PTERIDOLOGY TELOME CONCEPT

TELOME THEORY

- The Telome theory - Walter Zimmermann (1930).
- This theory is based on fossil record.
- According to this theory, all vascular plants evolved from a simple, dichotomously branched, leafless *Rhynia* type ancestor.

Telome:

- The single-nerved ultimate terminal portion of a dichotomising axis.

Mesome:

- The connecting axes between dichotomies are called mesomes.

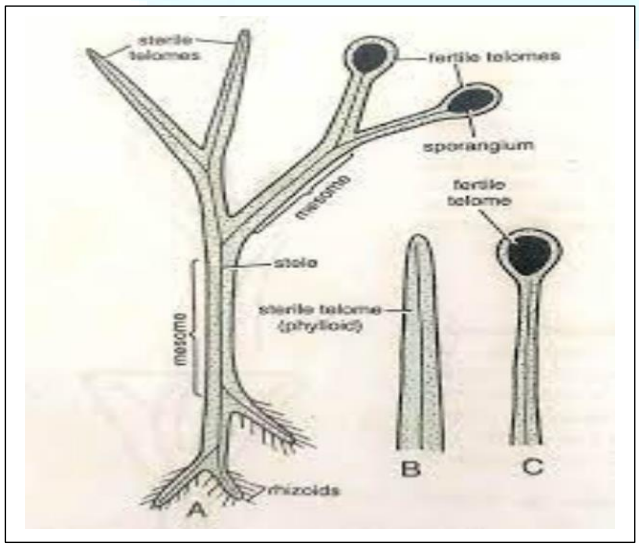
➢ Functionally, telomes are of two types:

1. Fertile telome:

- Those telomes which bore terminal sporangia.

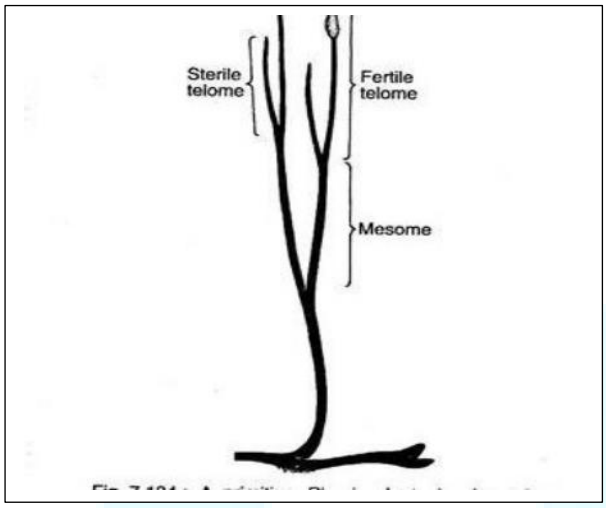
2. Sterile telome or phylloid:

- Those telomes without sporangia.



SYNTELOME OR TELOME TRUSS

- Several telomes, either fertile or sterile, becomes grouped together by connecting mesomes to form a more complex structure, called syntelome or telome truss.



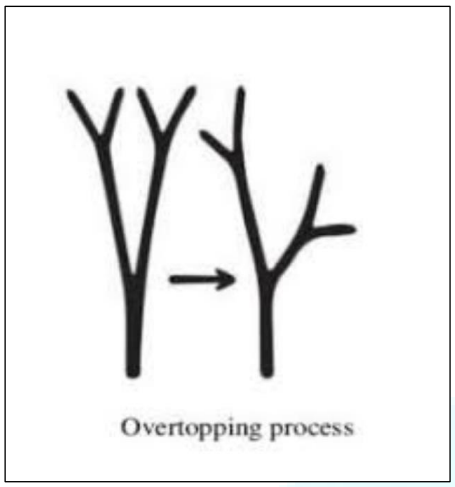
Processes of Telome Theory

- According to Zimmermann, these telomes or telome trusses of primitive *Rhynia* type of vascular plants have been subjected to certain evolutionary processes in varying degrees among the various taxonomic groups.
- These evolutionary processes are:
  - **(i) Overtopping**
  - **(ii) Reduction**
  - **(iii) Planation**
  - **(iv) Syngenesis or webbing**
  - **(v) Curvation**

(i) Overtopping

- In this process, one of the two dichotomizing branches of the primitive axis produced by the apical meristem outgrows or overgrows the other.

