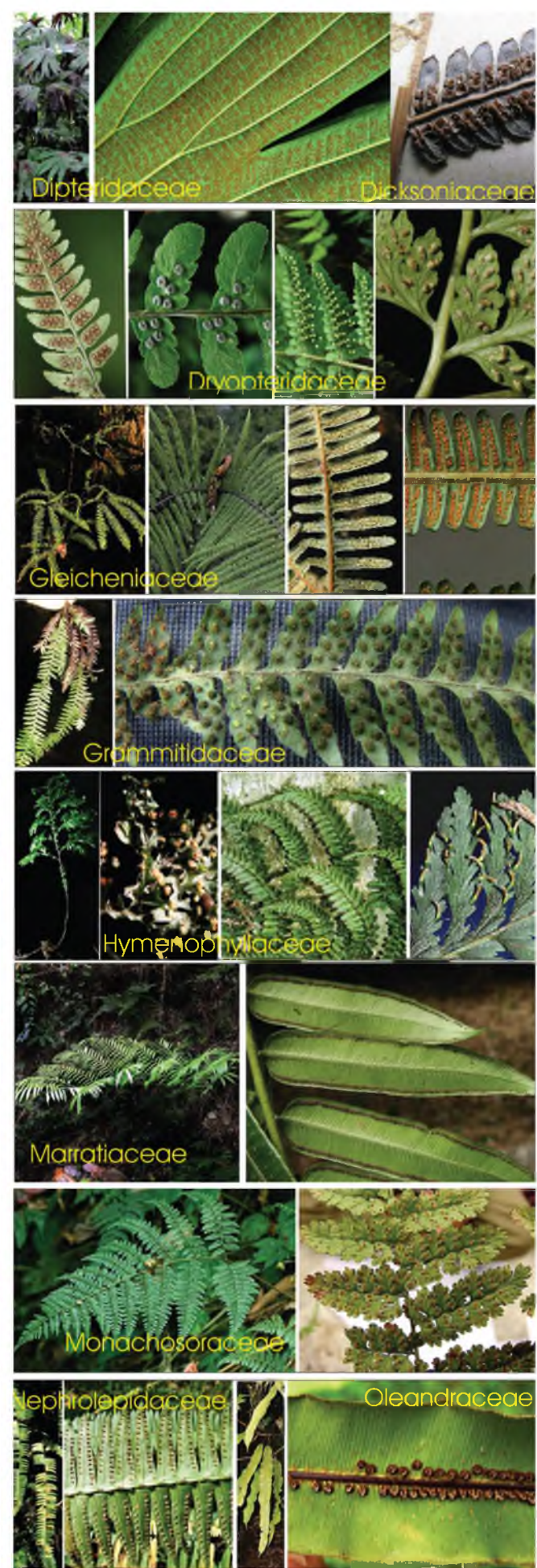


Ferns and Fern-allies



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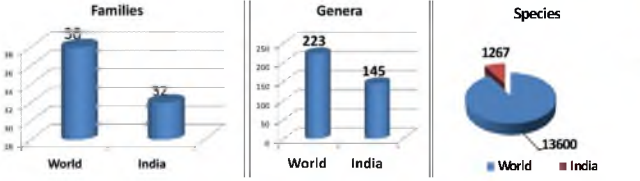
Pteridophytes, a natural group of plant kingdom, are represented by Ferns (Moniliophytes) and Fern-allies (Lycophytes). Like flowering plants they possess vascular system for conduction of water, hormones and nutrients but do not produce flowers and fruits for reproduction, however, their reproductive organs are hidden as in algae and bryophytes. Hence, they are also termed as vascular cryptogams.

Gigantic tree-like Pteridophytes were the dominant vegetation on earth for millions of years before the origin of seed plants. These were believed to be the food for Dinosaurs. During the course of evolution those carboniferous spore forests were vanished and fossilized and converted in to the fossil fuel (coal and petroleum). In recent era, seed plants replaced them but still in many forests their diversity is many-fold higher than the other groups of plants. They are the major understory vegetation and play a key role in those ecosystems.



DIVERSITY AND DISTRIBUTION

Pteridophytes, the second largest group of vascular plants, comprise about 13,600 species and distributed throughout the world except in deep seas, Arctic and Antarctic regions. The majority of the species are concentrated in tropical rain forests. Generally as one passes from equator to poles their number decreases gradually but in certain places such as Himalayas and southeast China this rule deviates due to variation in elevations and physiognomy. A total of 1267 species (about 9% of global ferns) of Pteridophytes are recorded from India. In India, Pteridophytes are distributed mainly in Himalayan region, northeastern states, southern India and Andaman & Nicobar Islands, where the climate is much humid or conducive for their growth.



MAJOR DIVISIONS

Usually Pteridophytes are divided into two major groups namely (i) **Ferns** and (ii) **Fern-allies**, and both the groups are further subdivided into many families. Kramer (1990) in his classification accepted 223 genera under 38 families of Pteridophytes. The easiest way to distinguish ferns from fern-allies is by their leaves. The leaves of fern-allies are small scale-like (except Isoetaceae) with only mid-vein and known as microphylls, whereas the leaves of true ferns are large and complex with branched venation and known as megaphylls.

