

# PSILOTUM



**P.nudum**



**P.complanatum**

# PSILOTUM

## Salient Features of Psilotum:

- i. The sporophytes are dichotomously branched with an underground rhizome and upright branches.
- ii. The upright branches are leafless.
- iii. Rhizoids present instead of roots.
- iv. Stem have a relatively simple vascular cylinder.
- v. The sporangia are borne in groups (trilocular) and form synangia
- vi. Spores produced are all alike (homosporous).
- vii. The development of gametophyte is exosporic and form monoecious subterranean gametophyte.
- viii. The development of embryo is exoscopic.

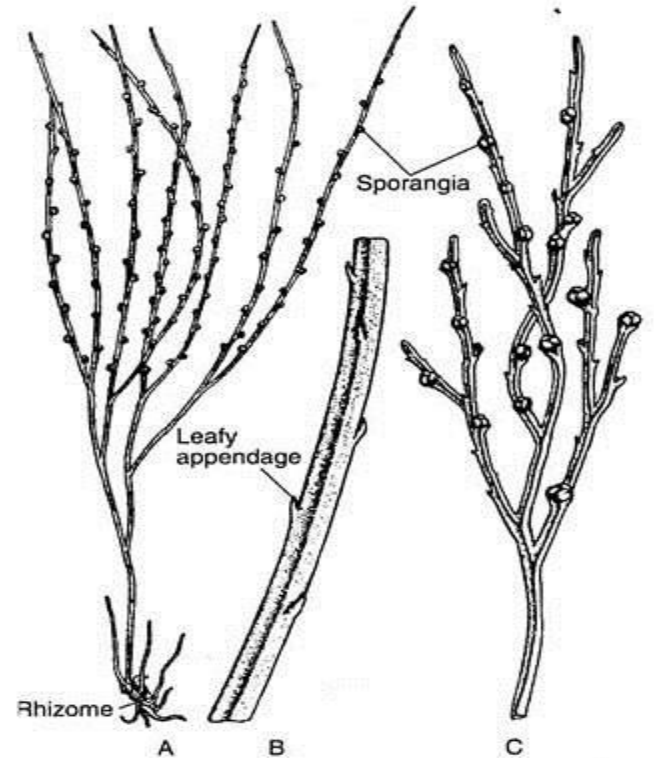


Fig. 7.11 : *Psilotum nudum* : A. A sporophyte plant, B. An enlarged part of stem showing scaly appendage, C. A fertile twig

# PSILOTUM

Division	: Psilophyta
Class	: Psilotopsida
Order	: Psilotales
Family	: Psilotaceae
Genus	: Psilotum

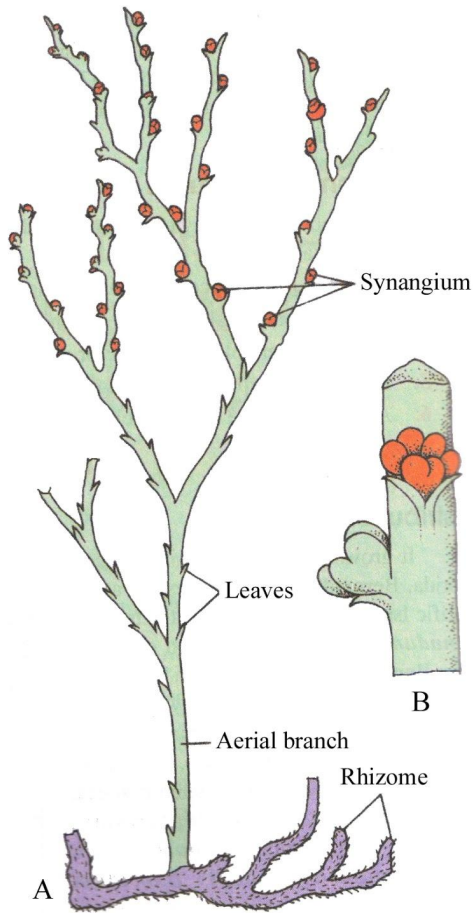


Fig : (A) A complete plant showing Synangia  
(B) A part of stem bearing Synangia.

