VIII DISCUSSION

Discussion :

Pteridaceae with about 55 genera is one of the advanced family of Filicean ferns along with Platyzomaceae, Dipteridaceae, Polypodiaceae, Vittariaceae, Davalliaceae, Aspidiaceae, Aspleniaceae, Parkeriaceae and Blechnaceae. Though they are considered as higher homosporous ferns atleast certain of these especially the Platyzomaceae. Dipteridaceae and certain Pteridaceae are in many respects more primitive or stand at the lower stage of evolution.

Pteris is the type genus of family Pteridaceae and is divided into Eupteris (Newman) and Litobrochia (Presl.) The Eupteris section is characterised by epidermal appendages as scales, divided leaf trace, venation open, lower indusium absent, receptacle superficial and sporangia mixed. The Litobrochia section includes the species with dermal appendages as scales, reticulate venation with no free veinlets, solenostelic with medullary system and undivided leaf trace, lower indusium absent, receptacle superficial and widened and sporangia mixed.

According to Bower's concept of evolution which is accepted by all modern pteridologists the creeping elongated rhizome is primitive condition. Pteris vittata studied here stands at lower level of evolution in this respect as it is characterised by creeping, almost unbranched rhizome. As in all other filicales the roots are well defined. The root-hairs are septate, dark colored.

The leaf form in higher Filicales is highly varied. The most primitive fern leaf is interpreted as a highly dissected multicompound one, the dissections being on a dichotomous plane and having small narrow pinnules either having a single median vein or a dichotomously branched vein. Such a leaf is supposed to be nearest to the primitive freely branched branch system which has undergone planation. Evolution is traced through lesser degree of dissection of lamina leading ultimately to a simple lamina by progressive assemblage. It seems that among Filicean ferns in general the pinnate pattern is primitive being predominant in all presumed primitive families like Gleicheniaceae, Schizaeaceae, Osmundaceae etc. (Bierhorst 1971). This conclusion has also been reached by Wagner 1952 and by R. Tryon (1964). Genus Pteris is characterised by pinnate or bipinnate fronds. Thus it stands at intermediate stage in the evolution of fronds. P. vittata with pinnate fronds is also at the intermediate stage in evolution of fronds.

In venation pattern, in accordance with leaf evolution, it is interpreted as progressing from dichotomous to pinnate having free veins to anastomised veins. The genus Pteris has got sps. with reticulate as well as open venation and those with slight union of veins also. P. vittata studied here has got open dichotomous venation with marginal

loops connecting the vein endings. The pinnules have an intramarginal vein formed by these connecting loops. Thus it shows a step advanced that the primitive pinnules with open dichotomous venation.

Dermal appendages in ferns are protectory in nature and have possibly evolved as a consequence to the exposed terrestrial habit. During evolutionary history, simple type of epidermal protrusions evolved, possibly papillate hairs, on the exposed surface. The sequence of evolution lead to well formed palae. The palae with broad base and attachement throughout its width to the epidermis of the organ are of primitive type. P. vittata has got simple scales with smooth margin, broad attachment and devoid of marginal hairs. The rachis of P. vittata has got narrow elongated scales as epidermal outgrowth. These scales are 3 - 4 cells broad at the attachment region. According to evolutionary sequence it stands at slightly higher level than those forms with simple hairs as epidermal outgrowths.

The eusporangiate type of massive sporangia borne singly or in small group and having no definite dehiscence mechanism are most primitive among ferns as shown by Bower (1923 - 28). Evolution has been towards simplification of the sporangia and in having them in large groups or restricted areas on the frond at first and later all over the lower surface of the frond i.e. acrostichoid condition.

The leptosporangiate type of sporangia are derived from eusporangiate sporangia. Thus the primitive leptosporangiate ferns have massive sporangium with thick stalk, multi-layered wall and large spore-output. During evolutionary progression the sporangia have become less massive, one cell thick wall, a distinct slender stalk and with a limited spore-output. Pteris vittata has pear shaped sporangia with wall consisting of single layer of cells with well defined annulus and stomium and a stalk consisting of two rows of slender elongated cells. The spores are large in size and having a limited number of spores i.e. 16 - 20 spores per sporangium. Thus in sporangial character it has reached the advanced stage in leptosporangiate ferns.

The morphology of the sorus and the position that the sorus occupies on the leaf has been regarded as the principal criterion to asses phylogeny and to group the ferns into taxa. With the advancements made in the fields of anatomy, palynology, gametophytic and biochemical studies the soral morphology is found to be unsuitable principal taxonomic crieterion. Still soral morphology continues to occupy its unique position in fern taxonomy.

Bower has shown that the most primitive condition among ferns is one in which solitary large sporangium is formed at vein tip. The aggregation of sporangia to form sori is a derived condition as also their protection by

indusia. The more primitive condition is obviously a small nearly circular sorus restricted to the tip of the vein and with all the sporangia maturing and developing simultaneously. A transition to a mixed condition has occured during evolution. Also the sorus spread along the vein from a condition where it was restricted to a point of the vein tips. The ultimate step in this process of spreading is the acrostichoid condition in which sporangia are found spread all over the leaf surface and are not restricted to the veins.

In Pteris the sporangiaare borne on the vein tips as well as on the loops connecting the vein endings thus forming a continuous coenosorus along the margin of the pinnules. Thus the soral condition in Pteris and so also in P. vittata is at advanced stage of evolution.

Another evolutionary significance in sorus of Pteris is the presence of indusium. Indusium is developed secondarily during evolution presumably for protection of the sorus. A typical indusium is present only in one of the major lines of evolution of modern ferns i.e. cyatheoid line in which it has developed as a special dermal appendage. In Lyqodiaceous derivatives to which Pteris belongs the leaf margin becomes modified as an indusium. In Pteris there is no lower indusium and the upper indusium is actually marginal in its origin appearing as a direct continuation of marginal segmentation of the blade.