The other differences between ferns and fern-allies are presence of coiled young fronds or crozier in ferns (except Ophioglossaceae though it is exceptionally found in *Ophioglossum indicum* from India) however, this circinate vernation is absent in fern-allies. In fern-allies, sporangia are borne in the axils of sporophylls, which may be scattered along the length of stem or crowded into specialized terminal cones or strobili but; in ferns sporangia are generally developed on the lower surface of leaves or fronds, or sometimes on specialized panicles (Osmundaceae, Ophioglossaceae, etc.).

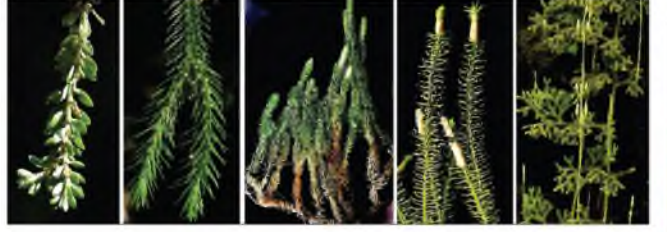
FERN-ALLIES OR LYCOPHYTES

Traditionally, Fern-allies are subdivided into five families, viz., Psilotaceae (whisk ferns), Lycopodiaceae (clubmosses), Selaginellaceae (spikemosses), Equisetaceae (horsetails) and Isoetaceae (quillworts). However, in modern phylogenetic classification, whisk ferns and horsetails are considered as true ferns.

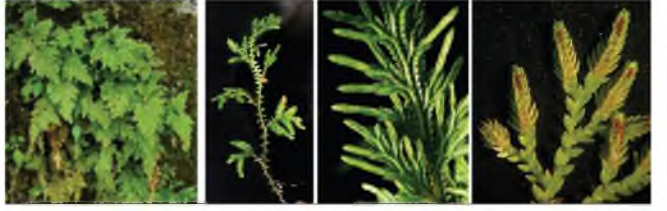
(i) Psilotaceae: The whisk fern family, Psilotaceae is represented by only two genera, *Psilotum* and *Tmesipteris* (restricted to Pacific islands only). In India, *Psilotum* is represented by only two species. *Psilotum* is a rootless plant with dichotomously forked aerial branches covered by minute, awl-shaped, veinless, scale-like leaves. The sessile, 3-celled sporangia are born at the base of forked branch.



(ii) Lycopodiaceae: Out of 4 genera and 300 global species, 3 genera and 30 species of Lycopodiaceae occurs in India. Members of Lycopodiaceae are terrestrial or epiphytes with erect or pendulous or pseudo-dichotomously branched stems covered by irregular, spiral or whorled microphylls. The sporangia borne in the axils of vegetative leaves are either distributed throughout the length of stem (*Huperzia*) or in the axils of specialized leaves (sporophylls), arranged into terminal loose or compact cones (*Lycopodiella*, *Lycopodium*).



(iii) Selaginellaceae: It is a monotypic family, represented by the genus *Selaginella*, is commonly known as dwarf clubmoss or spike-moss. Out of known 700 species, the genus in India is represented by about 70 species. In this genus, roots arise at the base of the stem but in many species rhizophores are also present on the aerial parts. The microphylls are either isomorphic and spirally arranged or heteromorphic and arranged in definite ranks on stem. The arrangement, size, shape and structure of microphylls vary from species to species and are taxonomically important. The sporophylls are also isomorphic or heteromorphic forming a spike or compact cone at the end of branches. The spores are of two types namely megaspores and microspores and are produced in two different types of sporangia (megasporangia and microsporangia).



(iv) Equisetaceae: The family Equisetaceae (horsetails) comprises only one extant genus *Equisetum*. Out of 15 worldwide species only 4 occurs in India. Due to deposition of silica on cell walls, *Equisetum* plants are with rough surface, used in scouring and polishing of pots, floors, and woodwork hence called 'Scouring Rush'. The aerial stems of *Equisetum* are tubular and hollow, and the external surface with ridges and furrows. The stems also consist of nodes and internodes like bamboos and hence sometimes also known as "Bamboo Ferns". At every node definite number of modified scaly leaves arise in whorls. Sporangia arranged in compact terminal cones having umbrella-like or peltate, compressed sporangiophores.



(v) Isoetaceae: The quillworts family Isoetaceae comprises the single genus *Isoetes* consists of about 200 worldwide species. In India, only 3-5 species occurs which grow in swamps and lakes. Species of Isoetes are grass-like annual or perennial herbs with linear phyllode-like ligule, spirally compressed leaves on corm. The leaf bases are expanded and with swollen heterosporous sporangia at fovea.



FERNS

The ferns are a very large and complex group of plants, comprise of about 12,000 species belonging to 214 genera and 33 families; among them about 1150 species belonging to 140 genera and 28 families have been reported to occur in India. The external morphology of fern plant is very complex and highly variable from one species to other but all ferns have same body plan with root, stem and leaf. Fern plants are generally herbaceous or bushy (except 600 species of arboreal tree ferns) and ranges from a few millimeter to 2-4 meter, however, the trunk of tree ferns is up to 50 feet high with a crown of leaves.