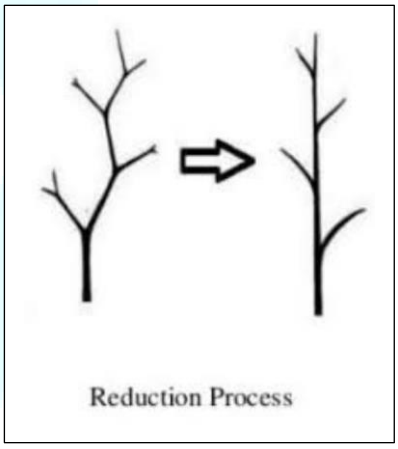
- The larger axis thus produced becomes the stem, while the shorter or overtopped branches represent the beginnings of lateral branches or leaves.



Overtopping process

(ii) Reduction

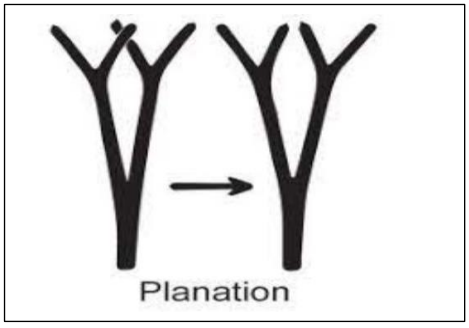
- In this process, the activity of terminal meristem of each telome of the truss becomes suppressed resulting into much shorter branches by decreasing the length of telomes and mesomes.
- This process is responsible for the formation of microphyllous leaves of the Lycopsida and Sphenopsida as well as the needle like leaves of conifers.



Reduction Process

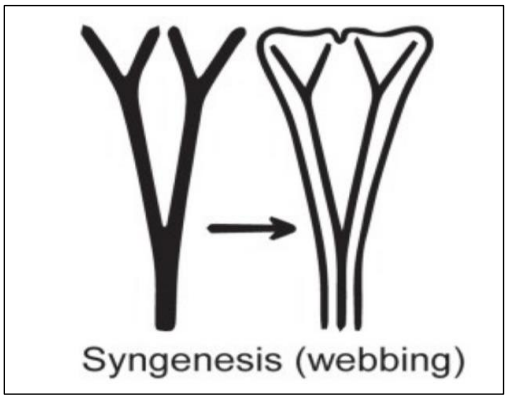
(iii) Planation

- The process of planation caused the telomes and mesomes of the truss to shift from a three dimensional pattern (cruciate dichotomy) to a single plane (fan shaped dichotomy)



Planation

(iv) Syngenesis /Webbing



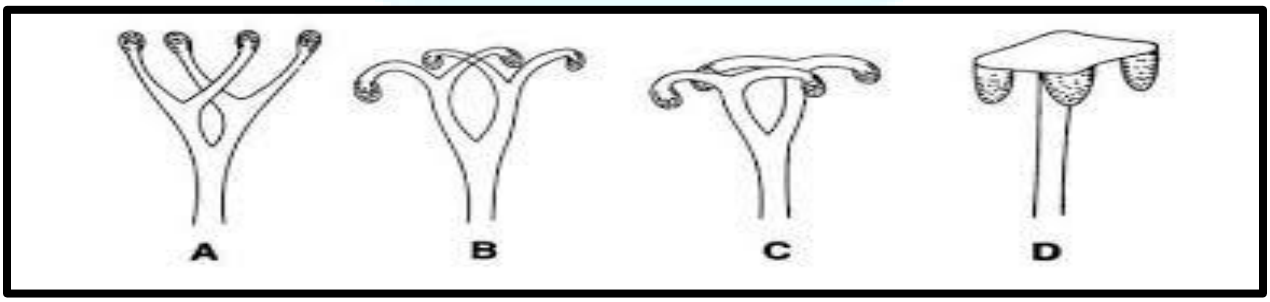
- Fusion of telomes and mesomes takes place by the development of parenchymatous tissue. It leads in the formation of
- Leaves with open dichotomous, pinnatified reticulate venation
- Polystelic condition in *Selaginella*

(v) Curvation

- The fertile telomes become curved or bend downwards. The two sub -processes of curvation are:
  - **a) Recurvation**
  - **b) Incurvation**

Recurvation:

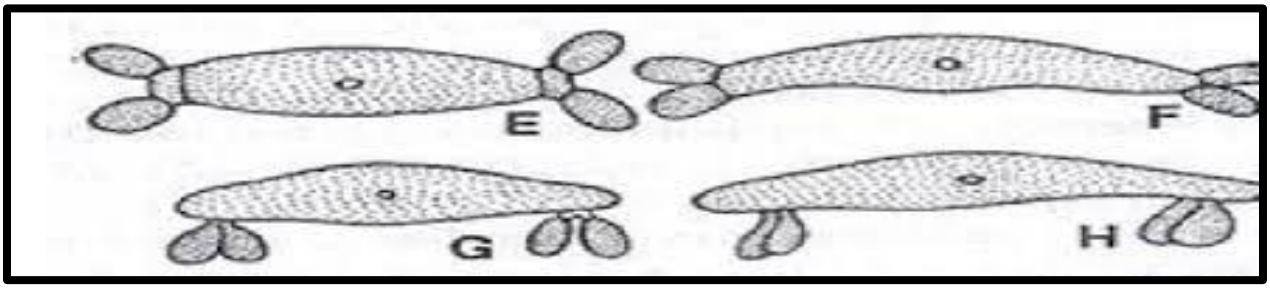
- In this sub-process the telome bends inward toward an axis .
- The inward-projecting sporangia on a sporangiophore of *Equisetum* (Sphenopsida) is the result of this sub-process



Incurvation:

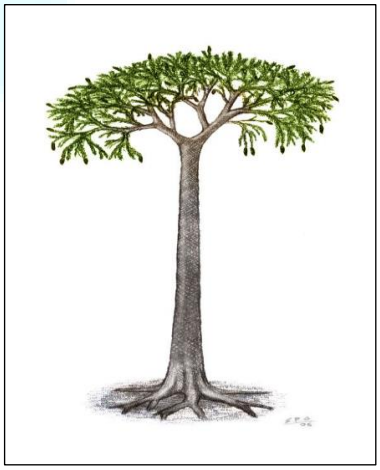
- In this sub-process, the fertile telome bends downward resulting in the downward shifting of the sporangia from terminal to the ventral surface of the leaf.

- This sub-process is responsible for the formation of ventral position of the sporangia in fern (Pteropsida) leaf.



SIGNIFICANCE OF TELOME THEORY

- The telome theory portrays the origin and evolution of the sporophytes in the earliest known land plants.
- It actually explains the phylogenetic relationship between the fossil and the living plants.
- The five elementary processes like overtopping, reduction, planation, syngenesis and curvation give a unified concept of the manner in which evolution might have proceeded in the land plants.
- These processes explain in a simple and lucid way as to how the primitive land plants led to the evolution of both the simple and complex plants of today.



DIVISION : LYCOPHYTA
CLASS : LIGULOPSIDA
ORDER : LEPIDODENDRALES
FAMILY : LEPIDODENDRACEAE
GENUS : LEPIDODENDRON

i. More than one hundred species under the genus *Lepidodendron* have been described.
ii. It appeared during upper devonian, flourished in carboniferous and disappeared in permian.

iii. It is giant tree and reaches up to a height of 40 meters and the diameter of the trunk was approximately 50 centimeters.
iv. The trunk was straight and columnar, unbranched upto certain distance above the ground.
v. The leaves known as lepidophyllum, are spirally arranged.
vi. Leaves (lepidophyllum) were deciduous, simple ligulate, linear to acicular in shape and 2 to 18 cm in length.
vii. Upon abscission a flat rhomboidal scar persisted on the stem resembling a small cushion.
viii. The base of the stem had a stigmarian type of root system.

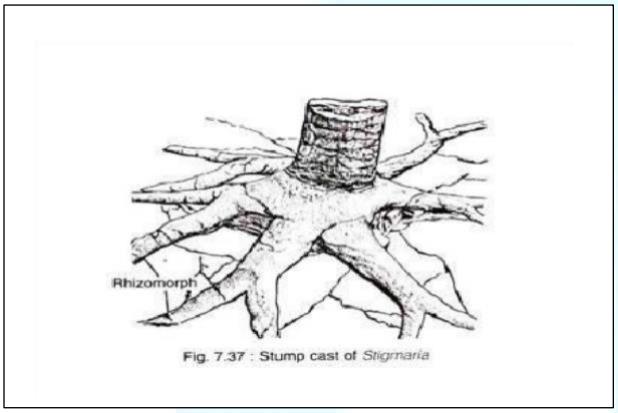


Fig. 7.37 : Stump cast of *Stigmaria*

ANATOMY OF THE TRUNK

- The trunk was differentiated into central stele surrounded by cortex.
- The cortical zone was very thick and can be differentiated into:
  - **a.** Inner cortex
  - **b.** Secretory zone
  - **c.** Middle cortex and
  - **d.** Outer cortex

i. The inner cortex was made up of parenchyma cells.