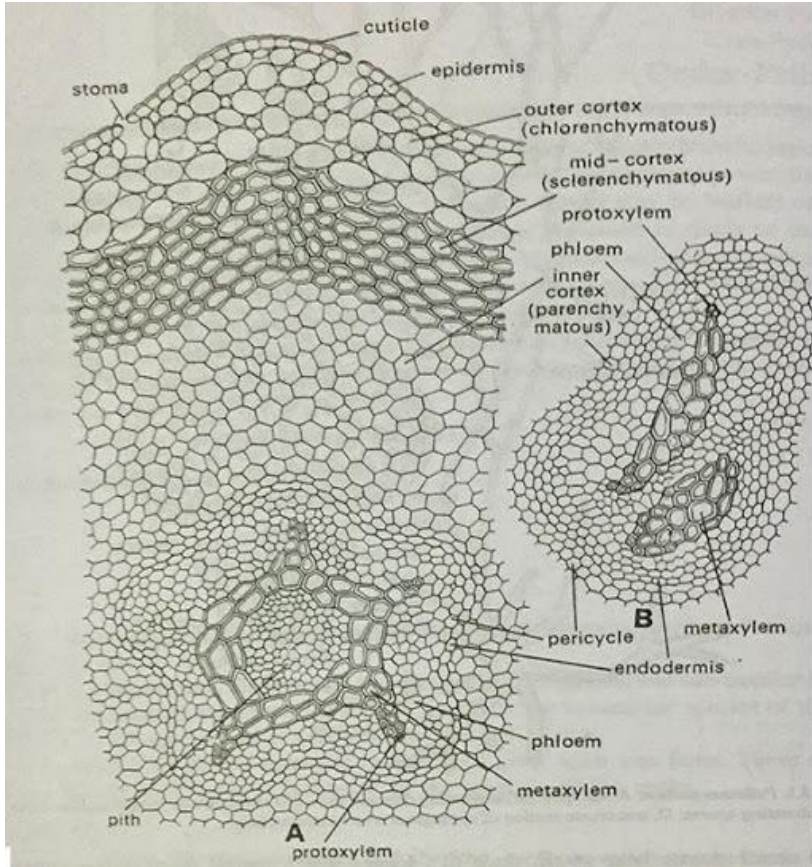
## **SPOROPHYTE:**

1. Sporophytic branched rhizome system.
2. Dichotomously branched, slender, upright, green aerial system
3. Bears small appendages and synangium

## **AERIAL STEM**

- \* Rhizome tips - turn upward - undergo several dichotomies - GREEN AERIAL SHOOT
- \* Aerial shoots - slender, erect (PENDENT - *P. flaccidum* - epiphyte) <https://www.pinterest.com/pin/855261785462631530/>
- \* Perennial, shrubby - due to dichotomy
- \* Height - upto 1m
- \* Aerial axis - cylindrical @ base, forrowed @ top, flattened with 3 triangular ridges at the top.
- \* basal part - smooth, distal part bears small scaly appendages & Synangia
- \* they are photosynthetic. Appear as xerophytic although grow in moist places

# PSILOTUM



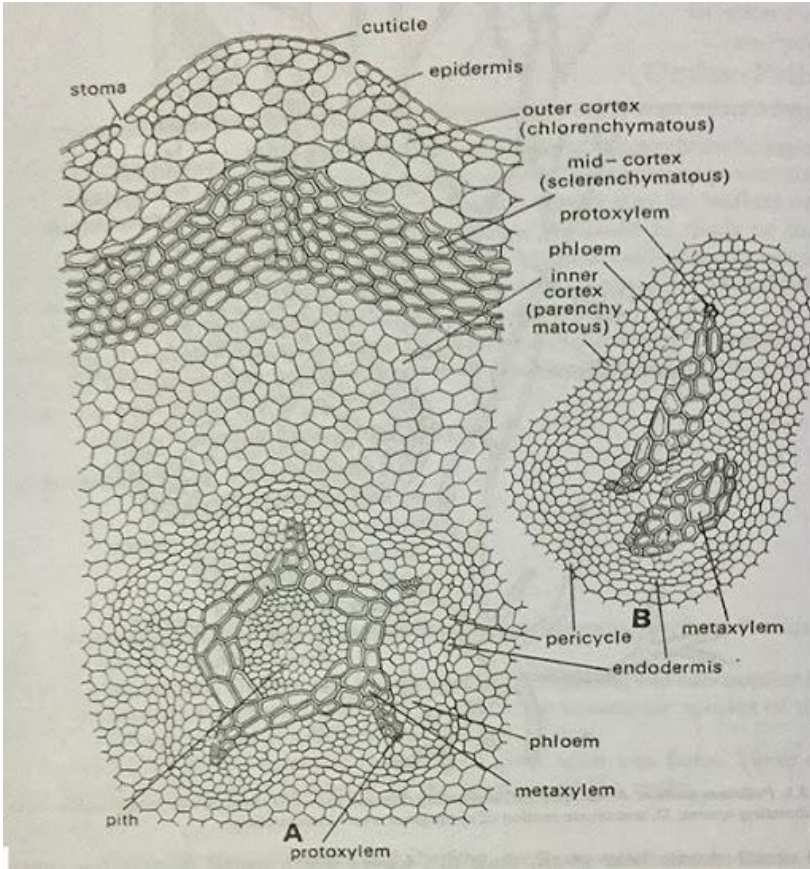
## 1. EPIDERMIS:

- Single layered, heavily cutinised
- Broken by stomata

## 2. CORTEX:

- Divided into three regions
- **OUTER:** Chlorenchymatous, elongated, lobed chlorophyllous cells with intercellular spaces
- 2 - 5 layered thick
- Consists of chloroplastids & starch grains
- **MIDDLE:** sclerenchymatous, 4 - 5 layered without intercellular spaces.
- Walls of these cells - lignified - lower portion of stem
- Provides mechanical support
- **INNER:** Parenchymatous cells (broader zone)
- Cell walls - becomes thinner - centre
- No intercellular spaces but contain **STARCH GRAINS**

