## Origin of Pteridophytes

There are two main theories regarding the origin of pteridophytes: one suggesting their origin from algae and the other from bryophytes. These theories are based upon comparative morphology of living and fossil forms.

### Origin from Algae

The proponents of algal origin of pteridophytes consider that similarities between pteridophytes and bryophytes are because of parallel evolution and not because of phylogenetic connection between the two. **Arnold** and **Church** consider that pteridophytes have evolved from **brown algae** (*Phaeophyta*) which grew near the upper limits of the tide levels and migrated to land. **Church** suggested the origin of pteridophytes from **green algae**. There are two views regarding this origin. According to **Bohlin, Fritsch, Lotsy** the pteridophytes evolved from a chaetophoraceous alga. However, **Fritsch** (1945) is of the view that pteridophytes came from an erect parenchymatous alga that exhibited isomorphic alternation of generations.

### Origin from Bryophytes

The bryophytes and pteridophytes are alike in so many features that there is good reason for thinking that there is a phylogenetic relationship between the two. These common features include:

i. Both exhibit terrestrial habit.
ii. The gametophytes in both are thallose.
iii. The sex organs, antheridia and archegonia exhibit similarity in development and structure.
iv. The development of embryo within the wall of venter.
v. Partial parasitism of mature sporophyte upon gametophyte. In pteridophytes the embryo is dependent upon gametophyte during earlier stages of development.
vi. The heteromorphic alternation of generations.

There are two schools of thought regarding origin of pteridophytes from bryophytes. According to one, the two are divergent evolutionary lines evolved from hypothetical primitive archegoniate type land plants. The other school of thought advocates the origin from true bryophytes like *Anthoceros*. It is called **anthocertotean origin**.

### Anthocertotean Origin of Pteridophytes

The theory was put forward by Campbell (1895). According to this theory the pteridophytes originated from *Anthocerotae*. The sporophyte, sex organs and embryos of anthocerotes have much common with their corresponding structures in pteridophytes.

i. **Evolution of Sporophyte:** It has been suggested that if meristem present at the base of anthocerotanean sporophyte is shifted to the apex, this would make possible an initiation of dichotomous branching by the meristem and restriction of spore formation to branch apices. The columella might metamorphose into a central conducting strand. Such a plant would resemble very closely the sporophyte of certain *Psilophytales*. Sporophytes have been

found in which there is a restriction of spore formation to the distal end and in which the columella was differentiated into a conducting tissue in the lower portion.

The opponents of the theory were of the view that there is a wide gap between the anthocerotean type of sporophyte and root-bearing, free-living sporophytes of pteridophytes. However, the discovery of *Psilophytales* in which the plant body is a rootless, leafless, dichotomously branched axis invalidates this objection.