The receptacle in Pteris is elongated without any marked convexity. The sporangia arise superficially from lower surface of the leaf blade. It is of mixed type from an early stage of development. Thus with regard to sorus morphology it has attained advanced state.

The spores in Filicales are also characteristic in shape, size, exine ornamentation and the recent work on spore morphology by Bir, et. al, (1976) have shown that various taxa and even the species of ferns can be distinguished from spore morphology alone. It is now considered as a very significant tool in understanding phylogeny and evolutionary trends among modern ferns. (Nayar and Kaur 1968). The primitive spore form among fern is the trilete or tetrahedral type and a monolete or bilateral form is derived from it. Most of the advanced ferns have monolete type of spores. In the schizaean derivatives to which Pteris belongs, the bilateral forms have evolved late in evolutionary sequence and hence many of the genera are characterized by trilete spores. Pteris having trilete, tetrahedral type of spores is thus primitive in evolutionary sequence. With regard to exine ornamentation the primitive ferns apparently had spores having a smooth exine or perhaps having a negative ornamentation. Advancement is indicated by the exine bearing characteristic excrescences. During evolutionary progression the excrescences became more and more prominent. The Pteroid ferns exhibit a progression

from rugulate to tuberculate to reticulate excrescences. In this series P. vittata, stands at higher level with exine having raised reticulum with blunt spines in between the lumina.

Anatomical Characters :

The vascular system of higher ferns range from protosteles-amphiphloic-siphonostele to dictyosteles with amphicribal bundles in majority of higher ferns. A relatively simple protostele with or without a degree of medullation is assumed to be ancestral to more elaborate steles of the Filicales. Bierhorst 1971 has recognized four stages of specialization in steles of Filicales. According to him a solenostele with a complete layer of internal and external phloem and endodermis and with well defined leaf gaps is the third stage leading to dictyostele and polycyclic dictyostele. This third stage appears in varying degrees of expression in Cyatheaceae, Pteridaceae, Anemiaceae etc. In so large a genus as Pteris including ferns sometimes with long creeping rhizomes as in P. grandifolia, sometimes with a compact, upright habit as in P. cretica or P. podophylla variations in vascular structure are to be expected. According to Bower (1935) a general comparision relates them all as natural derivaties from solenostele with an undivided leaf trace to a complicated polycyclic dictyostele. In P. vittata the vascular cylinder in mature parts of rhizome is solenostelic

while in younger parts of rhizome where leaves are slightly crowded it is dictyostelic. Thus in anatomy of rhizome it stands at the intermediate stage in Filicales.

Nayar (1971) differs markedly from other pteridologists in his concept of fern evolution. He agrees with other authors that a protostele is primitive. Still he maintains that atleast in some groups a solenostelic condition is derived from a dictyostelic condition. So according to Nayar also soleonstele is an intermediate stage in evolution of stele.

The leaf trace in Pteris varies from an un-interuppted horse-shoe to two straps originating separately from the stele of the axis. According to Bower (1935) the primitive leaf trace was structurally every much like the protostele of the axis with a single protoxylem group. That losing its cylindrical form it became flattenedd with various modification of outline. In leptosporangiate ferns it adopted the form of an adaxially concave strip curved like a horse-shoe as seen in transverse section and with a plurality of protoxylem-group on the adxial face of the xylem. In most advanced types of leptosporangiate ferns, this strip become disintegrated as a divided leaf trace. In the present species of Pteris i.e. P. vittata the rhizome is solenostelic and the leaf-trace comes out bodily as a sector of the vascular ring, leaving a wide leaf gap.

The trace widen out upward into a broad more or less gutter shaped. Thus phylogenetically the leaf trace in P. vittata is of intermediate type.

The pinna trace in P. vittata is seen cut off from the horse shoe-shaped vascular-strand of rachis by obstriction from the margin of the stele. Such a marginal origin of pinna-trace according to Bower (1935) is held to be the primitive method of supply of laterad pinna and it is characteristic of leaves of moderate size.

The usefulness of the stomatal type, a valuable character in plant taxonomy is shown by a number of authors. (Kondo 1962, Kondo and Toda 1956, Thurston 1969). Detailed studies of the stomatal character in Pteridaceae, Aspidiaceae, Polypodiaceae etc. of Filicales have already given promising results. (Van cottom 1968-70) Kondo 1962 has given four types of stomata based on the number of subsidiary cells.

Type - I - Has no subsidiary cells
Type - II - has one subsidiary cell
Type - III - has two subsidiary cells.
Type - IV - has two or three cells developed laterally from the stoma.

He has given phylogenetic significance of these types also. The first type is the characteristic of most primitive ferns and the other lower vascular plants. Type II is the characteristic of slightly advanced ferns while type III & IV are the characteristic of most specialized ferns. P. vittata has got stomata restricted to lower surface of the leaf lamina and each stomata has single subsidiary cell oriented at right angles to the longitudinal axis of stomata i.e. polocytic type. Thus in stomatal character also P. vittata stands at intermediate stage.

Thus according to Bierhorst's (1971) statement family Pteridaceae though it is one of the advanced family of Filicales at least in some respects it stands at lower level of evolution. This has been supported by the present morphological and anatomical studies of P. vittata. This sps. of Pteris stands at lower level of evolution with respect to morphology of rhizome, in possession of trilete spores and origin of pinna-trace. In soral morphology it has reached the advanced level. Anatomically it stands at intermediate stage of evolution.