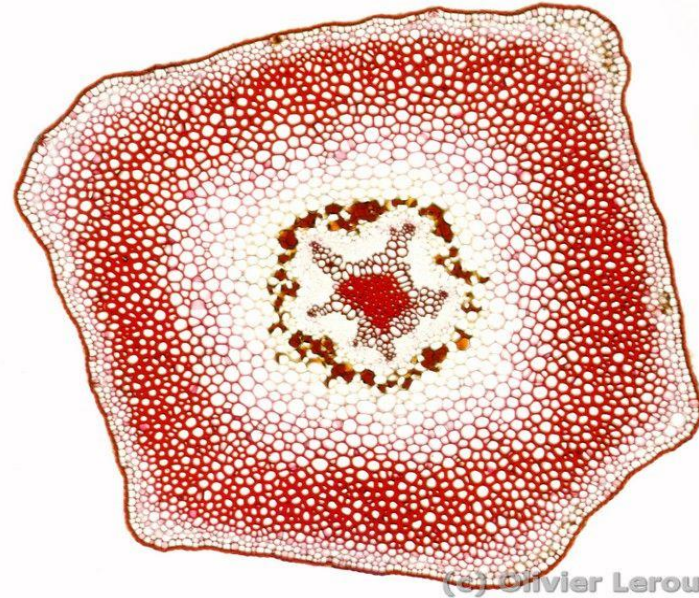
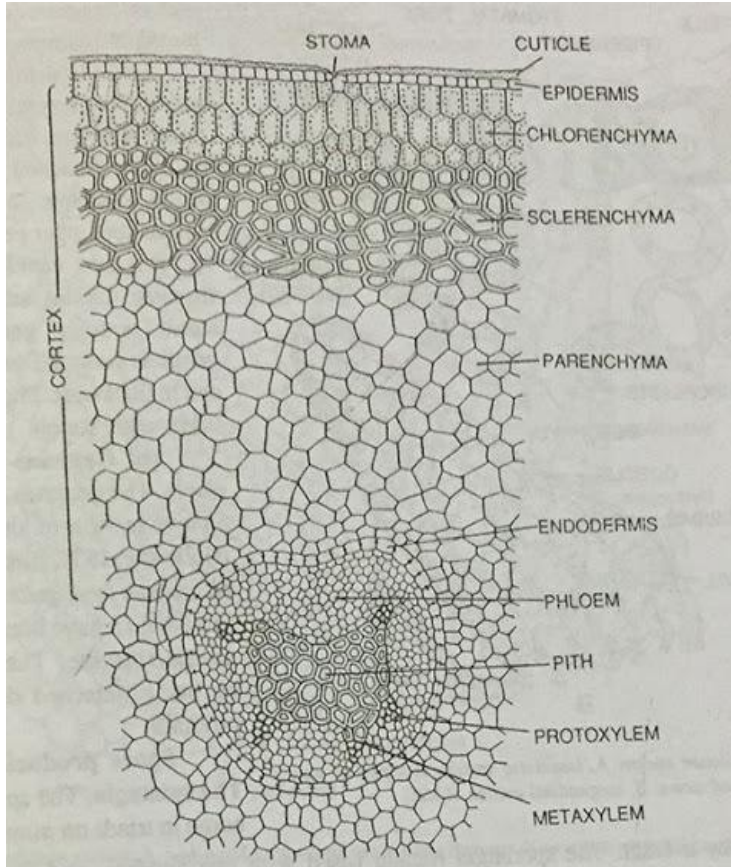
# PSILOTUM



## 3. ENDODERMIS:

- Cortical tissue - bounded by single layered Endodermis - vertically elongated cells - CONSPICUOUS CASPARIAN BANDS
- <https://www.encyclopedia.com/plants-and-animals/botany/botany-general/casparian-strip#:~:text=Casparian%20strip%20A%20band%20of%20waterproof%20C%20corky%20tissue%20that%20is,important%20in%20producing%20root%20pressure.>
- Centre of stem - flattened cylinder of primary xylem with protoxylem elements at the tip of the each ridge.
- May have 10 ridges - from transition region from rhizome - aerial stem
- Single layered parenchymatous pericycle - below epidermis
- Phloem is internal to pericycle & located between ridges of the xylem.

