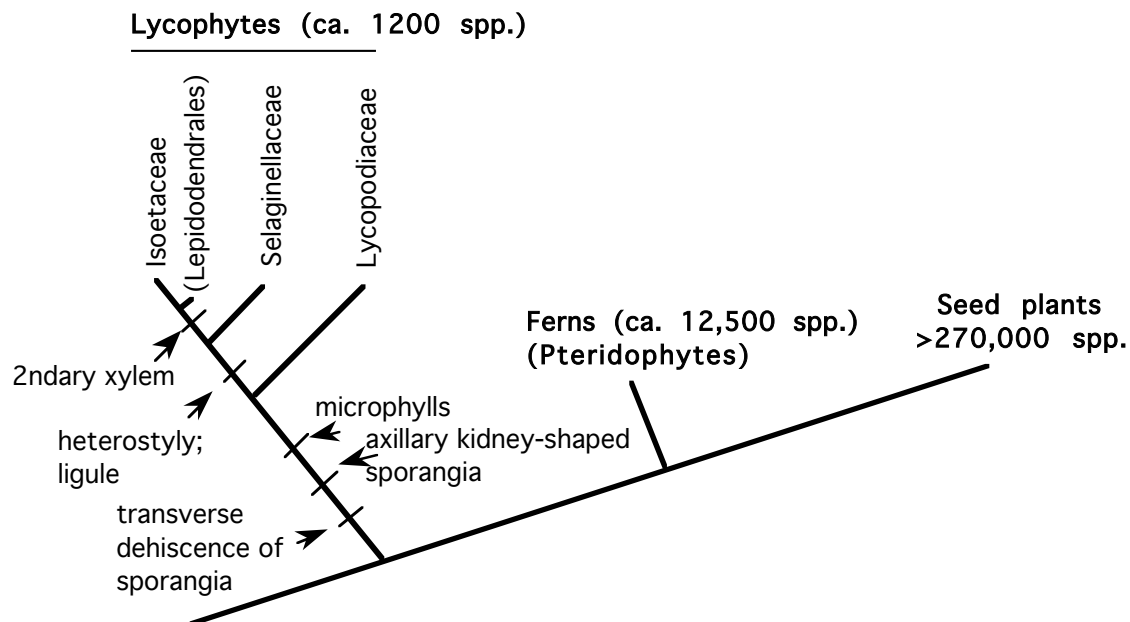


Lycophytes - An ancient lineage dating from the Devonian (>400 million years ago) and sister-group of other living tracheophytes.

Today, moss-like or onion-like plants; prehistorically, included dominant trees of swamp forests of the Paleozoic (e.g., *Lepidodendron*).

Diagnostic (synapomorphic) features of Lycophytes:

(1) microphylls (leaves with single strand of unbranched conducting tissue); (2) kidney-shaped sporangia that open transversely at maturity; (3) sporangia produced in microphyll axils (just above leaves; sometimes sporophylls (= leaves associated with sporangia) arrayed in cones (= strobili)).



Other (plesiomorphic) features of Lycophytes (all five features below resolved as present in the most recent common ancestor of all living tracheophytes):

(1) sporangia are eusporangia (sporangial outer wall > 1 cell layer thick); (2) spores globose with trilete scar; (3) free-living gametophytes (above or below ground), not attached to sporophyte at maturity; (4) stems dichotomously branching; (5) sperm with 2 flagellae (sperm of ferns and those seed plants with motile sperm have numerous flagellae).

Three extant families of Lycophytes (ca. 1,200 species):

(1) Lycopodiaceae: "Club mosses" -- homosporous, without ligules, with underground gametophyte; worldwide, rhizomatous moss-like plants, often in forest understories.

(2) Selaginellaceae: "Spike mosses" -- heterosporous, with ligules (scale-like outgrowth near base of each microphyll); mostly tropical but includes "resurrection plants" of dry areas (can dehydrate and rapidly rehydrate and resume photosynthesis); moss-like in appearance, sometimes grow on (but do not parasitize) other plants (that is, are often epiphytes).

(3) Isoëtaceae: "Quillworts" -- heterosporous, with ligules, sporangia embedded in leaf base; onion-like appearance; associated with water (often along edges of lakes, ponds).

Lepidodendron and other ancient (extinct) tree lycophytes were heterosporous, with ligules, and therefore thought to be closely related to Selaginellaceae and Isoëtaceae.

Ferns (approximately 12,500 species) -- the sister-group of seed plants:

~10× more diverse in living species than Lycophytes

Most with horizontal underground stem (= rhizome); above-ground biomass dominated by (or exclusively) leaves, which are usually lobed to compound.

Leaf blades of ferns = fronds.

Petioles of ferns = stipes.

Five major lineages of ferns now recognized; four of the five are eusporangiate and together constitute a small minority of ferns as a whole.

Eusporangiate lineages include:

(1) Marattiaceae (ca. 300 species):

Tropical group of ferns that remains similar in morphology to fossil relatives from Paleozoic.

Large, compound, fleshy leaves with minimal support tissue (contain mucilage instead).

Eusporangia sometimes (in *Marattia*) united in compound structure (synangium) on underside of leaves.

Gametophytes are free living and photosynthetic (green).

(2) Equisetaceae (ca. 15 species, in genus *Equisetum*)

Commonly known as horsetails or scouring rushes; most are north-temperate in distribution but widespread.