ii. The Secretory zone consisting of glandular cells which were filled with a dark coloured substance. They probably secreted the waxy material which covered the surface of the stem.
iii. The middle cortex was similar to inner cortex in structure and appearance.
iv. The outer cortex was composed of alternating patches of parenchymatous and sclerotic tissue. The outer cortex was encircled by hard periderm layer formed by phellogen.
v. The stele was either siphonostelic or protostelic.
vi. The protoxylem was exarch and polyarch.
vii. The meta xylem of tracheids was with scalariform thickening and the protoxylem was with spiral thickenings.
viii. The secondary wood has scalariform tracheids and small wood ray.

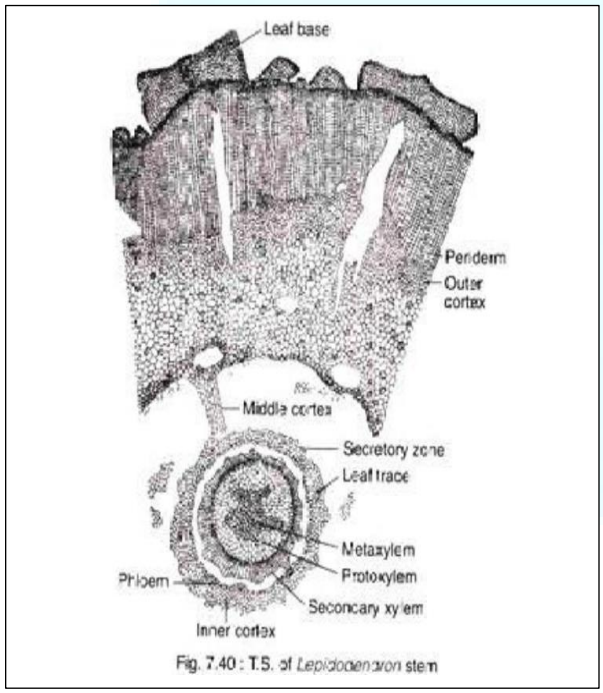


Fig. 7.40 : T.S. of *Lepidodendron* stem

ANATOMY OF LEAVES

- Leaf is known as Lepidophyllum.
- They were borne spirally on the stem and were triangular in shape.
- Stomata were present on the abaxial side.

- The leaf base was seen with a small single vascular strand.
- The vascular strand was flanked by two triangular or rounded areas or scars one on each side.

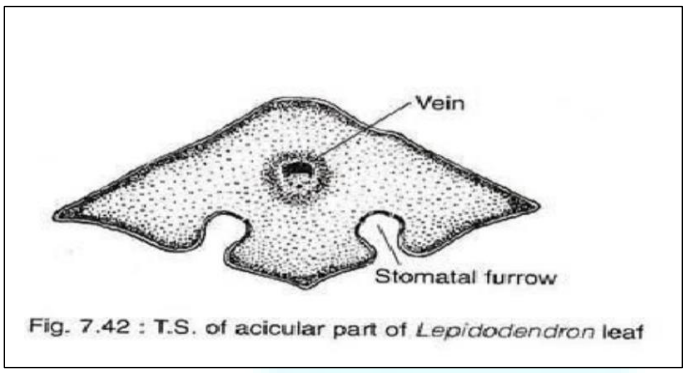


Fig. 7.42 : T.S. of acicular part of *Lepidodendron* leaf

- These scars were termed as parichnos. The parichnos represented secretory or aerating parenchyma cells extending from stem cortex into the leaf.
- A ligular scar or pit was present in the centre of the cushion above the parichnos.