# PSILOTUM



- Extreme base - stem is **protostelic**(actinostelic)
- Middle portion - stele is **siphonostelic** as centre of xylem is occupied by a patch of elongated sclerenchymatous cells(SCLEROTIC PITH)

# PSILOTUM

## PROTOSTELE

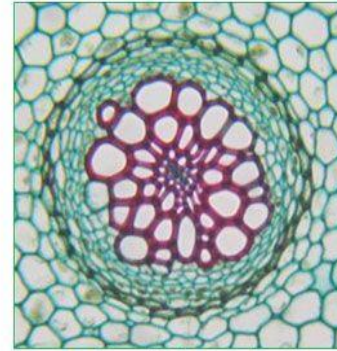
- Central core of xylem surrounded by band of Phloem & pericycle
- Single or multilayered
- Distinguishes stele than cortex
- Covered externally by endodermis

## ACTINOSTELE:

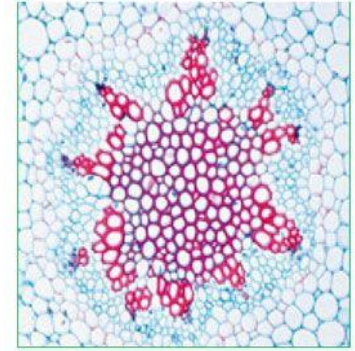
- Xylem - star shaped with many radiating arms
- Phloem - small patches in between the xylem radiating arms instead of continuous rings

## HAPLOSTELE

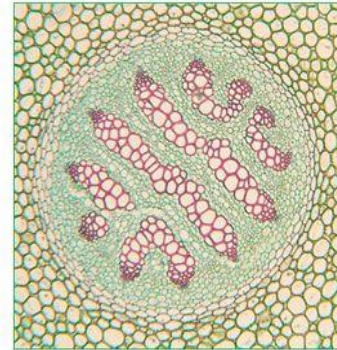
- Central solid core of xylem - surrounded by ring of phloem
- Found in fossil as well in living pteridophyte



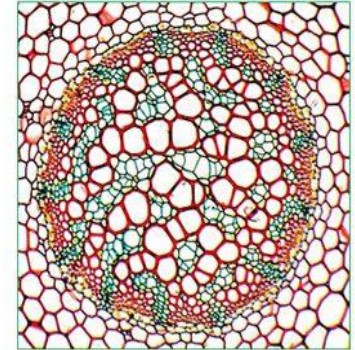
Haplostele (*Lygodium*)



Actinostele (*Psilotum*)



Plectostele  
(*Lycopodium clavatum*)

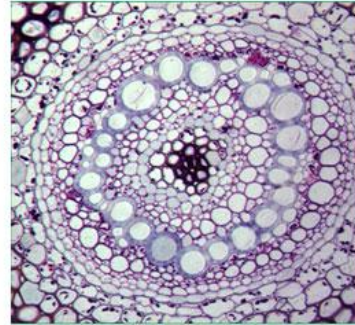


Mixed Protostele  
(*Lycopodium cernuum*)

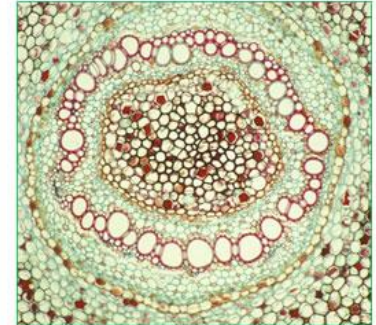
# PSILOTUM

## SIPHONOSTELE

- Phloem ring outside the xylem



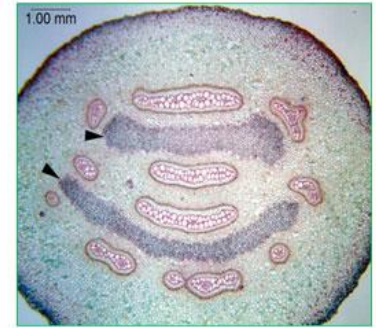
Ectophloic Siphonostele  
(*Osmunda*)



Amphiphloic Siphonostele  
(*Marsilea Rhizome*)



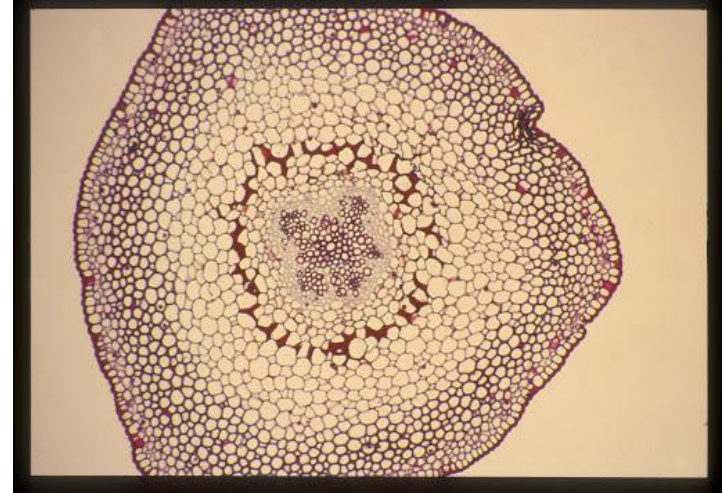
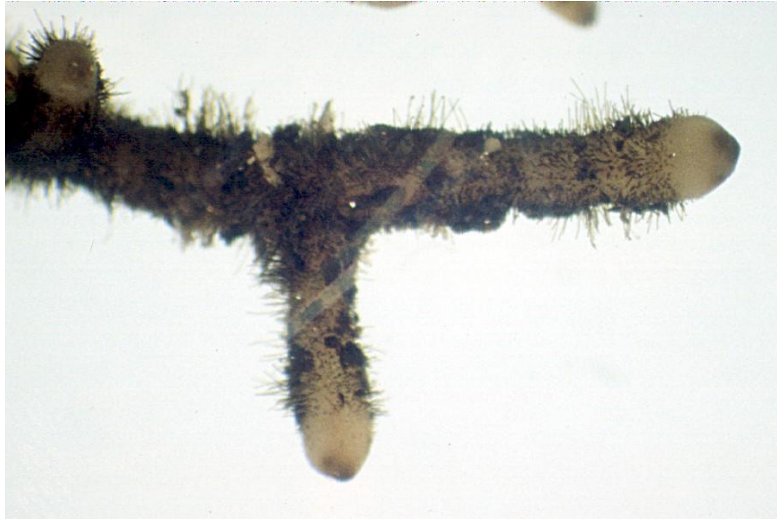
Amphiphloic Solenostele  
(*Adiantum pedatum*)



