BSc Part-I Hons

Paper -1 (Remaining topic)

Topic- Algae+Fungi+Bryophyte+Pteridophyte

Prepared by – Ajai Kishore Sharan

.Topic 12- Stele in Pteridophytes

Topic 13- Heterospory and seed habit

Topic 14- Prothallus of Lycopodium

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Topic-12

Stele in Pteridophytes

The term stele has been derived from a Greek word meaning pillar.Jeffrey (1898), for the first time pointed out the stelar theory from the point of view of the phylogeny. In a vascular plant, the stele is the central part of the root or stem containing the tissues derived from the procambium. These include vascular tissue, in some cases ground tissue (pith) and a pericycle, which, if present, defines the outermost boundary of the stele. Outside the stele lies the endodermis, which is the innermost cell layer of the cortex.

stele has following types:

There are two types of steles

1. Protostele -- In protostele phloem surrounds xylem. The type includes Haplostele, Actinostele, Plectostele, and Mixed protostele.

2. Siphonostele--- In siphonostele xylem is surrounded by phloem with pith at the centre. It includes Ectophloic siphonostele, Amphiphloic -siphonostele, Solenostele,

Haplostele- Xylem surrounded by phloem is known as haplostele. Example: Selaginella.

Actinostele- Star shaped xylem core is surrounded by phloem is known as actinostele. Example: Lycopodium serratum.

Plectostele- Xylem plates alternates with phloem plates. Example: Lycopodium clavatum.

Polystele- Xylem groups uniformly scattered in the phloem. Example: Lycopodium cernuum.

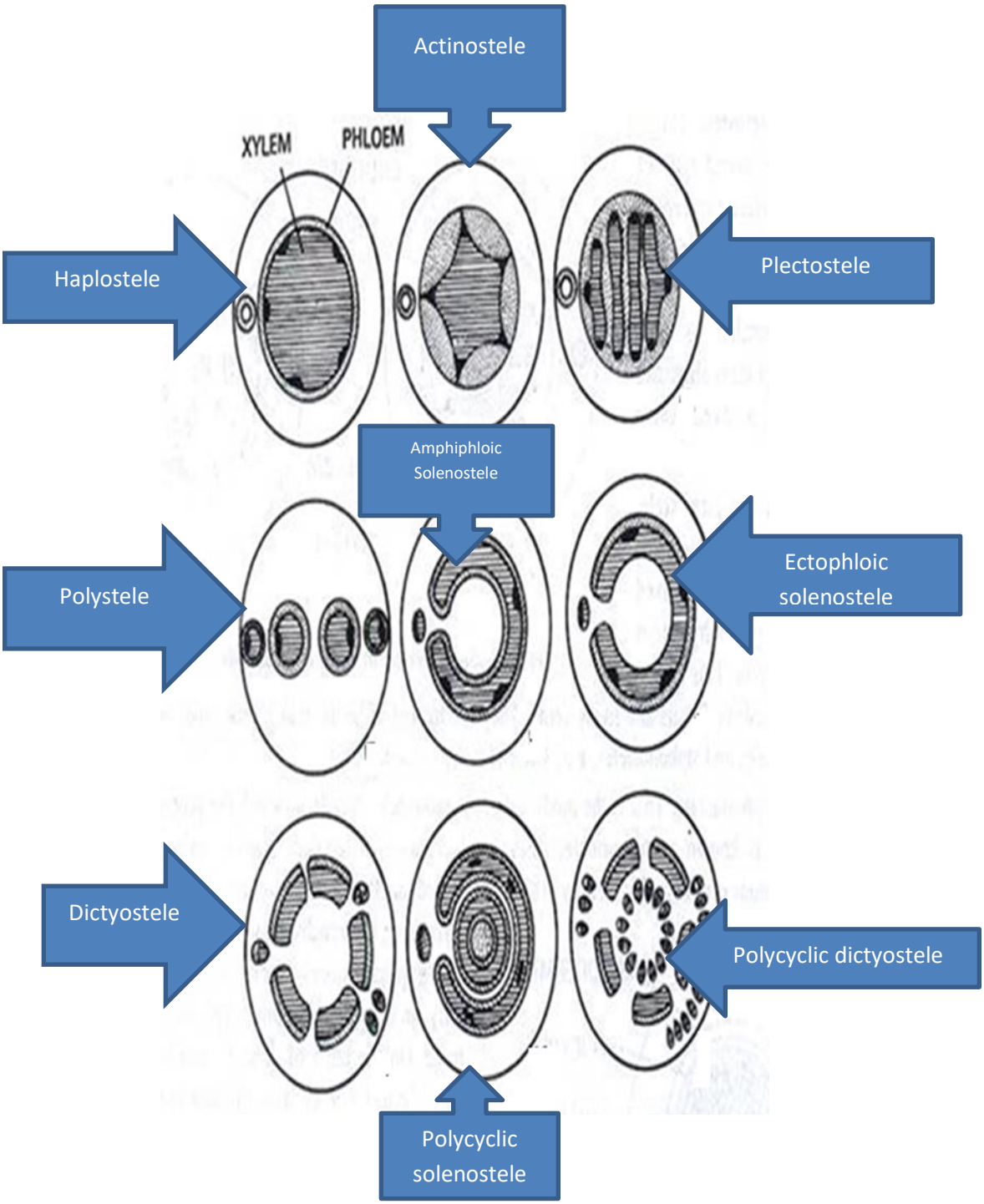
Amphiphloic solenostele-- The phloem is present on both the sides of xylem. The pith is in the centre. Example: Marsilea.