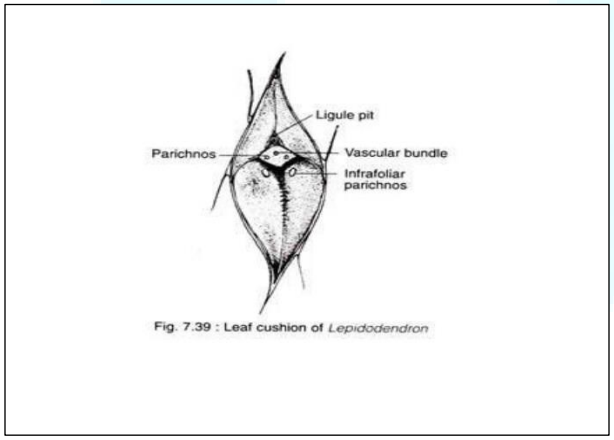


Fig. 7.39 : Leaf cushion of *Lepidodendron*

- The ligule was shrunken and small.
- The mesophylls were present in the central region of the leaf

REPRODUCTIVE ORGAN

- Strobili of Lepidodendraceae were discovered from carboniferous rocks and were named as form genus *Lepidostrobus*.

i. These strobili (lepidostrobus) were elliptical, born terminally on the lateral branches of the crown.
ii. They were 2.5 to 30 cm long and l to 7.5 cm in diameter.
iii. The strobili were heterosporous having microsporophylls and megasporophylls, arranged spirally on the axis of the strobilus.
iv. The sporophylls were ligulate.
v. The sporangia were sessile, elongated and of same size born on adaxial surface near the base of the respective sporophylls.
vi. The microsporangium had many small microspores and the megasporangium had 5-16 megaspores.
vii. The size of the microspores ranges from 0.02 to 0.03 mm in diameter and that of megaspores ranges from 0.5 to 2.0 mm in diameter.

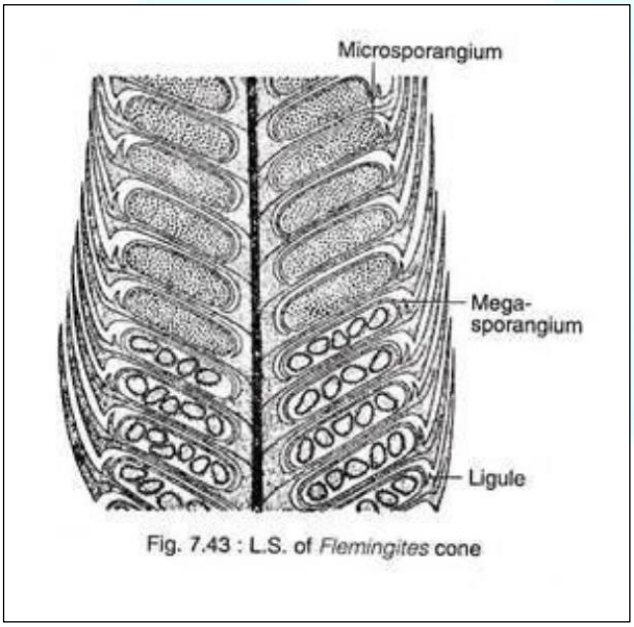


Fig. 7.43 : L.S. of *Flemingites* cone

STRUCTURE OF GAMETOPHYTE

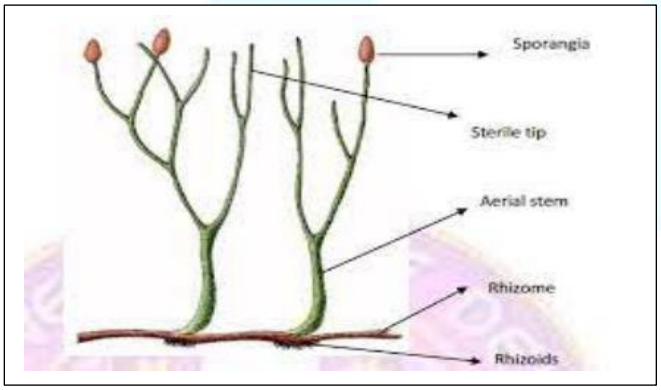
- The male gametophyte has not yet been reported.
- Female gametophyte with archegonia has been reported.
- The megaspore developed into female gametophyte while still within the megasporangium.

