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NAAC ACCREDITED 'A' GRADE

Topic:	GYMNOSPERMS
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PROGYMNOSPERMS

Meaning of Progymnosperms:

Some fossils of Devonian and Carboniferous periods of Palaeozoic era have been found which were earlier thought to belong to pteridophytes (Primofilices) but are now thought to be nearer to gymnosperms although not of full gymnospermous status.

When connections were found between two such fossils i.e. fern-like fronds of *Archaeopteris* and gymnosperm-like trunks of *Callixylon*, these members were grouped as a class of gymnosperms, the Progymnospermopsida by Beck (1960). According to Bonamo (1975) Progymnosperms are the **"plants exhibiting the features of pteridophytes reproduction and gymnospermic anatomy".**

Progymnosperms are thought to form a link between the Psilophytopsida (of pteridophytes) and the gymnosperms. Some palaeobotanists consider Progymnosperms to represent the origin of both Cycadales and Coniferales. Progymnosperms are actually not true gymnosperms and are still classified by some botanists as pteridophytes.

Stewart (1981) considers the discovery of Progymnospermopsida as "a landmark event which has enhanced our understanding of vascular plant evolution and more than any other finding" after the discovery of Rhyme flora and pteridosperms.

Classification of Progymnosperms:

Beck (1960) divided the class Progymnospermopsida into following three orders, and the same classification has been followed by Spome (1974) and Sandra Holmes (1986):

(i) Pityales:

- This order is equivalent to order Archaeopteridales (of subclass Primofilices, class Filicopsida) of pteridophytes.
- Plants had moderately complex lateral organs.
- Their xylem was compact.
- These have been considered as the possible ancestors of conifers, e.g. *Archaeopitys*, *Archaeopteris, Callixylon, Pitys*.

Archaeopteris halliana from the Devonian

(ii) Aneurophytales:

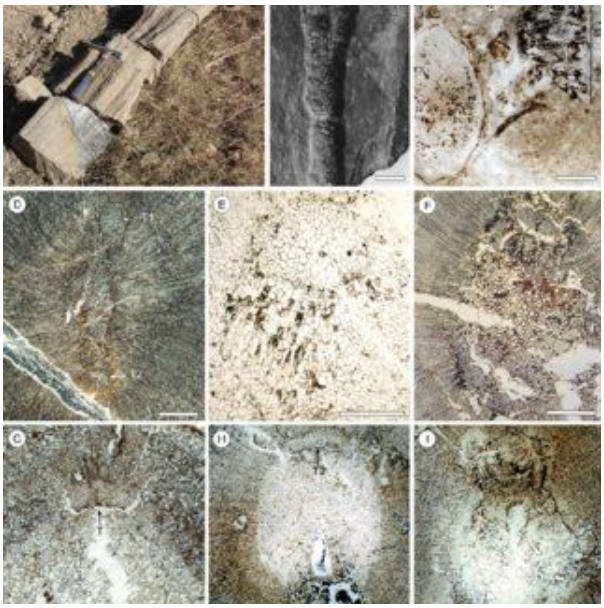
- This order is equivalent to order Protopteridales (of subclass Primofilices, class Filicopsida) of pteridophytes.
- Plants had complex pinnate lateral organs.
- Their xylem was dissected by several small medullary rays and considered pycnoxylic.

- They bore apparently leafless lateral branch systems which ultimately terminated in small, sparsely-branched, dichotomous branches.
- The branching pattern was either helical (*Aneurophyton*) or decussate (*Tetraxylopteris*) or in one plane.
- The sporangia were borne terminally on pedicles forming clusters or panicles.
- No representative is known to be heterosporous.
- These have been considered as the possible ancestors of cycads, e.g. *Rellimia, Tetraxylopteris*.

Rellimia hostinensis

(iii) Protopityales:

- Represented by a single genus *Protopitys*, this group is considered by paleobotanists as the possible ancestor of Pityales and Aneurophytales.
- Its leaf traces show affinities with cycads while its wood suggests affinities with conifers.
- Due to the presence of some early stages of heterospory, this may also belong to pteridophytes, e.g. *Protopitys*.