Ectophloic solenostele - Pith is in the centre and the xylem is surrounded by phloem Example Osmunda.

Dictyostele-- The stele is separated into several vascular strands and each one is called meristele. Example: -Adiantum.

Polycyclic solenostele-- In this type of stele if the outer cylinder is solenostelic it is called polycyclic solenostele

Polycyclic dictyostele-- if outer cylinder is dictyostelic it is known as polycyclic dictyostele.



Different Kinds of Stelar organization

Theories regarding origin of Siphonostele from Protostele

(a) Intraxylary or Intrastelar origin:

According to this theory the siphonostele is evolved by the conversion of the central mass of the xylem into parenchymatous pith. This theory is also known as expansion theory and it is supported by Boodle (1901), Bower (1911), Gwynne-Vaughan (1903, 1914). Petry (1914), Thompson and Gewirtz and Fahn (1960) etc.

(b) Extrastelar Origin: This theory is supported by Jaffery (1897, 1899, 1902, 1917). According to him the pith is originated as a result of invasion of the parenchymatous cells of the cortex into the stele. It takes place through the leaf gaps and branch gaps. This theory is also known as invasion theory.

Evolution of Dictyostele from Siphonostele:

Ultimately the siphonostele gives rise to dictyostele. In some of siphonostelic members due to the dwarf axis, the shoot and leaves become over-crowded resulting into the formation of several leaf gaps. The vascular supply given for a leaf from the main stele is called leaf trace.

The parenchymatous region left behind in the main stele after the departure of the leaf trace is called leaf gap. Similarly the vascular supply is also given to branch. Vascular supply given out for a branch from main stele is called branch trace.

The parenchymatous region left out in the main vascular cylinder due to departure of branch traces is called as branch gap forming the dictyostele (Brebner, 1902). This type of stele may further result into polycyclic condition by the formation of several rings.

Topic-13

Heterospory

The production of two types of spores which differ in size by some species is known as heterospory. In modern pteridophytes heterospory is found in eight genera(Selaginella, Marsilea, Salvinia, Isoetes,Stylites, Regnellidium, Pilularia and Azolla).The microspores are produced in Microsporangia but megaspores are produced in Megasporangia.

Origin of heterospory:

There are three evidences to prove the origin of heterospory, These are;

1) Palaeobotanical evidences

2) Developmental studies

3) Experimental evidences.