Dictyostele  
(*Pteris*)



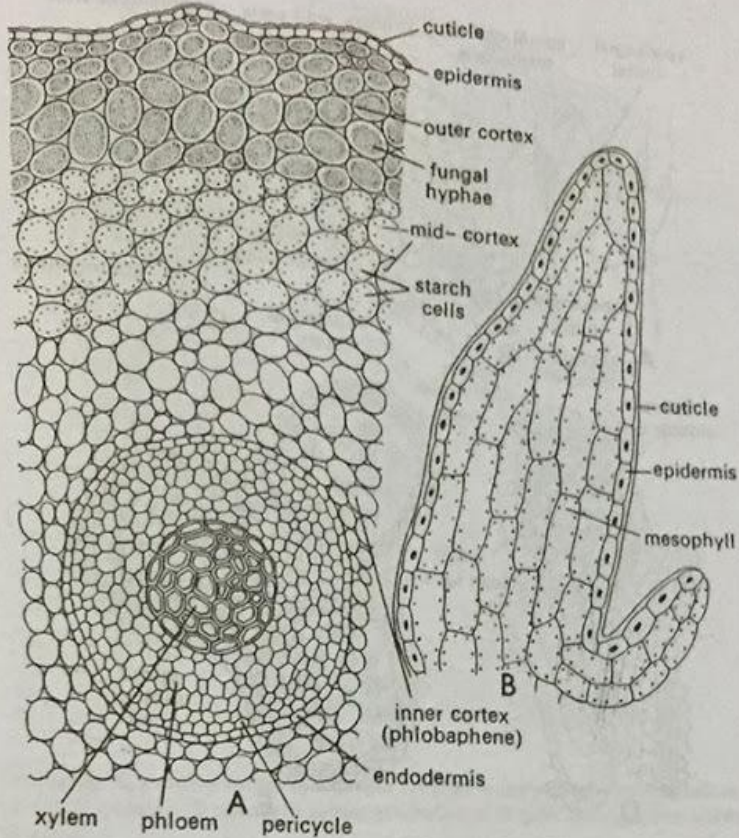
# PSILOTUM



- The basal subterranean branched rhizome- hidden beneath the soil or humus.
- It bears numerous rhizoids, instead of roots - functions of **absorption and anchorage**.

# PSILOTUM

## T. SOF RHIZOME



- outermost epidermis, cortex, endodermis, pericycle and stele
- The epidermis is indistinct and gives rise to 2-celled rhizoid
- The cortex - extensive, parenchymatous and differentiated into outer, middle and inner layers.
- Outer cortex: presence of Intracellular endophytic mycorrhiza
- Middle cortex: Large with starch grains
- Inner cortex: often dark, brown in colour (presence of Phlobaphene)
- Stele is protostelic (haplostele or actinostele)
- Surrounded by endodermal layer with conspicuous casparian bands on the radial walls.

# PSILOTUM

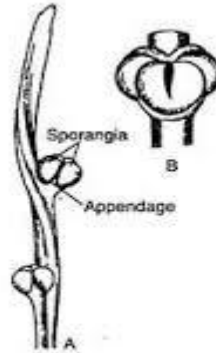


Fig. 7.16 : *Psilotum nudum* : A. A part of fertile axis bearing sporangia with bifid appendages, B. A trilobular synangia showing dehiscence

## Appendages:

1. small scale-like structures helically arranged on the upper part of the aerial system.
2. Internal - composed of parenchymatous photosynthetic cells.
3. Bounded by a single-layered cutinised epidermis.
4. There is no stomata in the appendages.
5. There is no vascular trace in the appendages of *P. nudum*

