established as morphological units, is doubtful."

HETEROSPORY AND SEED HABIT

Heterospory. The sporangia show greater specialization than those of ferns. They are differentiated into micro and megasporangia. The microsporangia contain microspores whereas megasporangia contain megaspores in them. Each microsporangium contains a large number of microspores whereas each megasporangium contains usually only four megaspores. The condition of the production of two kinds of dissimilar spores, differing in shape and size in the same species, is termed **heterospory.** When one kind of spores are present, *e.g., Equisetum* and ferns, the condition is said to be **homospory.** According to modern Pteridologists the heterospory is found in seven genera-*Selaginella, Isoetes, Marsilea, Salvinia, Azolla, Regnellidium* and *Pilularia.* Here one thing may be noticed that the microspores develop male gametophytes whereas the megaspores germinate into the female gametophytes which may also be called as microgametophytes and megagametophytes. In the case of homospory the sex may be differentiated only at the gametophytic stage, but here the sex may be differentiated even at the sporophytic stage by the presence of small and large sized microspores which produce antherozoids and eggs respectively.

The differentiation of microspores and megaspores and their dependence upon the sporophyte has certain advantages. The gametophytes of the ferns are, however dependent for their nutrition upon soil and environmental condition, whereas in the case of *Selaginella*, as far as the nutrition of gametophytes is concerned they derive it from the sporophyte, and therefore they are more independent to the external condition than those of ferns.

Seed habit. The condition of heterospory in *Selaginella* constitute one of the most important phases in the evolution of the plants. In certain species of *Selaginella* only one megaspore develops within the megasporangium. The highest evolved species, *i.e., S. apoda* has advanced almost upto the rank of a seed plant. Here, the megaspore remains within the sporangium ; it itself fertilizes and this way for the first time the gametophyte of *Selaginella* shows complete dependence of the gametophyte upon sporophyte as in angiosperms.

Biological importance of heterospory. The phenomenon of heterospory is of great biological advantage because of the fact that a large megaspore which contains female gametophyte derives its food from the sporophyte, and is independent of the external conditions as might interfere with the growth of a free living gametophyte. It thus forms better starting point for the new embryo, than an independent green prothallus which has to manufacture its own food.

In brief, the origin of seed habit is associated with the following important prerequisites:

1. The production of two kinds of spores (*i.e.*, heterospory).
2. The retention and germination of the fertilization of the egg and embryo formation, which is still within germinating megaspore.
3. Development of only one megaspore per megasporangium.

In *Selaginella*, there is remarkable approach to the seed habit, on account of the following important features:

1. *Selaginella* shows heterospory.
2. The megaspore usually germinates within the megasporangium and is not shed for a time which may very from species to species.
3. There is reduction to one megaspore in some species, *e.g.*,S. *rupestris* and S. *monospora* and a confirmed tendency to reduction in others.

It becomes quite evident that *Selaginella* has considerably advanced towards the seed habit in a few species, but its approach to the true seed is not complete due to the following features:

1. The megasporangium lacks an integument or covering.
2. The permanent retention of the megaspore within the megasporangium has not become established.
3. After the development of the embryo, the resting period is not there.

GENERAL CHARACTERS OF PTERIDOPHYTES

Occurrence

1. Most pteridophytes are terrestrial and grow in moist and shady places while some flourish well in open, dry places especially in xeric conditions. Some pteridophytes are aquatic and some are epiphytes.

The plant body (The adult sporophyte).

2. The sporophyte is the conspicuous and familiar plant body. It develops from the zygote, a diploid cell which results from the fertilization of the egg and antherozoid.
3. The sporophytic plant body remains differentiated into true roots, stem and leaves. Some primitive members lack true roots and well developed leaves (*e.g.*, in Psilophytales and Psilotales).

4. The branching of the stem may be of monopodial or dichotomous type.

5. There are two main categories of form and structure, one category comprises of megaphyllous types, in which the leaves are large in relation to the stem (*e.g.*, ferns); the second comprises of microphyllous types in which the leaves are quite small in relation to the stem (*e.g.*, Lycopods and Horse-tails).

6. All the vegetative parts of the sporophyte possess vascular supply.

Reproduction.

7. The sporophytes reproduce by spores which are produced within spoangia.

8. In some pteridophytes the sporangia develop on stems (*i.e.*, cauline in origin) while in other they are borne either on the leaves (foliar) or in the axils of the leaves. The leaves that bear sporangia are known as sporophylls.

9. The sporophylls may be widely scattered on a plant (*e.g.*, ferns) or may be clustered in definite areas and structures called cones or strobili (*Selaginella, Equisetum*).

