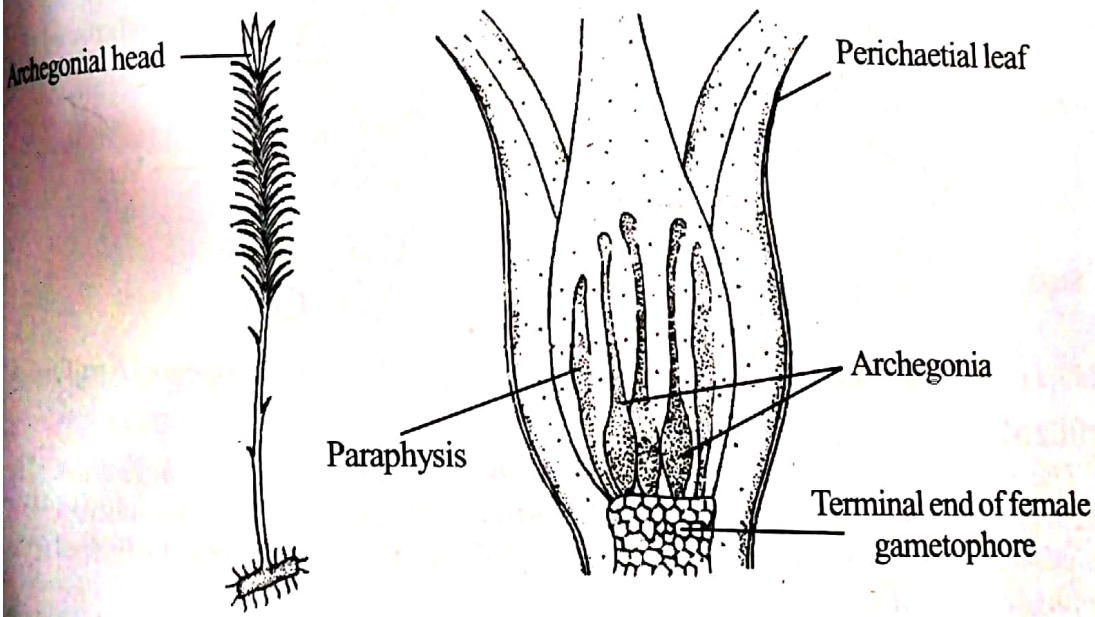

Fig. 31.10 : Vertical section of archegonial head of Polytrichum.

Like the antheridial head, the archegonial head also has a ***growing apex*** at its centre. But the apex does not grow further in the next growing season.

The growth usually stops with the end of the formation of archegonial head.

The ***mature archegonium*** is a ***flask-shaped*** structure. It consists of a ***neck***, a ***venter*** and a ***stalk***. The venter consists of a large ***egg*** and a ***ventral canal cell***.

The neck is long and is made up of six vertical rows of cells, enclosing a ***neck canal*** with more than ten ***neck canal cells***.

Towards maturity, the ventral canal cell, neck canal cells and cover cells disorganize and leave a narrow canal called ***neck canal***. The neck canal is filled with ***mucilage***.

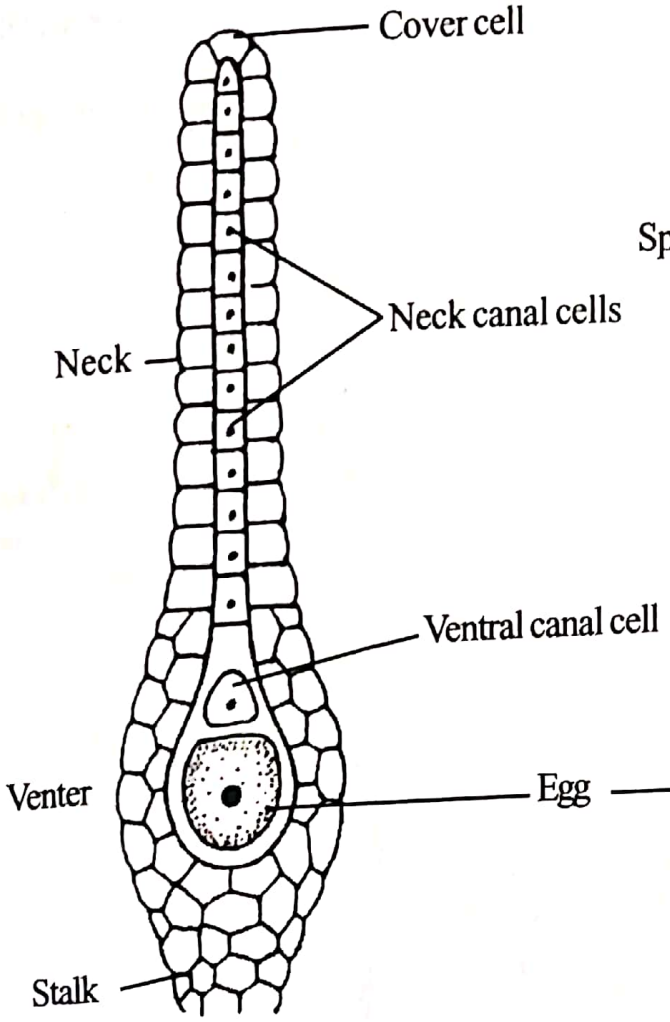

Fig.31.11 : Polytrichum - Mature archegonium.