1) Palaeobotanical evidences:

The fossil record of ancient Pteridophytes found in two species of Calamostachys such as C.binneyana and C.casheana, indicate the initial step that have led to heterospory(Williams and Scott,1894).Whereas, C.binneyana is homosporous but some of the sporangia contain spores of unequal size. C.casheana however shows distinct heterospory. The megasporangia contains aborted spores alongwith large spores. This suggests that abortion of some spore leads to differences in size and number..

2) Developmental studies

The developmental pattern of microsporangia and megasporangia is similar and so is the developmental pattern of microspore and megaspore. It appears that disintegration of spore mother cell probably leads to first incipient heterospory and then to heterospory in heterosporous species.Such development(along with disintegration of spore mother cell) however does not occur in homosporous species.

3) Experimental evidences

Goebel conducted experiment on Selaginella and showed that plants growing under less sunlight produced only Microsporangia but growing in under illuminated light produce only megaspore.

Shattuck(1910) was successful in altering spore size in Marsilea under variable conditions of light,temperature and nutrition.He stated that spore enlargement is proportional to spore abortion. On the basis of Palaeobotanical evidences, developmental studies and experimental results it has been suggested that heterosporous habit arose as a result of

a) Disintregation of certain number of spores and consequent better nutrition of surviving ones.

b) The time of which the sex determinants exert their influence to segregate sexes.

.Selaginella exhibits a remarkable approach to seed habit on account of the following features.

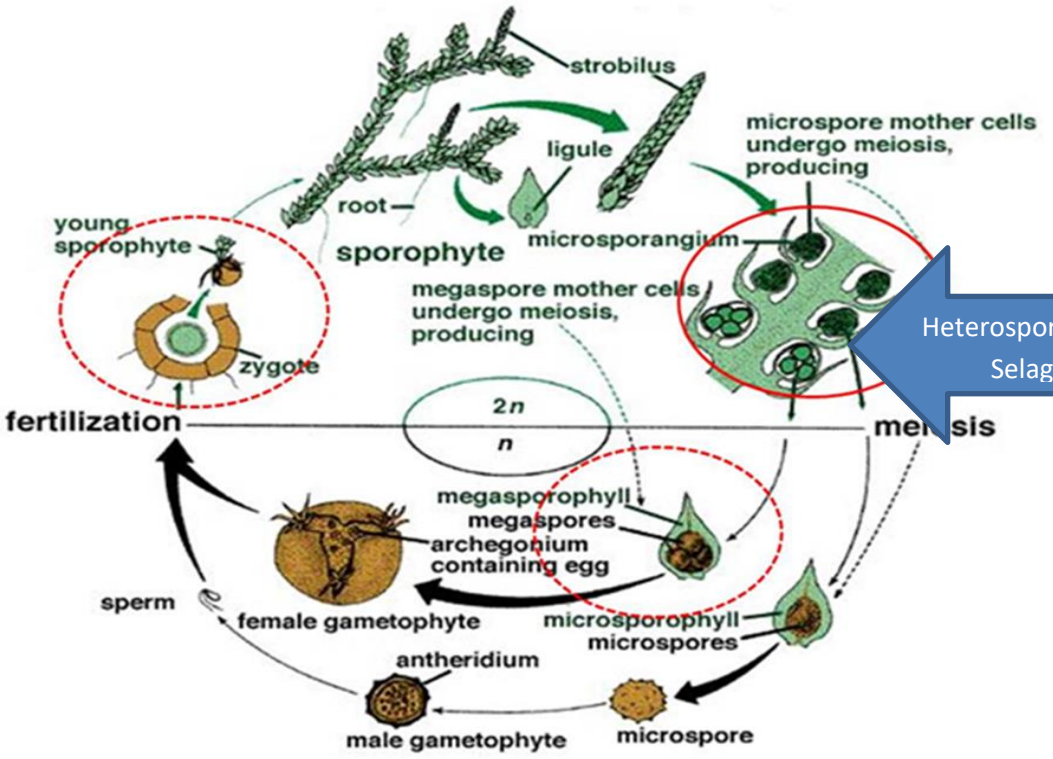
1. It is heterosporous

2. The number of megaspore is reduced to on in S.rupestris and S.monospora.

3 In S.rupestris the megaspore is never shed –a feature similar to a seeded plant.

4. The megaspore germinate inside the megasporangia and produces female gametophyte. Free nuclear division and wall formation during development of female gametophyte is similar to seed plant.