# REPRODUCTION IN PSILOTUM

The Psilotum reproduces vegetatively as well as by spores

## i. Vegetative Reproduction:

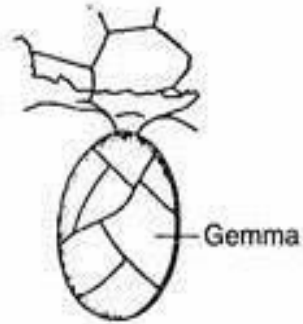
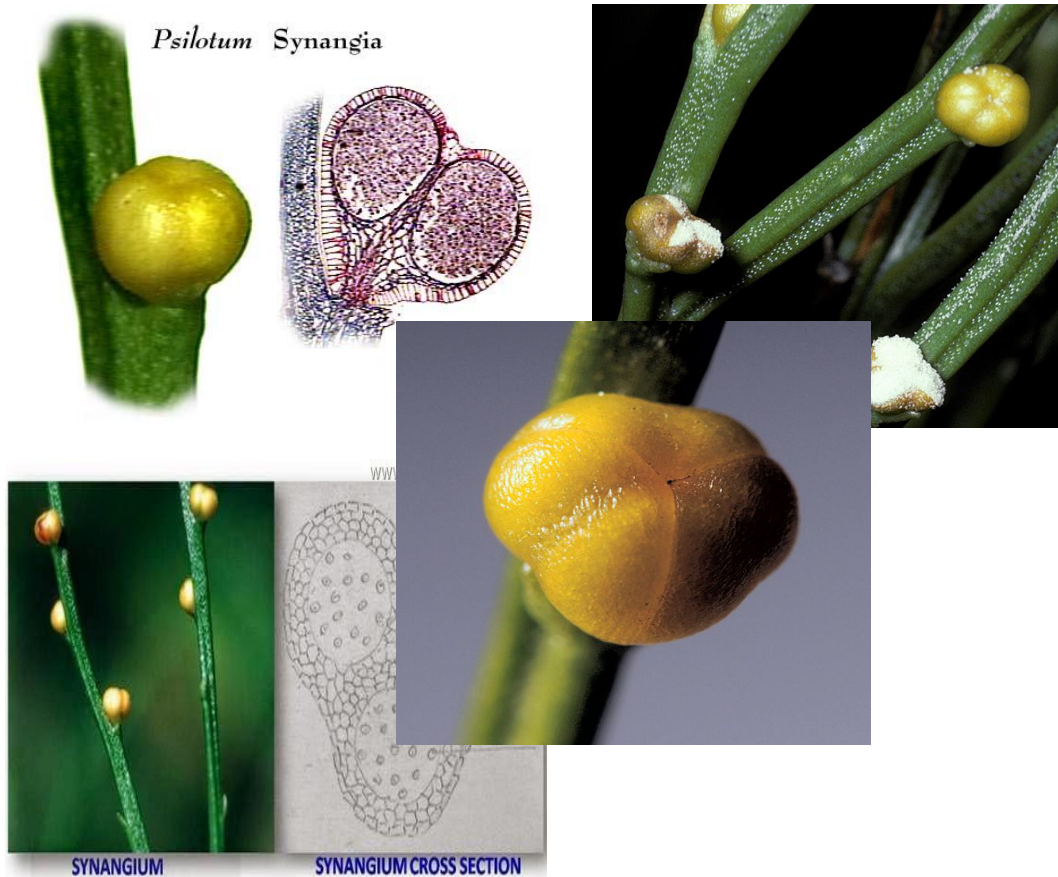


Fig. 7.15 : A gemma of *Psilotum*

- The sporophyte as well as gametophyte of *Psilotum* (e.g., *P. nudum*) propagate vegetatively through the production of Gemmae
- They are **small, multicellular and ovoid structures** developing on surface of rhizome (in sporophytic plant body) or prothallus (in the gametophyte).
- After detachment from the parent body, gemmae of sporophyte may germinate to **form a subterranean shoot**, while the gemmae of prothallus, on germination, form a **new prothallus**.

# REPRODUCTION IN PSILOTUM

*Psilotum* Synangia



## ii. Reproduction by Spores:

- Spore-Producing Structure:
- dichotomously branched aerial shoots become fertile - trilocular sporangia known as synangia
- The mature synangium is generally a three-lobed structure.
- Each lobe of the synangium corresponds to a sporangium.
- The synangia located at the tip of very short axis, measuring 1-2 mm in diameter
- At maturity, the synangium exhibits dehiscence.

