

THE CLASSIFICATION OF PLANTS, X.*

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Our knowledge of the anatomy, cytology, and life history of many of the groups of Pteridophytes is still far from satisfactory and only a tentative arrangement is at present possible. However, three great lines of development are clearly marked giving three great phyla with which to begin. There may be some dispute as to the true relationship of a few isolated groups but in the great majority of living forms the connection is quite evident. Some of the recent speculations in respect to the Pteridophytes have very little morphological evidence for their support. The writer believes that it is best not to disturb the arrangements of the various groups as accepted in the past until there is more than a mere foundation of assumptions based on doubtful evolutionary hypotheses, many of which are all but disproven at the present time.

There is a notion that external characters are less stable than internal anatomy. But there is really no evidence that this is so. We should first find out whether there is any ecological response and if so whether one set of structures responds more readily than another. Even if it could be shown that there is ecological adaptation by direct response to environment or by natural selection this would still be inconclusive, for the internal structure would necessarily have to be co-ordinated with the external. A given type of vascular system may be found in a group and thus indicate relationship, but the same is sometimes true of unimportant external structures like the ligule in *Selaginella*. The vascular system of the Pteridophyta, for example, shows a remarkable diversity and it is probably because of this very plasticity that some of the groups related to this phylum have evolved into the higher forms of seed plants.

The evolution of the Pteridophytes, in general, has been from the homosporous condition to the heterosporous; from the independent gametophytes to minute semidependent gametophytes; from low erect perennials to tree forms with little or no branching to branched forms and from these to geophilous perennials and occasionally to annuals. Several types of leaf venation appear to have developed independently and also several types of vascular system. What the true relationship between the several types is, is at present largely conjecture. There is no definite evidence as to which type of stele is the oldest, nor has there yet been much progress made as to the probable evolution and derivation of the several types. The hiatus between the primordial vascular systems of living Bryophytes and the highly specialized

*Contribution from the Botanical Laboratory of Ohio State University, No. 77.

steles of known Pteridophytes is too great to be bridged unless fossil forms can be found intermediate between the two. Since these forms should be discovered in the Ordovician, Silurian, or Cambrian rocks or perhaps in deposits of even earlier age, there is no immediate prospect of their coming to light even if any were preserved. The Silurian and Ordovician should be thoroughly searched for Pre-Devonian Pteridophytes for Ordovician fossils might give a clue as to the possible path along which the vascular plants evolved. In the meantime it is most reasonable to classify our living species on the basis of their entire morphology both internal and external.

Correction.

Through inadvertance the genus, *Microcycas* appeared as *Microzamia* in the IX paper of this series (*Ohio Naturalist* 13: 106). Read *Microcycas* instead of *Microzamia*.

In the following synopsis the segregation has been carried as far as the genus except in the complex *Polypodiaceae* which well deserve an independent treatment.

SYNOPSIS OF THE PTENOPHYTA.

- I. Sporophyte homosporous, having only one kind of nonsexual spores; leaves usually large and mostly compound; gametophytes comparatively large, hermaphrodite or unisexual. **FILICES.** Ferns.

1. Plants eusporangiate, sporangia developed from internal cells. **EUSPORANGIATÆ.**

- (1). Sporangia on a special sporangiophore distinct from the leaf-blade; gametophyte subterranean, without chlorophyll.

OPHIOGLOSSALES. OPHIOGLOSSACEÆ.

- a. With reticulate venation; sporangia in a single row on both margins of the sporangiophore. **Ophioglossum.**

- b. With dichotomous venation, sporangia clustered on the sporangiophore or the sporangiophore more or less branched.

- (a). Sporangia opening transversely; on the margin of a more or less branched sporangiophore. **Botrychium**

- (b). Sporangia opening longitudinally; in little clusters. **Helminthostachys.**

- (2). Sporangia on the underside of foliage leaves; leaves with two stipules; gametophytes with chlorophyll.

MARATTIALES.

- a. Sporangia in sori but free from each other.

ANGIOPTERIDACEÆ.

- (a). Sori very long, with 80-160 sporangia; leaves simply pinnate. **Archangiopteris.**

- (b). Sori short, elliptical, mostly with 10 sporangia, sometimes less or sometimes as high as 20; leaves two or more times pinnate. **Angiopteris.**

- b. Sporangia united forming syngangia.