10. In certain pteridophytes the sporangia are produced within specialized structure, the sporocarps (*e.g., Marsilea, Salvinia, Azolla*).

11. The sporangium in all pteridophytes, is initiated by the laying down of a cross-wall in a superficial cell or a group of cells. Since this wall is periclinal each initial cell is divided into an outer and inner daughter cell. If the sporogenous tissue is derived from the inner daughter cell, the sporangium is described as "**eusporangiate**" (*e.g.*, in most of pteridophytes) and if from the outer as "**leptosporangiate**" (*e.g.*, in advanced pteridophytes).

12. The sporophyte plant may be homosporous (*e.g., Lycopodium, Dryopteris*) or heterosporous (*e.g., Selaginella, Isoetes, Marsilea*).

The gametophyte.

13. The spores on germination give rise to the haploid gametophytes or prothalli which are small and inconspicuous. The gametophytes in some pteridophytes are subterranean and in others they are retained within the resistant wall of the spore. It is notable that wherever the gametophyte is retained within the spore the spores are of diffrent sizes (heterosporous). The larger megaspores give rise to female prothalli which bear only archegonia, and the smaller microspores giving rise to male prothalli which bear only antheridia.

14. The gametophyte or prothallus bears the sex organs, antheridia and archegonia. Normally, the gametophytes formed from the homospores are monoecious, that is both antheridia and archegonia are borne on the same gametophyte or prothallus. The gametophytes formed from the heterospores are dioecious, *e.g.*, the antheridia and archegonia develop in separate male and female gametophytes,

The antheridia.

15. The antheridia may be embedded in the gametophyte or they may project from it. The embedded antheridia are commonly found in eusporangiate pteridophytes while the projecting ones are usually found in the leptosporangiate ferns.

The mature antheridium is globular and consists of an outer sterile wall inside which are found a large number of androcytes. Each androcyte metamorphoses into a single motile antherozoid.

The archegonia.

16. The archegonia are flask-shaped. Each archegonium consists of a basal swollen, embedded portion the venter and a short neck. The venter encloses the egg and ventral canal cell. The neck contains the neck canal cells.

At maturity the apical cells of archegonium separate, the neck canal cells disintegrate forming a passage for antherozoids to reach the egg.

Fertilization.

17. In all cases the fertilization is accomplished by the agency of water. With the result of the fusion of male gamete and female egg a diploid zygote (2x) is formed.

The embryo (The young sporophyte)

18. The zygote undergoes repeated divisions to form a new sporophyte. The young sporophyte remains attached to the gametophyte by means of a foot and draws nourishment from the prothallus until it develops its own stem, roots and leaves. The sporophyte is dependent on the gemetophyte only during its early stages.

EUSPORANGIATE AND LEPTOSPORANGIATE SPORANGIA

The sporangium. The sporangium, in all pteridophytes is initiated by the laying down of a cross-wall in a superficial cell or group of cells. Since this wall is periclinal (*i.e.*, parallel to surface) each initial cell is divided into an outer and inner daughter cell. If the sporogenous tissue is derived from the inner daughter cell the sporangium is described as **'eusporangiate'** and if from the outer, as **'leptosporangiate'.** In leptosporangiate forms, the sporangium wall, stalk and the spores, are derived from the outer daughter cell, but in eusporangiate forms, the adjacent cells take part in the formation of part of sporangium wall and the stalk. In eusporangiate form the sporangium is large and massive, the wall is several cells in thickness and the spore content is high. In leptosporangiate forms, the sporangium is small, the wall is one cell in thickness and the spore content is low. Of these two types, the eusporangiate is primitive and the leptosporangiate advanced.

Eusporangiate sporangium	Leptosporangiate sporangium
A superficial cell divides by a periclinal wall forming an outer and inner daughter cell. The sporogenous tissue is derived from the inner daughter cell.	A superficial cell divides by a periclinal wall forming an outer and inner daughter cell. The sporogenous tissue is derived from the outer daughter cell.
The adjacent cells are involved in the formation of part of the sporangium wall and the stalk.	The sporangium wall and the stalk, as well as th spores are derived from the ouuter cell.
The sporangium is large and massive; the wall is several cells thick and the spore content is high.	The sporangium is small, the wall is only one cell thick and the spore content is low.
Primitive.	Advanced.

WORK ON PTERIDOPHYTES IN INDIA

Lycopodiaceae

Chaudhary (1937) reported 33 species of *Lycopodium* from India, ha[illegible]