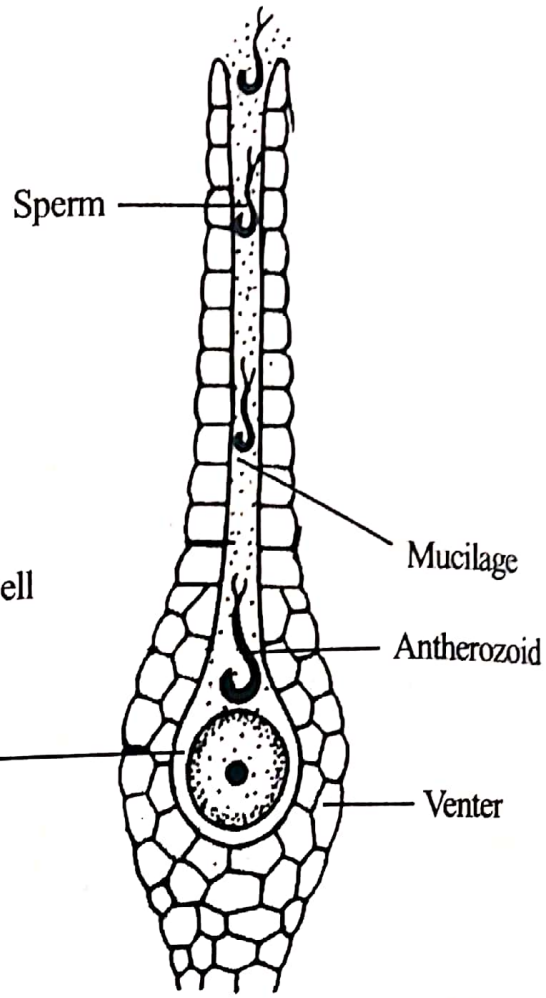

Fig. 37.12 : Polytrichum -Fertilization.

Fertilization

The water is essential for the ***antherozoids*** to swim upto the ***archegonium***. The antherozoids are attracted towards the archegonia by the chemical present in the mucilage. One of the ***antherozoids*** fuses with the egg to form a diploid ***zygote.*** The zygote is the first cell of the ***sporophytic*** generation.

3. Asexual Reproduction

The sporophyte of *polytrichum* reproduces asexually by producing ***spores***. The sporophyte is ***attached on*** the ***female gametophyte***.

The sporophyte contains a ***capsule***. The capsule encloses ***spore mother cells***.
The spore mother cells undergo ***meiosis*** to produce ***haploid spores***.
The spores are released by the ***dehiscence*** of the capsule.
The spore germinates into a ***filamentous structure*** called ***protonema***.
The protonema produces ***buds***.
The buds grow into gametophytes.

Sporophyte

The sporophyte is the ***spore-producing*** asexual plant. It is ***diploid***.
It is attached on the ***female gametophyte***.

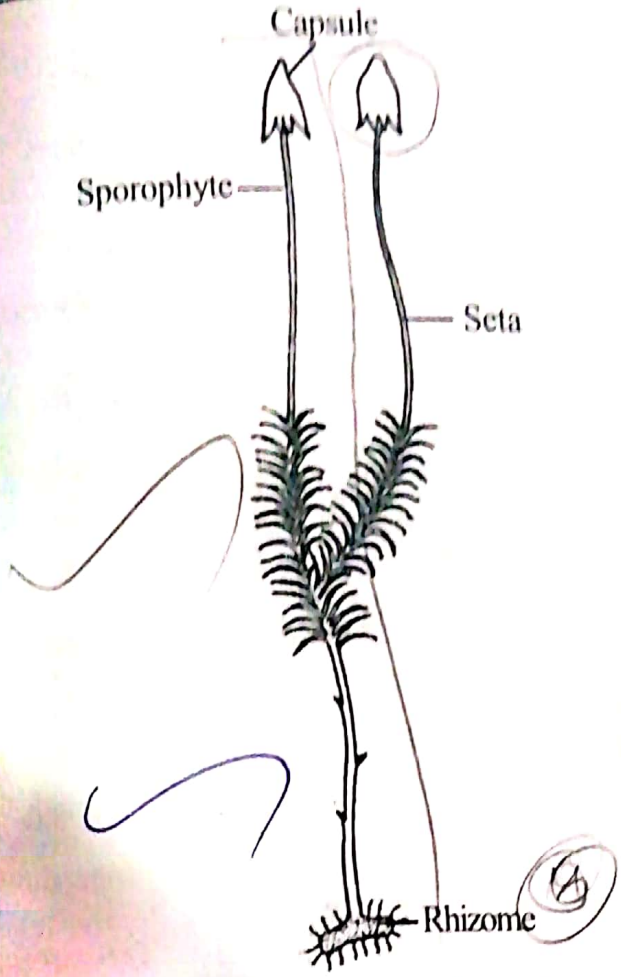

Fig. 31.13 : Polytrichum: Sporophyte.

The ***diploid zygote*** is the first cell of the ***sporophytic generation***. The sporophyte is also called ***sporogonium***.

The zygote undergoes repeated divisions to form a sporophyte. The mature ***sporophyte*** has three parts namely a basal ***foot***, a middle ***seta*** and a terminal ***capsule***.