- (a). Each locus or sporangium of the syngangium longitudinally dehiscent. **MARATTIACEÆ.**

- ((a)). Syngangia elongated, oval, venation not reticulate; leaves large pinnately compound. **Marattia.**

- ((b)). Syngangia round, venation reticulate; leaves digitate. **Kaulfussia.**
- (b). Each loculus of the syngangium opening by a terminal pore; leaves simple or simply pinnate.
DANÆACEÆ. **Danæa.**
2. Plants leptosporangiate, sporangia developed from superficial cells.
LEPTOSPORANGIATÆ. **FILICALES.**
- (1). Sporangia without a true annulus, but with a group of thick walled cells which are sometimes arranged in a ring at the apex or side; sporangia nearly sessile; sporophores usually different from the foliage leaves or leaflets.
- a. Sporangia with an irregular group of dorsal thick-walled cells, not arranged in a definite ring, globular; spores with abundant chlorophyll.
OSMUNDACEÆ.
- b. Sporangia with an apical ring of cells, ovoid.
SCHIZÆACEÆ.
- (2). Sporangia provided with a true, complete or incomplete annulus.
- a. Annulus usually complete; that is not interrupted by the stalk of the sporangium.
- (a). Sporangia mostly 2 to 8, not on a prolonged or projecting receptacle; dehiscence vertical; indusium none, veins free.
GLEICHENIACEÆ.
- (b). Sporangia on a convex, projecting or thread-like receptacle; dehiscence vertical, diagonal, or transverse; indusium usually present.
- a. Sori round, on the end or the back, or in the axils of the veins.
(a). Sori with 6 to 10 sporangia.
MATONIACEÆ. **Matonia.**
- (b). Sori with numerous sporangia.
CYATHEACEÆ.
- b. Sori always on the leaf margin at the end of a vein; leaf texture filmy. HYMENOPHYLLACEÆ.
- b. Annulus incomplete, interrupted by the stalk of the sporangium; dehiscence transverse; stalk usually long.
a. Usually perennial terrestrial plants.
POLYPODIACEÆ.
- b. Annual hydrophytes; sporangia sessile, scattered, covered by the reflexed margin of the leaf. CERATOPTERIDACEÆ. **Ceratopteris.**
- II. Sporophyte heterosporous, producing two kinds of nonsexual spores; gametophytes much reduced, unisexual.
1. Plants leptosporangiate, the sporangia in sporocarps, produced on the leaves; leaves without ligules. HYDROPTERIDÆ.
- a. Plants rooted, mostly perennial; sporocarp a modified leaflet with a thick, hard wall; terminal bud with a 3 sided apical cell; megasporangia and microsporangia in the same sorus. **MARSILEALES.** MARSILEACEÆ.
- b. Plants floating, mostly annuals; sporocarp thin walled, representing a sorus; terminal bud with a two-sided apical cell; megasporangia and microsporangia in separate sporocarps. **SALVINIALES.** SALVINIACEÆ.
2. Plants eusporangiate; sporangia in the bases of the grass-like leaves not in sporocarps; leaves with ligules.
ISOETÆ. **ISOETALES.** ISOETACEÆ. **Isoetes.** Quillwort.

SYNOPSIS OF THE FAMILIES OF FILICALES CONTAINING MORE THAN ONE GENUS.

No complete presentation is given of the Polypodiaceae, but a few genera are named under each subfamily to indicate the general trend of the phyletic series.

OSMUNDACEÆ.

1. Fertile leaflets not at all or only slightly contracted.
 - a. Epidermis with stomata. **Todea.**
 - b. Epidermis without stomata; leafblade thin. **Leptopteris.**
2. Fertile leaflets much contracted. **Osmunda.**

SCHIZÆACEÆ.

1. Vascular strand central.
 - a. Leaves erect, spores bilateral. **Schizæa.**
 - b. Leaves twining, spores not bilateral. **Lygodium.**
2. Vascular bundles forming a net-like hollow cylinder in the stem.
 - a. Sporangia single or rarely in twos at the end of the vein. **Mohria.**
 - b. Sporangia in two rows along the midrib of the leaf segment. **Ornithopteris.**

GLEICHENIACEÆ.

1. Rhizome erect; leaves simply pinnatifid. **Stromatopteris.**
2. Rhizome creeping; leaves mostly dichotomously branched. **Gleichenia.**

CYATHEACEÆ.

- I. Sori at the ends of the fertile veins; indusium forming a cup-like sheath together with the more or less modified leaf tip around the sorus.
 1. Annulus of the sporangium with a stoma or mouth of specialized cells.
 - (1). Fertile lobe of the leaflet slightly or not at all modified; forming with the indusium a two-valved cup.
 - a. Stem not raised above the ground or only slightly so. **Balantium.**
 - b. Aerial stem erect, well developed. **Dicksonia.**
 - (2). Fertile lobe of the leaflet highly modified, similar to the Indusium. **Cibotium.**
 2. Annulus of the sporangium with cells all alike. **Thyrsopteris.**
- II. Sori on the back or in the fork of the fertile veins; indusium inferior; annulus of the sporangium of nearly similar cells, the mouth only slightly differentiated.
 1. Sorus without indusium. **Alsophila.**
 2. Sorus with an indusium.
 - a. Indusium scale-like. **Hemitelia.**
 - b. Indusium cup-like, with a smooth margin or at first closed and later breaking irregularly. **Cyathea.**

HYMENOPHYLLACEÆ.