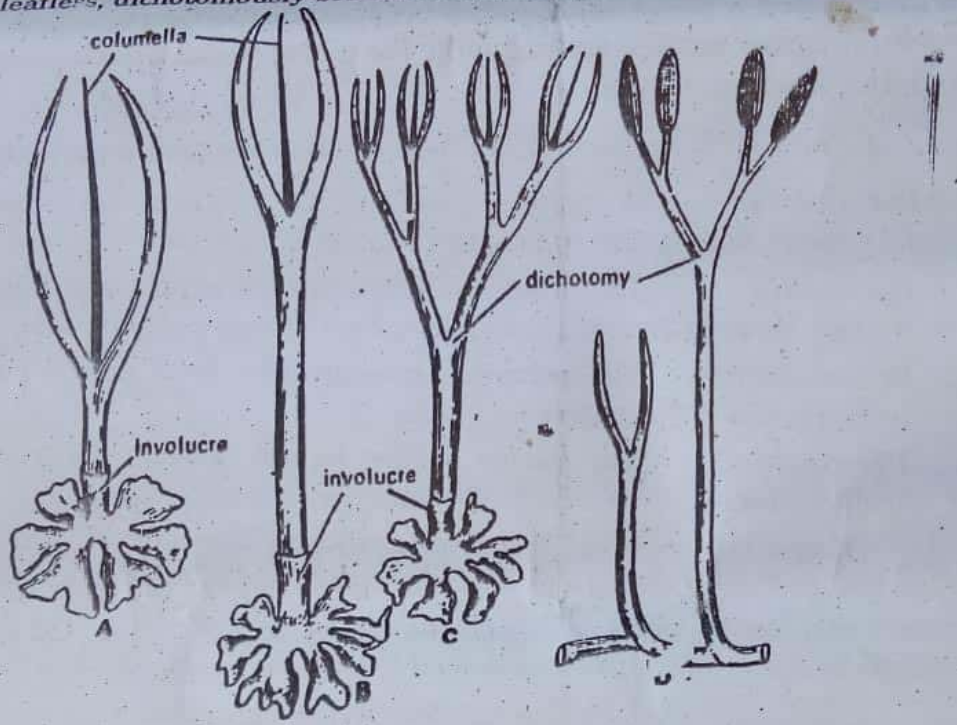


***Fig. 1.9: Origin of pteridophytes from Anthoceros like ancestor.***

**ii. Evolution of Sex Organs:** In both bryophytes and pteridophytes, the sex organs are embedded in the gametophyte. In *anthocerotes*, the archegonial initial functions as primary archegonial cell which divides to produce an axial cell and three jacket initials. The archegonia are reduced and consist of jacket, cover cell and an axial row of cells. The **pteridophyte archegonium** developed by further reduction. The archegonial initial functions as axial cell directly and does not form jacket initials. Thus, the pteridophyte archegonium is homologous to axial row and cover cell of anthocerotean archegonium.

In *anthocerotes*, the **antheridium** develops in a cavity, the antheridial chamber. A superficial cell of the gametophyte divides periclinally into two daughter cells, the inner daughter cell developing into an antheridium, the outer developing into roof of the antheridial chamber. In **primitive pteridophyes** (*Lycopodium, Equisetum, eusporangiate ferns*), the antheridium consists of many fertile cells surrounded by a layer of sterile cells. The fertile portion of pteridophyte antheridium is considered to correspond to entire anthocerotean antheridium and sterile layer is homologous to the cover of the archegonial chamber.

**iii. Evolution of Embryo:** The embryos of living *Psilotales* show a remarkable superficial resemblance to those of anthocerotes.

## Classification of Pteridophytes

The classification of vascular cryptogams is in state of flux. **Haeckle** was first to introduce the term *Pteridophyta*. Earlier taxonomists classified the vascular plants into two **divisions:** *Pteridophyta* and *Spermatophyta*. They included non-seed; spore-bearing plants in the division *Pteridophyta*. However, later the discovery of fossil fern-like plants (*Cycadofilicales*) that produced seeds and contained leaf gasp in the stele, suggested a closer relationship between the pteridophyta and spermatophyta. Therefore, taxonomists classified both *Pteridophyta* and *Spermatophyta* in the same group, the *Tracheophyta*.

**Eames** (1936) classified *Tracheophyta* into **four main groups:**

i. ***Psilopsida:*** It includes primitive pteriodphytes represented by extinct *Rhynia* (*Psilophytales*) and living *Psilotum* (*Psilotales*).

ii. ***Lycopsida:*** The group comprises of both extinct and living genera. The living members include *Lycopodium*, *Phylloglossum*, *Selaginella* and *Isoetes*.

iii. ***Sphenopsida:*** The group is represented by fossil genera mostly. The only living genus is *Equisetum*.

iv. ***Pteropsida:*** The group is the largest among the pteridophytes and includes **ferns**.

**Tippo** (1942) raised the *Tracheophyta* to the rank of phylum and treated these groups *Psilopsida*, *Lycopsida*, *Sphenopsida* and *Pteropsida* as **sub-phyla**.

**Wardlaw** (1955) assigned the rank of a **division** to *Trcheophyta* and *Psilopsida*, *Lycopsida*, *Sphenopsida* and *Pteropsida* were treated as **sub-divisions**.