The ***foot*** is a dagger shaped structure. It is buried deep in the tissue of ***female gametophyte***. It consists of ***parenchymatous*** cells. It serves as the organ for ***absorption*** and ***attachment.***

The ***seta*** is a long, slender, stalk like region. It carries the ***capsule*** at its distal end. It attaches the capsule with the ***foot***. The seta is more than 5cm long. ***Support*** and ***conduction*** are its two functions. It consists of an outer ***epidermis***. This is followed by ***sclerenchymatous hypodermis***. Inner to the hypodermis is a broad ***cortex*** consisting of green, thin walled ***parenchymatous*** cells with ***intercellular spaces***. A central core is formed of elongated thick walled cells.

The upper portion of the seta, just below the capsule, is swollen and ring-like. This is known as ***apophysis***.

Apophysis is the main ***photosynthetic part*** of the ***capsule***. It is separated from the capsule by a ***groove***.

Stomata are present in the groove. Structurally it consists of an outer ***epidermis*** followed by 3-4 layers of thin walled spongy ***parenchymatous cells*** containing ***chloroplasts***. The central conducting strand is similar to that of the rest of the seta.

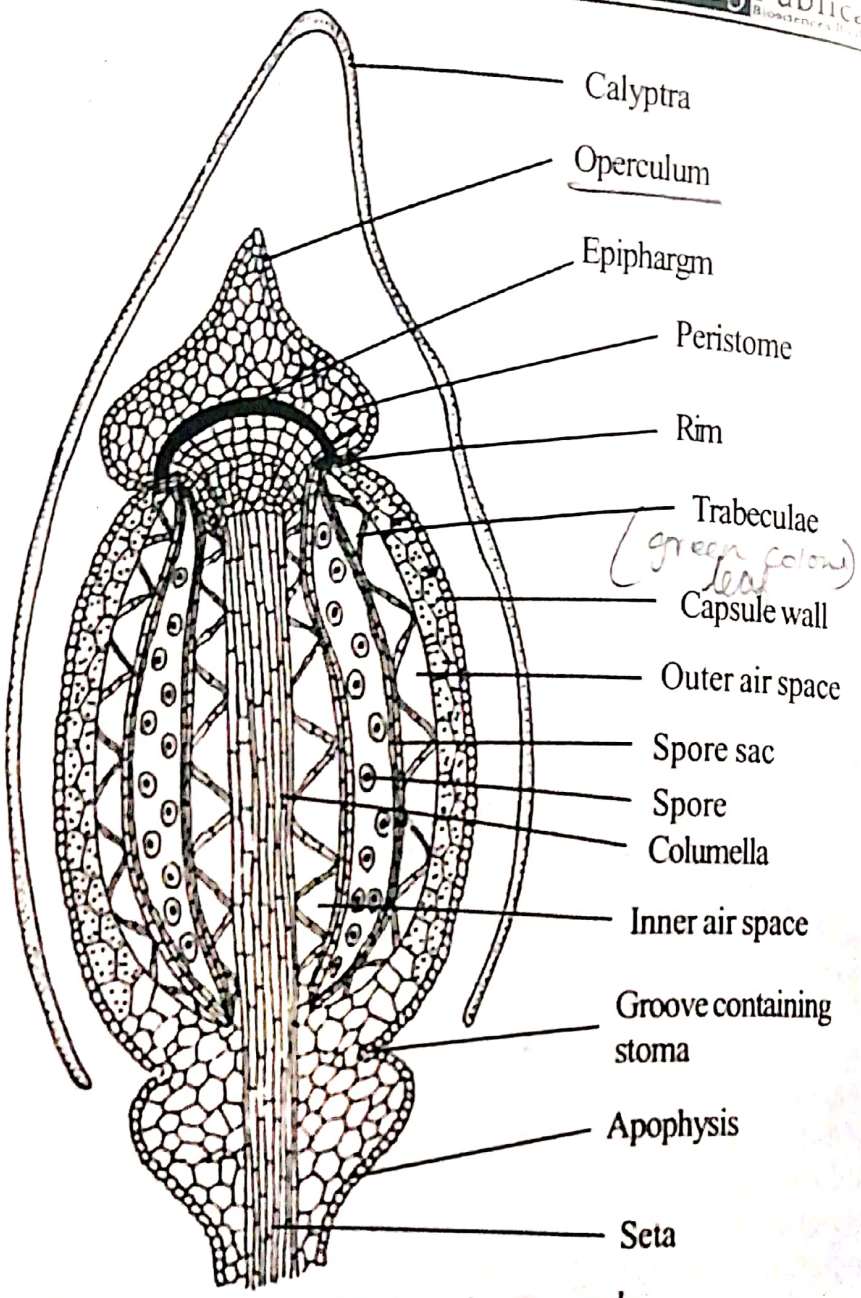

Fig. 31.14 : L.S. of Polytrichum capsule.

The ***upper part*** of the sporophyte is the ***capsule***. It is surrounded by a sterile envelope called ***calyptras***. It is differentiated into the lower ***spore forming*** region called ***theca*** and the upper sterile portion called ***operculum*** or ***lid***.

The lower spore forming region of the capsule is known as ***theca***. It is the ***mainbody*** of the capsule and it is ***four-sided*** in cross section.

Externally, the theca is covered by a ***calyptra***. The capsule consists of an outer ***capsule wall***, an ***outer air space***, a ***spore-sac***, an ***inner air space*** and a central core of ***columella***.