# REPRODUCTION IN PSILOTUM

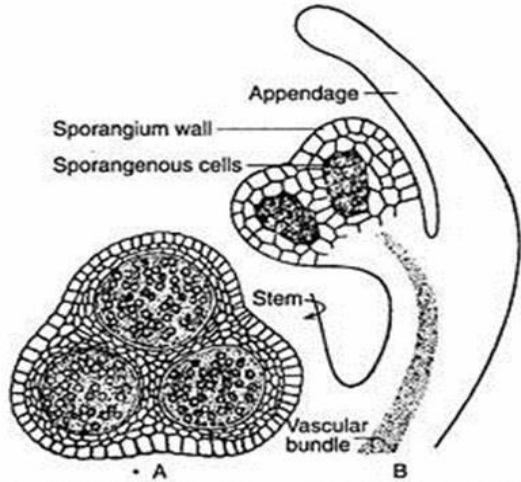
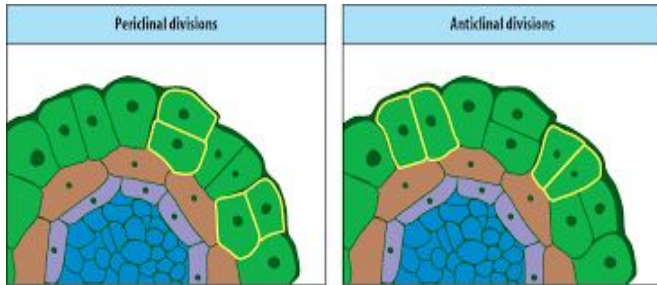


Fig. 7.17 : *Psilotum nudum* : A. T.S. of synangium, B. V.S. of fertile axis through a synangium



## Development of sporangium - EUSPORANGIATE TYPE

<https://www.merriam-webster.com/dictionary/eusporangiate>

## Sporangium - develops - SUPERFICIAL INITIAL CELLS

Periclinal division

Primary wall initials

PD AD

Sporangial wall(4-5)

Primary sporogenous cells

Sporogenous tissue

Spore mother cells

Meiosis

Spores

Spores - **HOMOSPOROUS**  
 Bilaterally symmetrical  
 Colourless  
 Kidney shaped

# GAMETOPHYTE

<https://byjus.com/biology/gametophyte/>

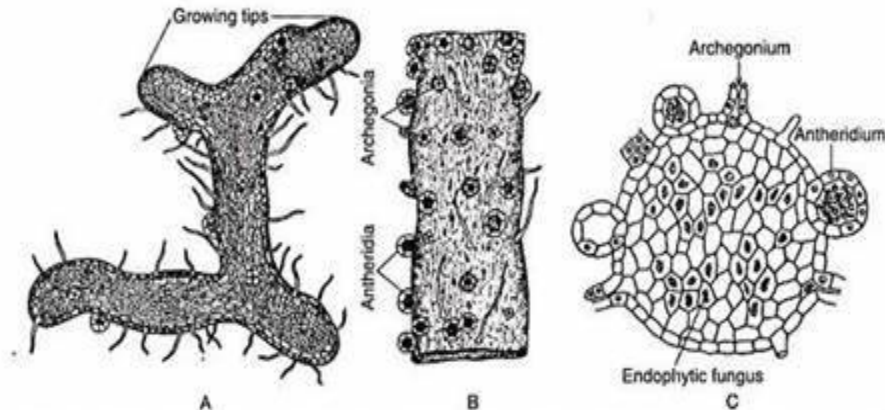


Fig. 7.18 : *Psilotum nudum* : A. A gametophyte, B. An enlarged portion of the gametophyte showing sex organs and rhizoids, C. T.S. of gametophyte

- ❖ mature gametophyte - similarity - sporophytic rhizome
- ❖ It grows as saprophyte with an associated fungus.
- ❖ Spores - Germinate **exosporically** - GAMETOPHYTE
- ❖ Mature gametophyte - **brown, cylindrical, subterranean, dichotomously branched**
- ❖ Surface - Long unicellular, brownish rhizoids
- ❖ Gametophyte - grows - means - **APICAL MERISTEM**

- ❖ In T.S - **cutinised peripheral cells** - encloses many-layered **thin-walled parenchymatous cells**
- ❖ Internal parenchyma cells - filled with - **Hyphi of symbiotic fungus.**
- ❖ *Psilotum* is the only plant in the plant kingdom where the **vascular tissues develop in the gametophytic generation.**

## SEX ORGANS:

- The gametophytes of *Psilotum* are **monoecious (i.e., homothallic).**
- Sex organs i.e., antheridia and archegonia - **SUPERFICIAL**
- Scattered over the surface of gametophyte.
- Antheridia are more in number than archegonia

# ANTHERIDIUM

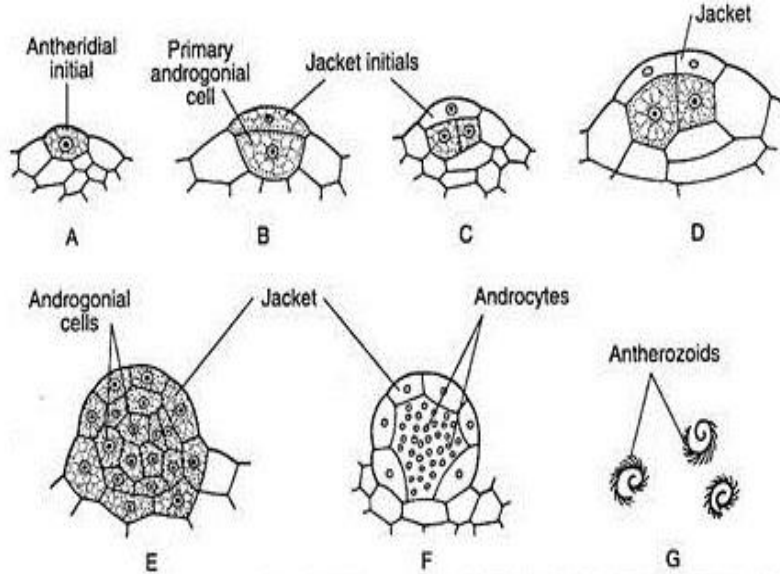


Fig. 7.19 : *Psilotum nudum* : A-E. Stages in the development of antheridium, F. A mature antheridium, G. Antherozoids