Not thought to be ferns until results of recent molecular phylogenetic analyses became available.

Much more diverse in Paleozoic, when some were tree-like.

Have rhizomes, like most ferns, but have extensive above-ground, vertically oriented, hollow, green stems and tiny, scale-like leaves arrayed in whorls.

Eusporangia are borne in terminal cones or strobili, on the underside of umbrella-shaped sporangiophores.

Spores are green and associated with elaters (filaments that expand upon drying, thereby dispersing the spores from the rupturing eusporangia)

(3) Ophioglossaceae (ca. 80 species)

Adder's tongue ferns and moonworts; distributed in temperate regions and high-elevation tropics

Basal segments of leaves modified as sporangia-bearing structures (sporophores)

Gametophytes are underground, fungal-associated

One species with highest chromosome number known in plants (ca. 600 pairs)

(4) Psilotaceae (ca. 15 species)

Mainly tropical, often epiphytes (growing on other plants without parasitizing them)

Long thought to be closely related to extinct Rhyniophytes because of resemblance of *Psilotum* to the earliest known fossil tracheophytes

Presumed primitive features of *Psilotum*: (1) dichotomously branching stem, (2) rootless, (3) apparently leafless

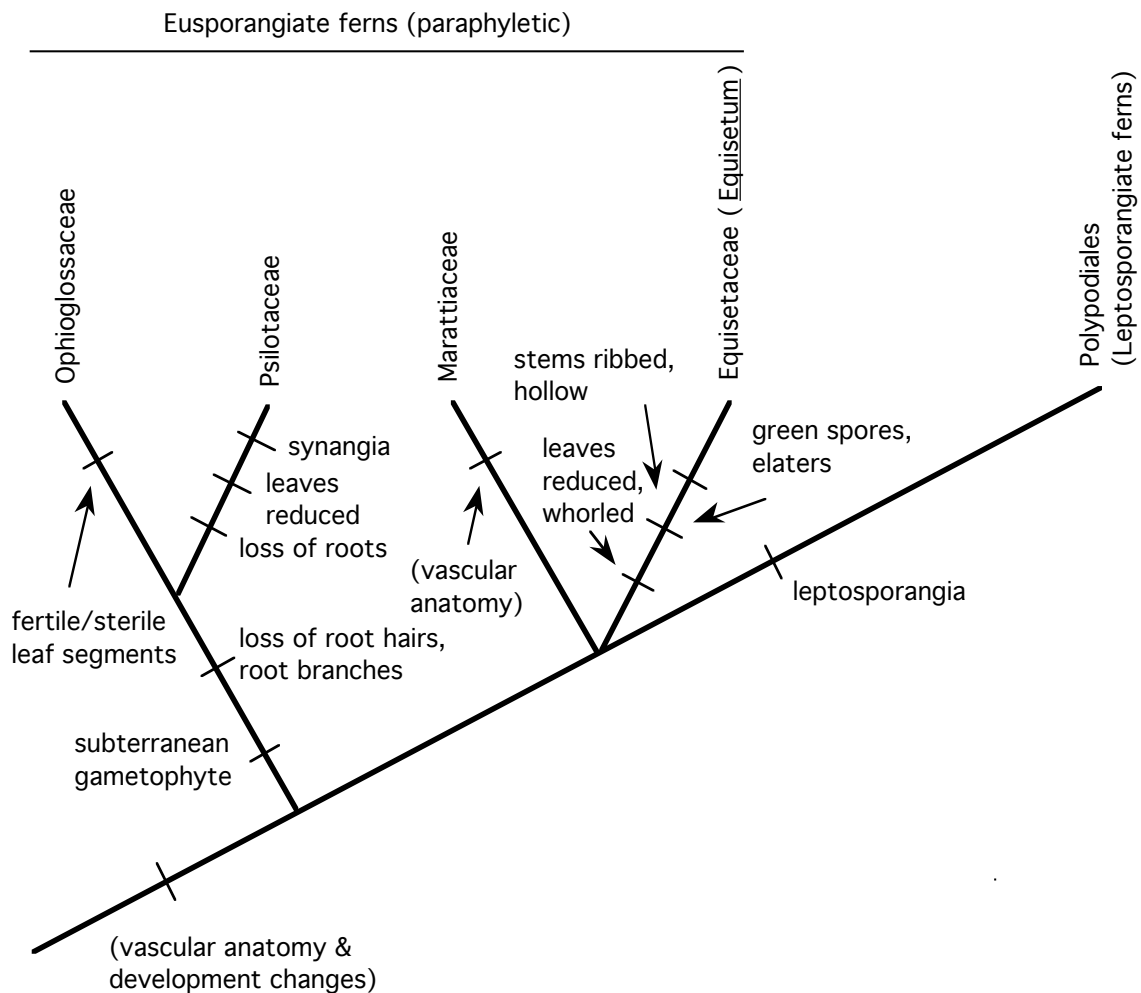
Recent molecular data shows that Psilotaceae is the sister-group of Ophioglossaceae

Like Ophioglossaceae, Psilotaceae have an underground, fungal-associated gametophyte; sporophytes are radically different

One interpretation now is that entire sporophyte of *Psilotum* may be a modified leaf rather than a stem system

Leaf-like structures of *Psilotum* called enations; a strand of conducting tissue reaches toward but does not enter base of the enation

Eusporangia of Psilotaceae are united together into a synangium



Next time: Polypodiales = Leptosporangiate ferns