The capsule wall is made up of an outer ***epidermis*** and an inner ***chlorophyllous tissue***. Inner to the capsule wall is the ***outer air space***. It is traversed by filaments called ***trabeculae***. The trabeculae connect the ***capsule wall*** with the wall of the spore sac.

The spore sac contains the ***spores***. The air space present next to the spore sac is called ***inner air space***. The ***trabeculae*** of inner air space connect the inner wall of spore sac with the ***columella***. The central core of the capsule is columella. It is made up of sterile cells.

The spore sac encloses ***archesporium***. It develops into ***sporogenous tissue***. All the sporogenous cells are ***fertile*** and become ***spore mother cells***.

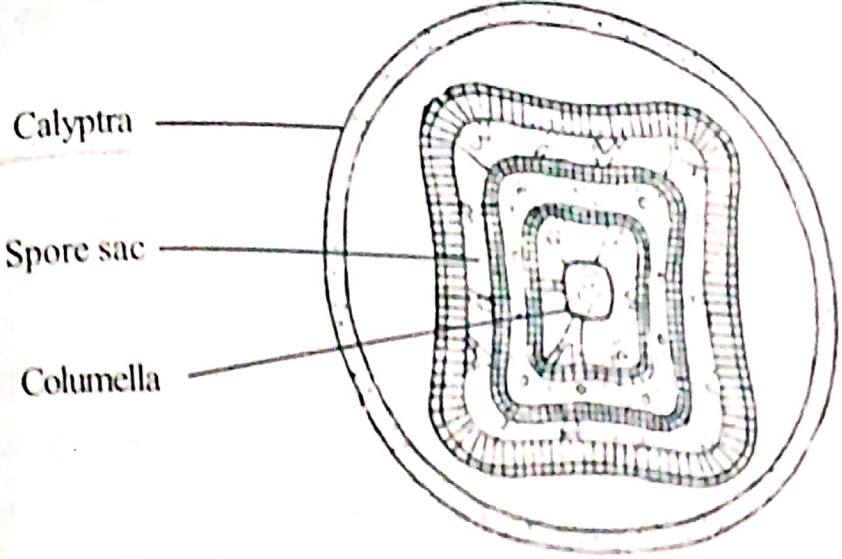

Fig. 31.15 : T.S. of Polytrichum capsule.

The spore mother cells undergo ***meiosis*** to produce haploid spores called ***meiospores***. erminal portion of the theca has a wide opening called ***peristome***. The peristome is cov- by a fan-like membrane called ***epiphragm***. The peristome has ***peristome teeth***. They ate the rate of discharge of spores.

The upper most part of the capsule is the ***operculum***. It appears as a conical ***cap*** on the r part of the theca. The free terminal end of the operculum is a pointed beak-like structure wn as ***rostrum***. The operculum is covered by ***calyptras*** for a considerable time. Since the ptra forms a shaggy ***hairy cap*** covering the entire capsule, *Polytrichum* is known as a moss". The operculum is delimited from the theca region by a narrow circular constriction led ***diaphragm*** or ***rim***.

32 to 62 teeth

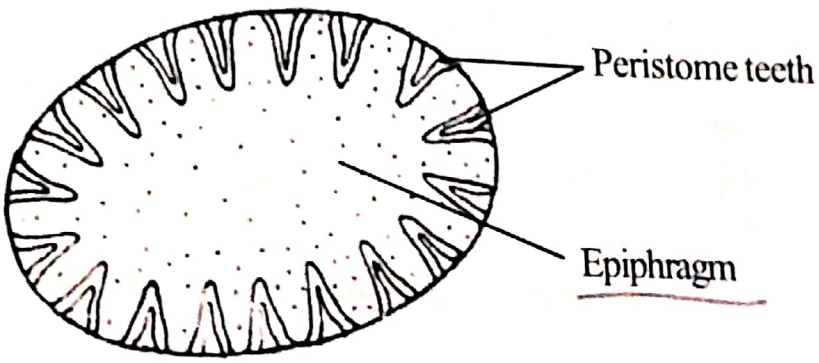

Fig. 31.16 : Peristome teeth of Polytrichum capsule.

During dry conditions the epiphragm dries up. This results in the separation of operculum. e calyptra falls off and the peristome teeth becomes exposed. The peristome teeth are ***not*** ***groscopic***. The minute spores are released through the small pores found among the teeth. e discharge of the spores is regulated by the ***movements*** of ***epiphragm***.

The spores are minute ***spherical*** and ***smooth***. Each spore remains surrounded by two yers, the outer ***exospore*** and the inner ***endospore***. The cytoplasm of the spore contains a cleus, chloroplasts and oil globules. The spores are ***haploid***. They are ***yellow*** in colour. The ores give rise to the ***gametophytes (N)***.