**SUPERFICIAL CELLS(Antheridicial initials)**

**Outer Jacket Initial  
Inner Primary Androgonial cell**

**Outer Jacket Initial - AD  
Single layered Jacket cells**

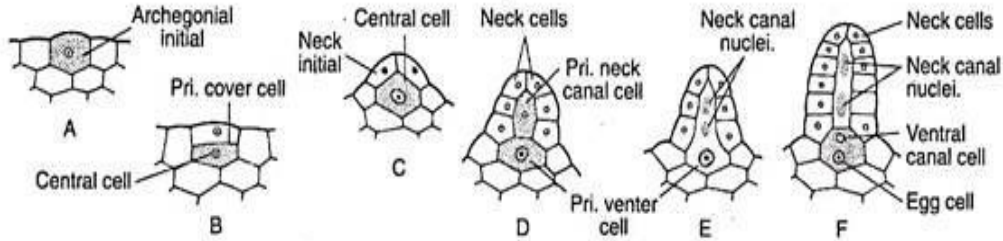
**Inner Primary Androgonial cell  
Mass of Androgonial cells - ANDROCYTES**

**Antheridium projects above - surface of  
prothallus**

**Each androcyte - Spirally coiled,  
multiflagellate antherozoid  
Escapes by the disintegration of Opercular  
cells**



# ARCHEGONIUM



## FERTILIZATION

- Maturity - cell wall - lower tier neck cells - thick wall & cutinized
- Apical tier - breaks (presence of water)
- Mucilagenous contents - neck cells - released
- Free passage - entry of Antherozoids
- Fertilization - union of multiflagellate sperm & egg - DIPLOID ZYGOTE

SUPERFICIAL CELLS(Archegonial initial)

Outer Primary cover cell  
Inner Central cell

Outer Primary cover cell - PD  
Neck - 4 vertical rows of cells (4 - 6 cells each row)

Central cell - transverse division  
Upper primary neck canal cell  
Lower primary venter cell

Nucleus of primary neck canal cell - 2 neck canal nuclei

Primary venter cell - TD - produce  
Large egg & small ventral canal cell

# EMBRYO (NEW SPOROPHYTE)

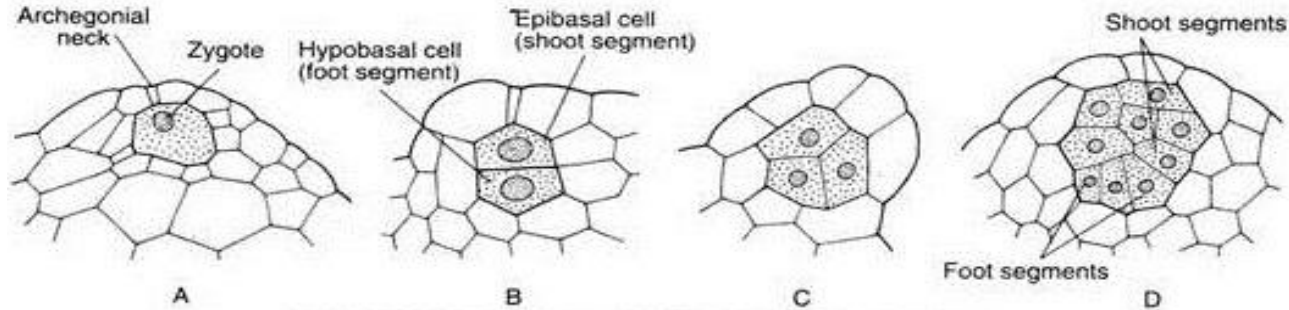


Fig. 7.21 : *Psilotum nudum* : A–D. Stages in early embryony

- ★ **Diploid zygote** - Mother cell - SPOROPHYTIC GENERATION
- ★ 1st division - TD - **OUTER EPIBASAL CELL** (neck of archegonium) - SPOROPHYTIC BRANCH SYSTEM (aerial & underground)
- ★ **INNER HYPOBASAL CELL** (base of archegonium) - FOOT

- ★ This type of embryony where the shoot forming apical cell is directed outward (towards the neck of the archegonium) is called exoscopic mode of embryo development.
- ★ The foot anchors the young sporophyte securely to the gametophyte and absorbs nutrients until the sporophyte becomes physiologically independent.

# LIFE CYCLE OF PSILOTUM