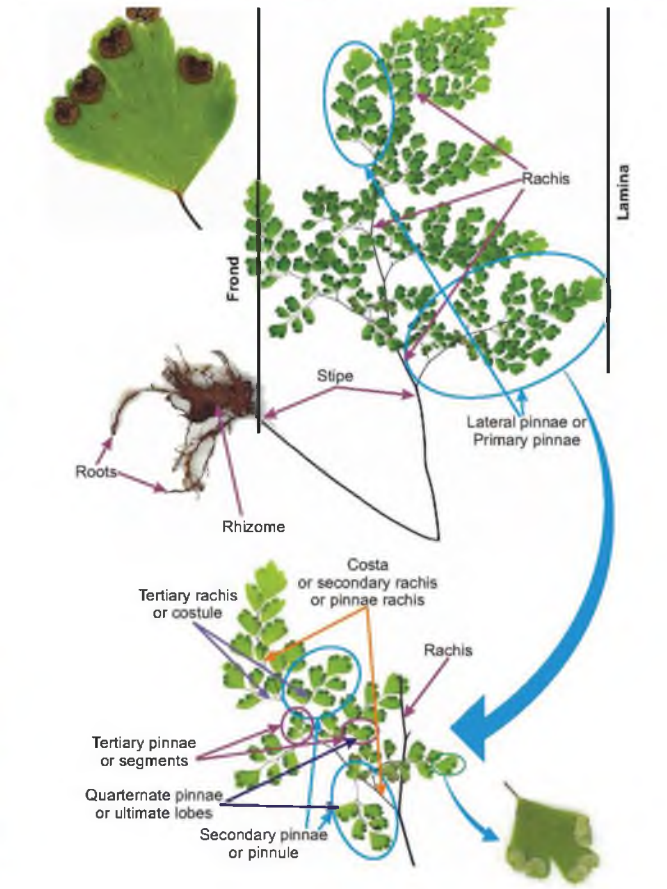
The roots arise on rhizome and are not well-developed; they are small and fibrous and lack any taxonomic significance. The stem of fern is generally underground rhizome or it may grow epiphytically on tree trunks or lithophytically on the rocks. The rhizome may be erect, suberect, creeping or upright caudex or trunk or sometimes reduced into a very short rootstock. It may be unbranched to dichotomously, pseudo-dichotomously or profusely branched.



The above ground part of fern plant is a leaf or frond. Each frond is with a short to long petiole or stipe and simple to variously dissected leaf blade or lamina of variable shape and size. The stipe may be small to very long in relation to lamina length. It may be round, three-angled or more-angled in outline and without groove or with a groove on upper surface. The colour of stipe is also variable such as green, stramineous or straw-coloured, ebeneous or chestnut-coloured, purple, black, etc. The surface of stipe may be smooth, rough, muricate, spinous, etc. The stipe and lamina are often covered by various types of scales, hairs, trichomes.



The lamina is of various shape and size. It may be grass-like, ribbon-like, linear, lanceolate, elliptic, cordate or heart shaped, ovate or egg-shaped, reniform or kidney-shaped, orbicular or round, sagittate or spear-like, palm-like or palmate, pentagonal, etc. The size of fern lamina is also variable from 5 mm to about 30 feet; and it may be simple to 5-6-pinnate.



Spore producing organs called sporangia are variously positioned on fronds. These are either grow separately on specialized fertile portion or spikes as in some families such as Ophioglossaceae, Osmundaceae, Schizaeaceae, etc., or scattered on lower surface of fertile fronds as in Lomariopsidaceae. In remaining fern families, sporangia are aggregated in sori. Sori found generally on the lower surface of the normal fronds in definite position, however, in some ferns fronds are dimorphic and sori found on separate fronds (Plagiogyriaceae, Lomariopsidaceae).

In water fern families (Azollaceae, Marsileaceae and Salviniaceae) sori are produced in specialized organ called sporocarp. Arrangement of sori is the chief taxonomic character for identification and classification of ferns. They may arise on margins (marginal, as in Pteridaceae, Hymenophyllaceae), on the submarginal or intramarginal position (Dennstaedtiaceae, Dicksoniaceae, Davalliaceae) or on lower surface of lamina (abaxial). Sori may be round, reniform, circular, oblong, globose, notched, J-shaped, horseshoe-shaped, linear, cup-shaped, pouch-shaped, bilipped, chain-like, etc. The sori may be covered by various types of covering known as indusium, and such kind of sori are called indusiate sori. However, in many fern groups, sori are naked and are known as exindusiate sori. Besides indusium, in few forms, sori are covered by peltate scales, stellate hairs, trichomes, etc. The position of sori in relation to veins is taxonomically important. In some families, sori are found on the veins, however, in other families they found on the tip of the veins, at the bifurcation of veins, along the veins on anterior or posterior side or both sides, on marginal commissure of veins, inside the areoles, on included veinlets of areole or along the costa. The spores are monoete or trilete and generally homosporous except water ferns (Azollaceae, Marsileaceae and Salviniaceae) where spores are heterosporous.