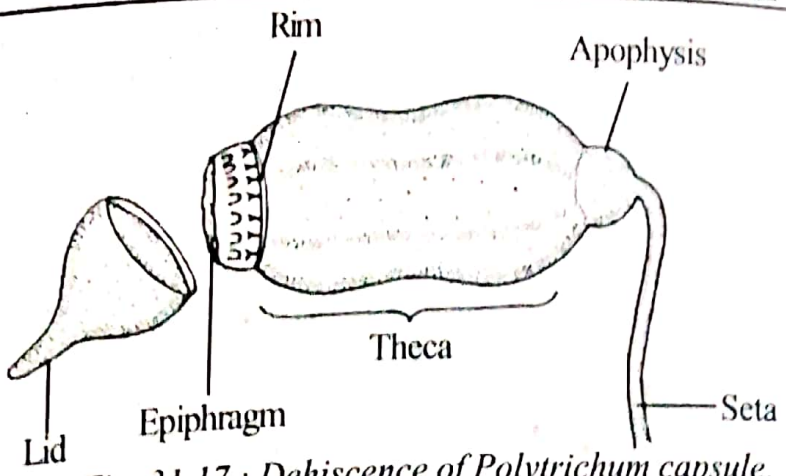

Fig. 31.17 : Dehiscence of Polytrichum capsule.

After reaching suitable substratum the spore starts germination. The spore absorbs water and swells up. The exine ruptures and produces a ***germ tube.***

The germ tube divides and gives rise to a branched, septate filamentous thallus called ***protonema***.

Some of the branches become colourless and form ***rhizoids***. The other branches are ***green*** due to the presence of chloroplasts in their cells. These branches are called ***chloronemal branches***. Many small bud-like structures develop on the surface of the ***chloronemal branches***. Each bud develops into a leafy gametophyte.

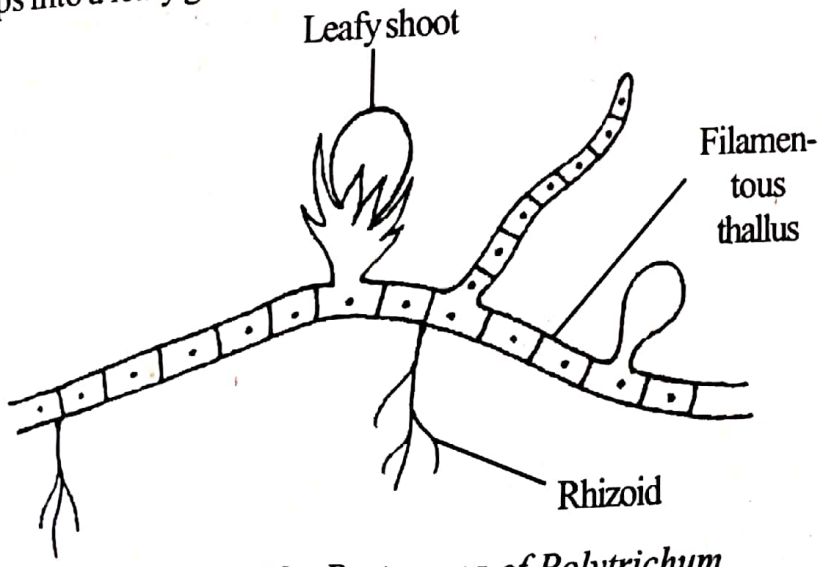

Fig. 31.18 : Protonema of Polytrichum.

Conclusion

Polytrichum shows distinct ***alternation of generation*** in its life cycle. The haploid ***gametophytic*** generation alternates with a diploid ***sporophytic*** generation.

The plant is a ***haploid gametophyte***. It is an ***independent*** plant. Vegetatively, it reproduces by ***fragmentation***, ***bulbils*** and ***protonema***. Sexually it reproduces by ***gametes***.

Polytrichum is ***dioecious*** and male and female sex organs are produced in separate plants. The male gamete antherozoid fuses with the egg to form a ***diploid zygote*** (2N). It divides and gives rise to a ***sporophyte***. It is, ***diploid***. It is ***attached*** on the ***female gametophyte***.

The sporophyte produces spores by ***meiosis***. The ***spores*** are ***haploid***. They develop into filamentous ***protonema***. This protonema produces small buds each of which then grows into a haploid leafy ***gametophyte***.

The gametophyte and sporophyte are morphologically dissimilar. Hence it ...-hum is known as **heteromorphic** type. The life cycle is *diplohaplontic*