1. Receptacle not projecting far if at all beyond the indusium.
 - a. Indusium tubular or cup-shaped; gametophyte filamentous. **Trichomanes.**
 - b. Indusium two-lipped; gametophyte flat or ribbon-like. **Hymenophyllum.**
2. Receptacle projecting far beyond the indusium; sori marginal; indusium urn-shaped. **Loxsonia.**

POLYPODIACEÆ.

- I. Sori naked or with marginal indusia.
1. Sori naked or at least without a typical indusium and not covered by the reflexed margin of the leaf-blade.
POLYPODIATÆ. **Acrostichum, Polypodium, Phegopteris, Vittaria.**
 2. Sori marginal and usually covered by the reflexed margin of the leaf-blade.
PTERIDATÆ. **Notholæna, Adiantum, Petris, Pteridium, Pellæa, Cryptogramma, Cheilanthes.**
- II. Sori with special indusia.
1. Sori linear or oblong, more than twice as long as broad.
ASPLENIATÆ. **Anchistea, Lorinseria, Asplenium, Athyrium, Phyllites, Comptosorus.**
 2. Sori roundish, not more than twice as long as broad, usually nearly circular in outline. DRYOPTERIDATÆ. **Dryopteris, Polystichum, Oleandra, Nephrolepis, Davallia, Dennstædtia, Filix, Woodsia, Matteuccia, Onoclea.**

SYNOPSIS OF MARSILEACEÆ AND SALVINIACEÆ.

MARSILEACEÆ.

- a. Leaves with 4 leaflets; sporocarp bean-shaped, with several to many cavities. **Marsilea.**
- b. Leaves grass-like; sporocarp globose, with 2-4 cavities.
Pilularia.

SALVINIACEÆ.

- a. With true water roots; sporocarps (sori) on the floating leaves. **Azolla.**
- b. Without roots but with root-like dissected leaves; sporocarps (sori) at the base of the submerged dissected leaves. **Salvinia.**

SYNOPSIS OF THE CALAMOPHYTA.

- I. Sporophyte homosporous; leaves united into a sheath with teeth; sporophylls shield-shaped, with sack-like sporangia on the lower or inner side; stem with a ring of vascular bundles and central pith which is usually hollow. EQUISETÆ, **EQUISETALES**, EQUISETACEÆ, **Equisetum.** Horsetail, Scouring-rush. Note.—The lowest forms are the large species with evergreen aerial stems of one type; the most specialized species have two types of annual aerial stems.
- II. Sporophyte heterosporous; leaves in whorls, free or united into a sheath; all fossil; some of the groups placed here are still imperfectly known and may be homosporous.
 1. Stems with a central triarch vascular bundle; leaves not fused into a sheath; sporangia stalked, on the upper side of the sporophyll. Paleozoic herbs or trees.
SPHENOPHYLLÆ, **SPHENOPHYLLALES.**
 - a. Leaves small or medium in size, usually more or less wedge-shaped. SPHENOPHYLLACEÆ, **Sphenophyllum.**
 - b. Leaves large, deeply pinnatifid.
PSEUDOBORNIACEÆ. **Pseudobornia.**
 2. Stem with a ring of vascular bundles, increasing in diameter by a cambium zone, and with a central pith, usually hollow; leaves whorled, free or at first united; Paleozoic plants often tree-like CALAMARIÆ, **CALAMARIALES**, CALAMARIACEÆ, **Calamodendron, Calamites,** and other genera are recognized.

SYNOPSIS OF THE LEPIDOPHYTA.

I. Sporophyte homosporous; leaves without a ligule.

LYCOPODIEÆ, **LYCOPODIALES.**

1. Sporangia unilocular; sporophylls undivided. LYCOPODIACEÆ.

a. Stems branched, with numerous leaves. **Lycopodium.**
Note—The lower species are without terminal cones but with zones of sporophylls alternating with sterile foilage leaves, the higher have definite terminal cones.

b. Stems unbranched with a few basal leaves and a small cone at the tip of a naked peduncle. **Phylloglossum.**

2. Sporangia bilocular or trilocular; sporophylls two-parted.

PSILOTACEÆ.

a. Leaves numerous, rather large and spreading, with a definite midrib; sporangia with two cavities.

Tmesipteris.

b. Leaves small and rather distant without a definite midrib; sporangia with three cavities. **Psilotum.**

II. Sporophyte heterosporous; leaves with a ligule. SELAGINELLEÆ.

1. Without increase in thickness of stem, herbs.

SELAGINELLALES, SELAGINELLACEÆ, **Selaginella**

2. With increase in thickness of stem, fossil trees. **SIGILLARIALES.**

a. Leaves spirally arranged, but the bark without parallel vertical flutings or ridges.

LEPIDODENDRACEÆ, **Lepidodendron, etc.**

b. Leaves spirally arranged, but the bark with parallel, vertical flutings or ridges, the leaf-scars thus appearing in vertical rows. SIGILLARIACEÆ, **Sigillaria, etc.**

Note—Several other imperfectly known families belong to this order.