The early carboniferous progymnosperm *Protopitys*

Phylogenetic Consideration of Progymnospermopsida:

Some of the characters shared commonly by all the three orders (Pityales, Aneurophytales and Protopityales) of Progymnospermopsida include their:

(i) Woody habit,

(ii) Complex system of branching,

(iii) Pycnoxylic secondary wood made of closely packed tracheids and narrow rays,

(iv) Dichotomous and pinnate pattern of fertile organs and

(v) Terminal sporangia.

Since *Protopitys* occurred in Lower Carboniferous period, *Rellimia* and *Aneurophyton germanicum* in Middle Devonian and genera such as

Tetraxylopteris and *Archaeopteris* in Upper Devonian age, Bonamo (1975) opined that direct-line evolution of these genera appears to be impossible.

Most probably the evolution did not progress from one order to another, and chief morphological characters evolved quite independently from one another. On the basis of the similarity in the basic organisation of the fertile organs, **two independent lines of evolution may be traced among members of Progymnospermopsida.**

One line is exemplified by ***Rellimia* to *Tetraxylopteris* type** of Aneurophytales, in which the fertile organs were very complex and the number of sporangia was very large.

The **other line** of evolution is exemplified by ***Rellimia* to *Archaeopteris* type**, in which the reduced type of fertile organs were present, and the sporangia were quite few in number.

Although, much can still not be said with certainty about the evolution of progymnosperms, some probable evolutionary trends of this group include:

(i) Three-dimensional to planted branching systems,

(ii) Un-webbed to webbed leaves or terminal appendages,

(iii) Spiral to opposite decussate phyllotaxy,

(iv) Homospory to certain evidences of heterospory, and

(v) Protostelic to siphonostelic type of anatomy.

Paleobotanists, such as Bonamo (1975) and Beck (1976) opined that gymnosperms have evolved from progymnosperms. The primitive aspects of Aneurophytales of Progymnosperms are well- established.

- These members extend farthest back in the geological column and
- include three- dimensional branching system,
- terminal sporangia and
- a protostele.
- These members must have led to eustele found in Archaeopteridales (progymnospermous order), conifers and cycads.

Scheckler (1978) also advocated for the evolution of the Archaeopteridales from some protostelic ancestors.

Close relation between Aneurophytales and Archaeopteridales is also evidenced by the discovery of ray tracheids and grouped pittings in the secondary wood of Archaeopteris of Archaeopteridales and Triloboxylon of Aneurophytales.

Some palaeobotanists also believe that Aneurophytales of Progymnosperms gave rise to Upper Devonian and Carboniferous members of Pteridospermales via Calamopitaceae of Palaeozoic Pteridosperms.

Beck (1976) advocated that conifers originated from Archaeopteridales of progymnosperms.

Such a view came because of the striking similarities between the secondary wood of *Callixylon* of Pityales and lateral branch system of Archaeopteridales and those of Coniferales.

Taylor (1981) and supporters, however, believe that **"Archaeoptendales may be closely related to an enigmatic group of plants referred to as the Noeggerathiales**". Members of Noeggerathiales are regarded by

Taylor (1981) “as closely allied to sphenophytes by some and associated with ferns by others.”

The complex problem of ancestory of gymnosperms has been tackled in several directions by botanists.

Some are of the opinion that Aneurophytes form a complex of progymnosperms from which two lines diverged, one leading to the Upper Devonian – **Lower Carboniferous-Cycadophyta (pteridosperm) line** and the other to **the Upper Devonian-Lower Carboniferous Archaeopteris-Coniferophyte line**. Beck (1976) analysed this problem slightly differently.

He mentioned that although on the basis of available studies, it appears that Aneurophytes and Archaeopterids belong to two clearly-defined lines of evolution, yet the “**progymnosperms may comprise one branching line of evolution from which two mam lines of evolution among gymnosperms (Cycadophytes and Coniferophytes) originated”.**

If these are the facts, **“the gymnosperms could be considered to be of monophyletic origin”** (Beck, 1976).