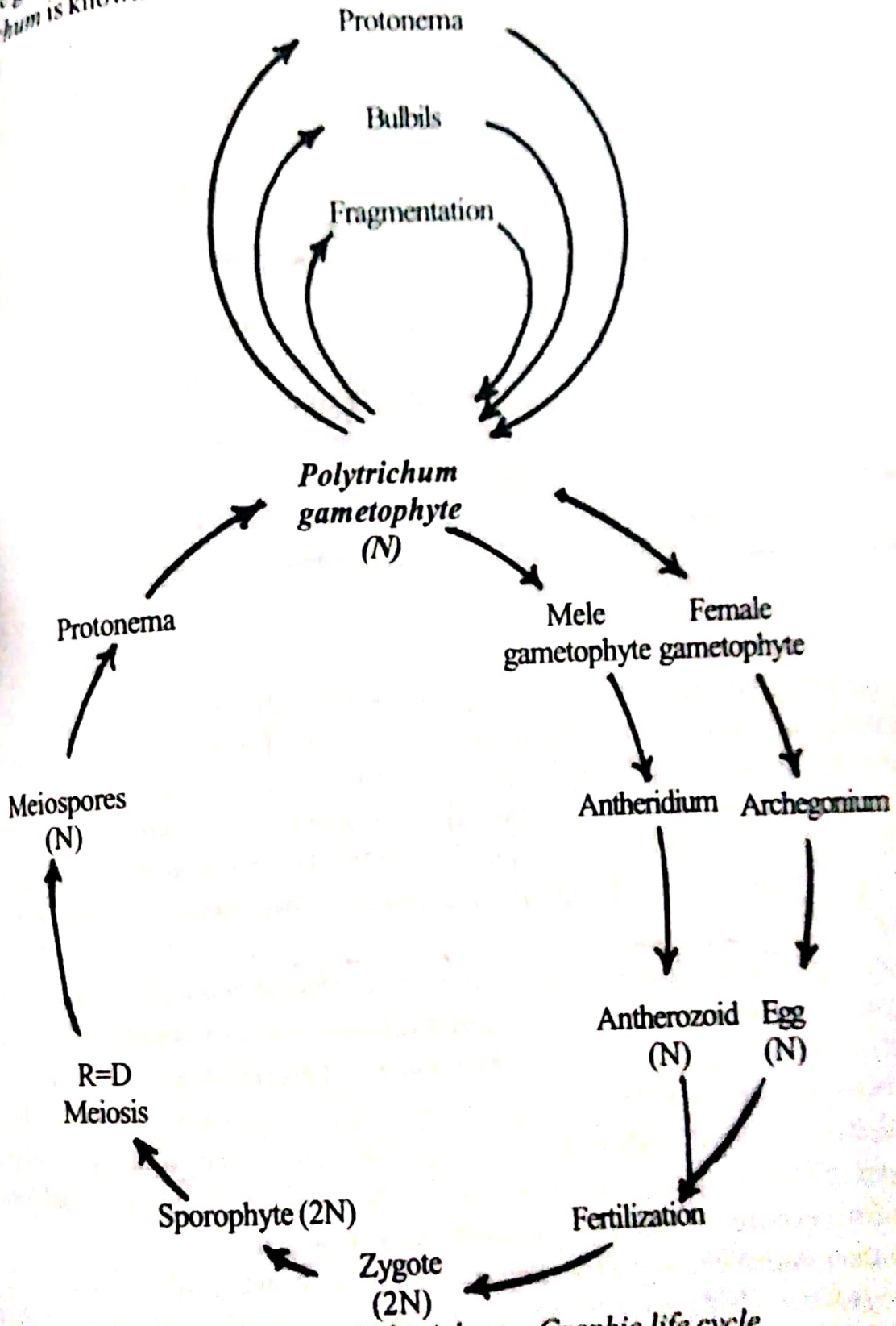

Fig. 31.19 : Polytrichum – Graphic life cycle

Economic Importance of *Polytrichum*

1. The tea made of *Polytrichum commune* helps to dissolve stones of kidney and gall bladder.
2. The hair-cup mosses are also used for stuffing ***mattres***
3. The long stem of the moss is used to make ***brooms*** and ***brushes***. The broom is called ***besom***. It is used to dust beds, carpets and curtains.

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Life Cycle of *Polytrichum*

Polytrichum is a ***Bryophyte***. It is commonly called ***hairy cup moss***. It is one of the highly evolved mosses.

Polytrichum is ***cosmopolitan*** in distribution. It is found in cool and ***shady*** places. It is found growing in bogs, on rocks and cliffs, swamps and as ***epiphytes*** on tree trunks.

The plant is a ***haploid gametophyte***.

The gametophyte consists of two parts, the underground ***rhizome*** and upright leafy ***shoot***.

The rhizome bears three rows of colourless leaves called ***'scale leaves'***. The rhizome bears many ***rhizoids***. The rhizoids provide ***mechanical support*** and serve as ***absorptive organs***. They help in vegetative reproduction.

The leafy shoot is an ***erect***, axis arising from the horizontal rhizome. It may be ***branched*** or ***unbranched***.

Each ***leafy shoot*** consists of a central axis called ***stem*** and many lateral expansions called ***leaves***. The stem bears two kinds of ***leaves***, the small ***scale leaves*** and large ***foliage leaves***.

The mature gametophyte bears the ***sporophyte***. The sporophyte reproduces asexually by spores:

In *Polytrichum*, reproduction takes place by three methods:

1.Vegetative reproduction

2.Sexual reproduction

3.Asexual reproduction

Vegetative reproduction takes place by ***fragmentation, bulbils, protonema***.

The sexual reproduction is ***oogamous type***. The plant is a ***haploid gametophyte*** (N). It is ***heterothallic***. The male and female sex organs are produced on separate plants.

The ***male sex organs*** are called ***antheridia***. The ***female sex organs*** are called ***archegonia***. The gametophyte that produces antheridia are called ***male plant*** or ***male gametophyte***. The gametophyte that produces ***archegonia*** are called ***female gametophyte*** or ***female plant***.

The sex organs are produced in clusters at the tip of ***leafy shoots*** (gametophores).

The cluster of antheridia is called ***antheridial cluster*** or ***antheridial head.***

The cluster of archegonia is called ***archegonial cluster*** or ***archegonial head.***

The ***archegonial head*** is produced at the tip of leafy shoot of ***male gametophyte***. It consists of ***axillary*** clusters of ***antheridia*** intermingled with ***paraphyses*** and ***perigonial leaves***.

The apex of the stem occurs as a ***small bud*** in the middle of the ***antheridial head***. It grows further in the next growing season producing antheridia.