DIVISION : PSILOPHYTA
CLASS : PSILOPHYTOPSIDA
ORDER : PSILOPHYTALES
FAMILY : RHYNIACEAE
GENUS : RHYNIA

- Fossil plant.
- *Rhynia major* and *Rhynia gwyne vaughani*.
- Discovered by – Robert Kidston and William Lang (1971).
- Devonian period

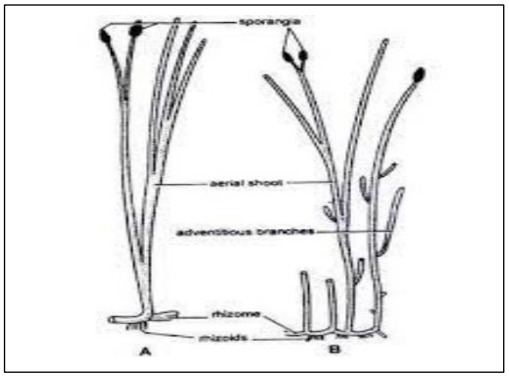
MORPHOLOGY

- Plant Body – subterranean, creeping, cylindrical and dichotomously branched rhizome with dichotomously branched aerial leafless shoots.
- Root absent but tuft of rhizoids develop from rhizome.



SPOROPHYTE

- In *Rhynia gwyne vaughani* aerial shoots has many adventitious branches.
- Aerial branches ends in tapering vegetative apices or pear shaped sporangia.



ANATOMY OF RHYNIA STEM

1. Epidermis:

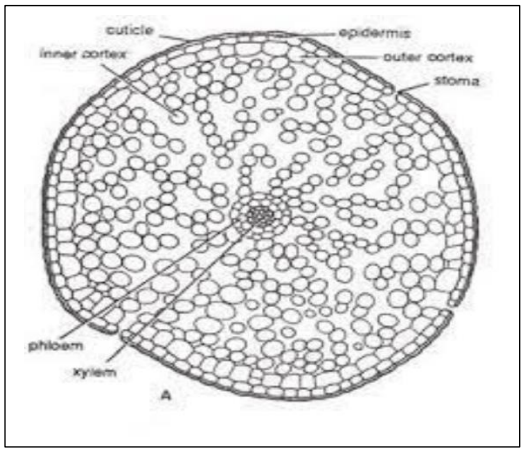
- single layered.
- thick cuticle.
- stomata present.

2. Cortex:

- outer and inner.
- Outer 1-4 layered, compact polygonal parenchymatous cells.
- Inner- spherical, parenchyma cells with intercellular spaces.

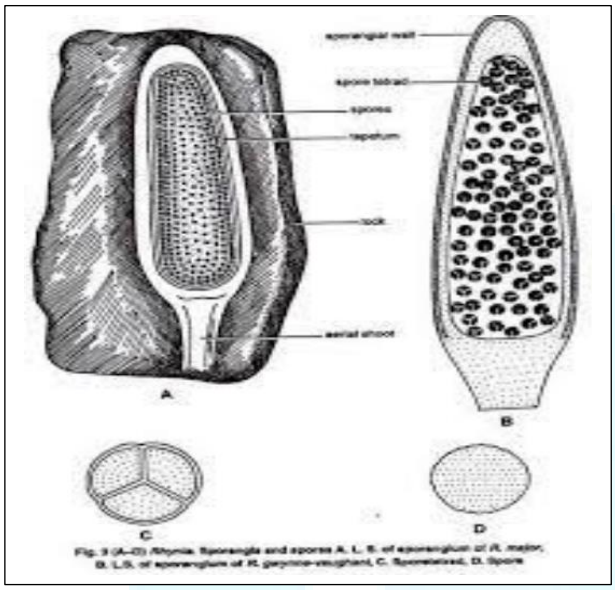
3. Central Cylinder:

- Protostele
- primitive.
- Xylem composed of tracheids with annular and spiral thickening.
- No sieve plates in phloem.
- Endodermis and pericycle absent



REPRODUCTIVE STRUCTURES

- Sporangia were present singly at the tips of some aerial branches.
- Sporangia – oval to cylindrical, with distal pointed and broad basal end.
- Sporangia of *Rhynia major* were larger than *Rhynia gwyne vaughani*



STRUCTURE OF SPORANGIUM

- Sporangium is surrounded by multilayered jacket.
- Outer layer was a cuticularised epidermis.
- Middle layer – 2-3 layers of parenchyma cells.
- Innermost layer – tapetum.
- Large number of spore tetrad in sporangial cavity.
- Spores homosporous.
- No specialised mechanism for dehiscense

GAMETOPHYTE

- Lyon (1957)-Some germinating spores which show multicellular structure developing at the end of germ tube was the indication of the presence of gametophyte in *Rhynia*.

- Merker(1959) is of the opinion that the underground creeping parts of *Rhynia* is the gametophyte but not the rhizome.
- Not much is known about gametophyte of *Rhynia*