5. Megagametophyte dehisces out of megasporangium wall and hence creates an opening.Microgametophyte enters into the vicinity of the Megagametophyte to bring about incipient pollination. This character appears to be identical to a seeded plant



Heterosporous cone of Selagunella

Topic-14

Prothallus of Lycopodium-

Prothallus in the members of Pteridophytes marks the beginning of gametophytic generation. Lycopodium is homosporous, therefore, spore germinates exosporically to produce gametophytic prothallus, which bears both male and female sex organs (i.e., monoecious and homothalic). The germination of the spores may be immediate in some species (e.g., Lycopodium cernuum, L. inundatum) or after a delay of several years (L. clavatum, L. complanatum).

The spores absorb water before germination. The first division of the spore is asymmetric to produce one small biconvex rhizoidal cell and a large cell. Soon after this division, the exine ruptures along the triradiate ridge. The rhizoidal cell dis-integrates, while the large cell again divides by a vertical wall to form two cells.

Of these two cells, the one nearer to rhizoidal cell is called basal cell which does not divide further. The other cell, by further divisions, forms apical cell with two cutting faces. The further development of gametophyte does not proceed if there is no infection into the basal cell by the mycorrhizal fungus.

The Prothallus of Lycopodium can be of three different types such as :

1. Cernuum Type

These types of gametophytes are found in most of the tropi-cal species (e.g. L. cernuum, L. innunda- tum). Here spore germinates immediately and the gametophyte completes its growth in one season. The prothalli are small, green and aerial with a lower conical basal region buried in the soil. Rhizoids occur in the colourless subterranean (basal) region.

The subterranean region always contains an endophytic fungus. The entire plant body may not be over 3 mm long and are annual in nature. The upper green part is exposed and has a number of irregular leaf-like lobes (photosynthetic) forming a crown. Nutri-tionally, the prothallus is both autotrophic and saprophytic. The sex organs (antheri-dium and archegonium) generally occur near the bases of the aerial lobes.