The ***mature antheridium*** is ***club-shaped***. It has ***stalk*** and a ***body***. The body is surrounded by a ***jacket***. . Inside the jacket are present ***androcyte mother cells***. Each androcyte mother cell divides into two ***biflagellate sperms***. At the distal end, the jacket layer has an ***operculum***.

The antherozoids come out of the antheridium by the opening of the operculum.

The ***archegonial head*** is produced at the tip of the stem of ***female gametophyte***. Each archegonial head consists of a single row of ***perichaetial leaves*** with ***three archegonia*** inter-

paraphyses. Spathulate paraphyses are absent. The archegonial head also has a group ... at its centre. It does not grow further in the next growing season.

The mature archegonium is a ***flask-shaped*** structure. It consists of a ***neck***, a ***venter*** and ... The venter consists of a large ***egg*** and a ***ventral canal cell***. The neck is made up of ... *canal cells.*

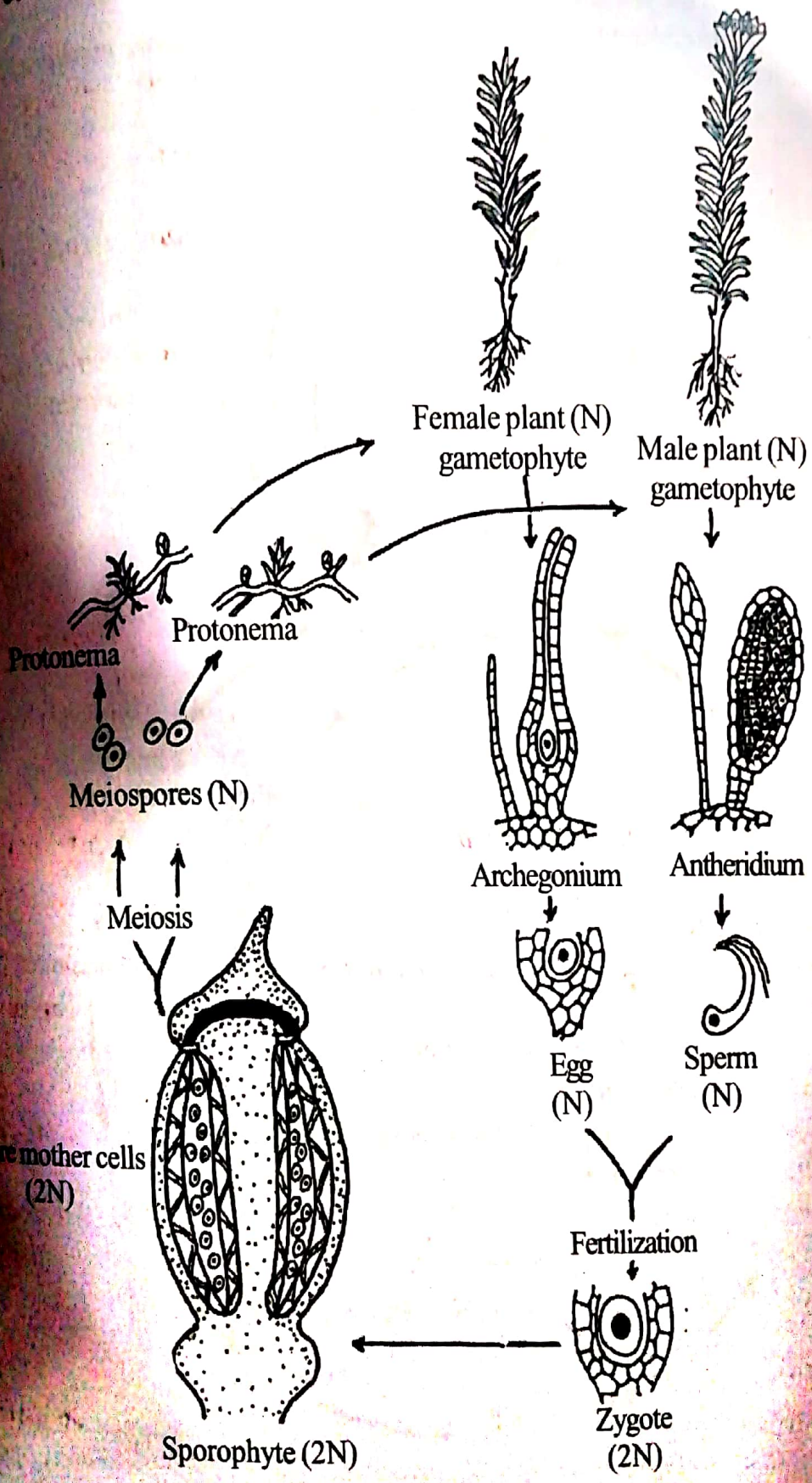

Fig. 31.20 : Diagrammatic life cycle of Polytrichum.

Towards maturity, the ventral canal cell, neck canal cells and cover cells disorganiz
e a neck canal. The neck canal is filled with ***mucilage***.
The ***antherozoids*** are attracted towards the archegonia. One of the antherozoids fuse
the egg to form a diploid ***zygote***.
The sporophyte of *polytrichum* reproduces asexually by producing *spores*. The sporo-
te is ***attached*** on the ***female gametophyte***.
The sporophyte contains a ***capsule***. The capsule encloses ***spore mother cells***.