Comparative morphological discoveries, particularly among the fossils, have suggested that *Tracheophyta* does not represent a phylogenetic taxon of the plant kingdom, but is combination of various independent taxa. Also knowledge about vascular anatomy and the position of sporangia revealed that there is a marked difference among *Psilopsida*, *Lycopsida*, *Sphenopsida* and *Pteropsida*. Therefore, modern taxonomists treated these sub-divisions to the rank of a division.

**International Rules of Botanical Nomenclature** (1952) recommended that the name of a **division** must end in suffix ***-phyta***, of a **sub-division** in ***-phytina***, of a **class** in ***-opsida***, and of a **sub-class** in ***-ideae***.

**Smith** (1955), on the basis of these recommendations modified his classification and divided pteridophytes into **four divisions**. This is most widely accepted classification with one or more modification.

## AN OUTLINE OF CLASSIFICATION BY SMITH

### Division 1: Psilophyta

The division includes most primitive rootless and leafless vascular cryptogams. The division is further classified into **two classes:** ***Psilophytopsida*** which includes fossil plants like *Rhynia* and *Horneophyton*; and ***Psilotopsida*** that comprises of living genera, the *Psilotum* and *Tmesipteris*.

### Division 2: Lepidophyta

The characteristic feature of the members of the division is presence or

absence of ligules. The division is sub-divided into **two classes:** *Eligulopsida* which include homosporous, non-ligulate forms such as *Lycopodium* and *Phylloglossum*; and *Ligulopsida* which include heterosporous forms with ligulate leaves such as *Selaginella, Isoetes*, etc.

***Division 3:*** **Clamophyta**

The division includes **two classes:** *Sphenophyllopsida* that include extinct plants such as *Sphenophyllum*; and *Calamopsida* which include living and fossil form. The most common living genus is *Equisetum*.

**Division 4: Pterophyta**

The division include ferns. It is further sub-divided into **four classes:** *Eusporangiopsida* represented by *Ophioglossum* and *Marattia*; *Protoleptosporangiopsida* which includes *Osmunda*; *Leptosporangiopsida* containing *Adiantum*, *Marsilea*, *Salvinia* and *Azolla*; and *Primopteropsida* which includes extinct genera of ferns.

**Cronquist, Takhtajan and Zimmermann (1966)** classified the pteriodphytes into **five divisions: i.** *Rhyniophyta* (*Rhynia*); **ii.** *Psilotophyta* (*Psilotum*); **iii.** *Lycopodiophyta* (*Lycopodium, Selaginella*); **iv.** *Equisetophyta* (*Equisetum*); and **v.** *Polypodiophyta* (*Marselia*)

## AN OUTLINE OF CLASSIFICATION BY B. C. BOLD

**Bold has classified pteridophytes into four divisions:**

**1. *Microphyllophyta***

*The division includes* **club- and spike-mosses** called so because of their moss-like size and leaves. The sporophylls of certain species are aggregated to form terminal groups or spikes. The division is divided into two classes on the basis of presence or absence of **ligule:** *Aglossopsida* (*Lycopodium*) and *Glossopsida* (*Selaginella*).

**2. Arthrophyta**

The division includes vascular cryptogams known from Devonian period. The plants were abundant during Paleozoic, but only a single genus, *Equisetum* is found in our present flora.

**3. Pteridophyta**

The division includes **ferns**. The members are megaphyllous. The division is divided into two series on the basis of type of sporangium produced: the **eusporangiates**, in which the sporangia contain a large number of spore, and **leptosporangiates** in which the sporangia contain a definite number of spores. The **living ferns** are grouped into **five orders** namely: *Ophioglossales* (*Ophioglossum*), *Marattiales* (*Marattia*), *Filicales*, *Marsileales* (*Marselia*) and *Salviniales* (*Salvinia*).

**4. Psilophyta**

The division includes two living genera *Psilotum* and *Tmesipteris* and extinct genera like *Psilophyton*, *Rhynia*, and *Asteroxylon*. The plants consist of dichotomously branched axes that arise from rootless rhizomes. The sporangia are united to form synangia and are borne on short lateral branches. The gametophytes are cylindrical, underground and saprophytic. The division includes a **single order:** *Psilotales*.