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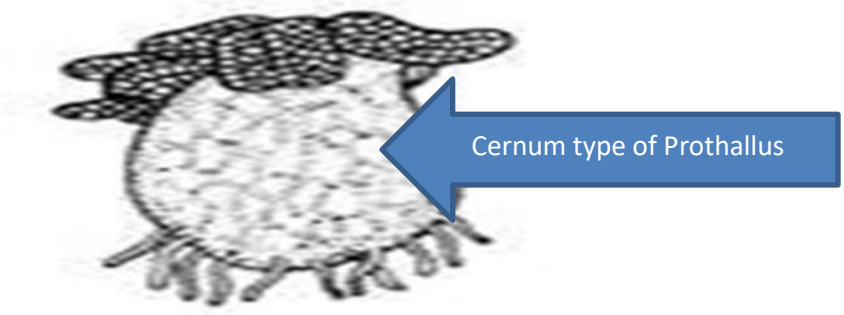
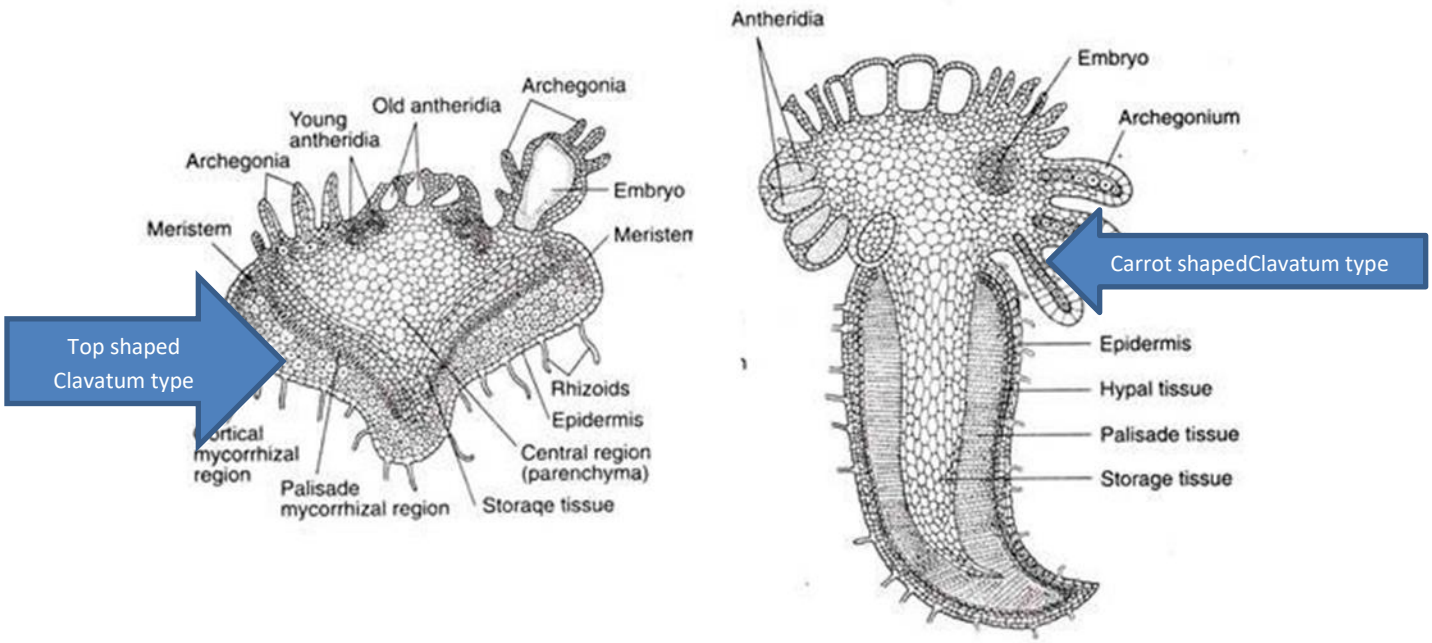


2. Clavatum Type :

In this type, the spore germination is delayed for a long time (one to many years), thus the prothallus has a longer lifespan. Here the prothalli are fleshy, non-green, totally saprophytic and completely subterranean and perennial in nature. Development takes place beneath the surface of the ground or within a layer of humus.

The prothalli are large and may be up to 2 centimeters in length. They may be top-shaped with a convolute margin (L. clavatum) , or carrot- shaped (L. complanatum and L. annotinum)



The top of the prothallus are lobed and the sex organs and the growing embryos are located on these lobes. Although all the gametophytic cells are parenchymatous, the tissue differentiation is noted in the lower portion.

The central region constitutes storage tissue made up of vertically elongated cells. The radially elon-gated, closely packed chlorenchymatous cells constitute the palisade mycorrhizal layer. External to the palisade tissue is the cortical mycorrhizal region. The epidermis is present outside the cortical mycorrhizal region, some of the epidermal cells produce rhizoids..

3. Phlegmaria Type :

Here the pro-thalli are aerial but saprophytic in nature, grow on tree trunks below a coating of humus. This type is found in epiphytic species of Lycopodium (e.g., L. phlegmaria). Here the spore germination is immediate and the gametophyte grows for only one season.

The prothallus consists of a short, tuberous cen-tral part from which a number of colourless, slender and cylindrical branches develop in an irregular fashion. These branches bear sex organs and they are usually surrounded by glandular hairs called paraphysis.

There are also some intermediate types in between these forms. For example, the gameto-phyte of L.selago is in-between the Cernuum and Clavatum types. Here spore germination and gametophyte development take place immediately like Cernuum type.

However, the spores germinate after a long resting period if the spores are deeply buried in the soil. As a result a subterranean saprophytic Clavatum type of gametophyte is formed. Hence more than one type of prothalli may occur in the same species.