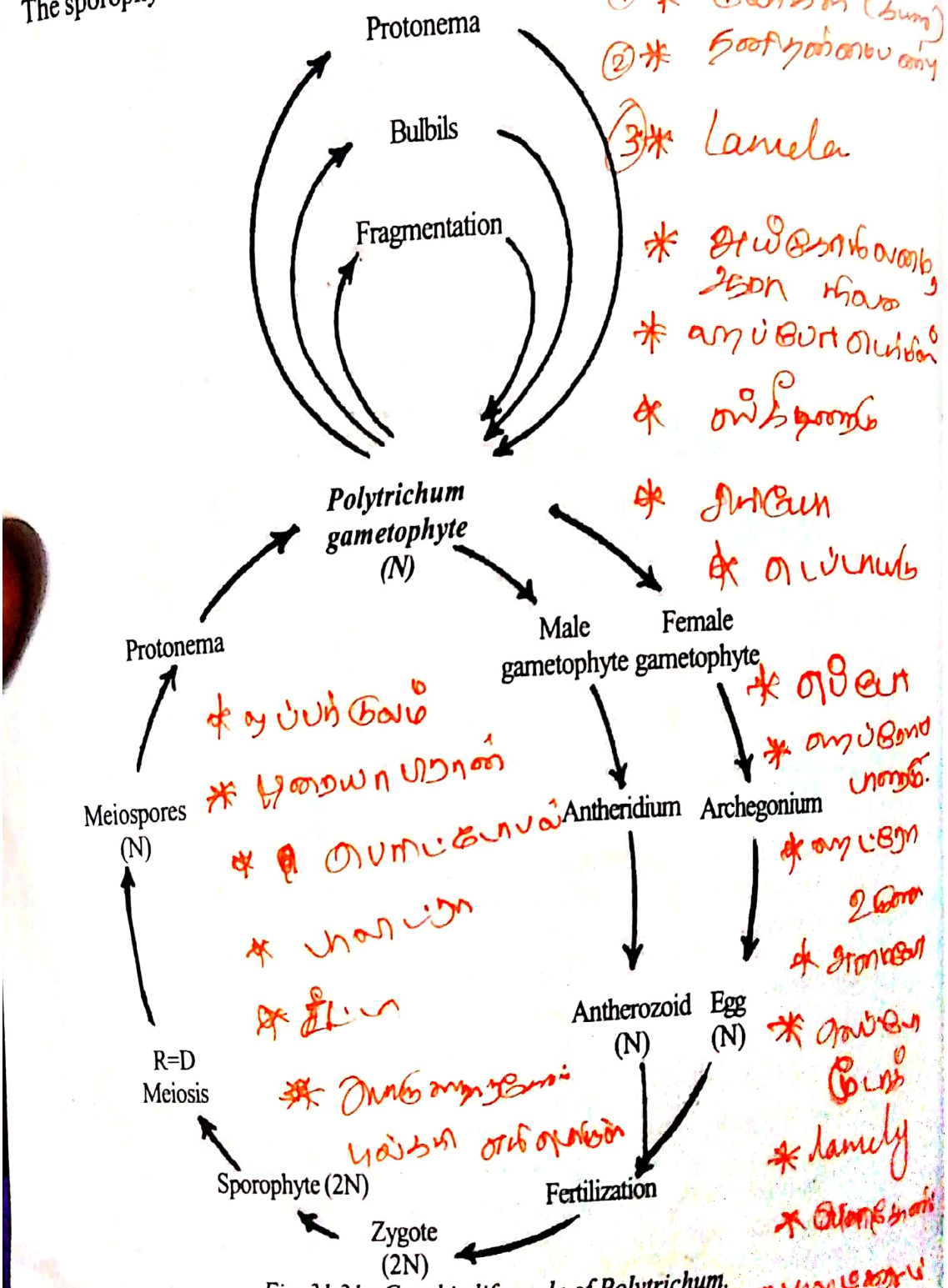

Fig. 31.21 : Graphic life cycle of Polytrichum.

The spore mother cells undergo ***meiosis*** to produce ***haploid spores***.
The spores are released by the ***dehiscence*** of the capsule.
The spore germinates into ***filamentous structure*** called ***protonema***.
The protonema produces ***buds***.
The buds grow into ***gametophytes***.

Conclusion

Polytrichum shows distinct ***alternation of generation*** in its life cycle. The ***haploid gametophytic*** generation alternates with a diploid ***sporophytic*** generation.

The plant is a ***haploid*** gametophyte. It is an ***independent plant***. Vegetatively it reproduces by ***fragmentation***, ***bulbils*** and ***protonema***. Sexually it reproduces by gametes.The antherozoid fuses with the egg to form a diploid zygote (2N). The zygote divides and gives rise to a sporophyte. It is ***diploid***. It is ***attached*** on the female gametophyte.

The sporophyte produces ***spores*** by ***meiosis***. The spores are ***haploid***. They develop into ***filamentous protonema***. This protonema produces ***small buds*** each of which then grows into a haploid ***gametophyte***.

The ***gametophyte*** and ***sporophyte*** are morphologically ***dissimilar***. Hence the life cycle of ***Polytrichum*** is known as ***heteromorphic*** type. The life cycle is ***diplohaplontic.***

Highlights