

PTERIDOPHYTES

(Lycophytes and Ferns)

蕨类植物 jue lei zhi wu

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Plants with a regular alternation between larger asexual sporophytes and mostly inconspicuous, sexual gametophytes, mostly free-living but retained within sporocarps of heterosporous ferns or developed mostly within spore walls of heterosporous lycophytes (Isoëtaceae and Selaginellaceae). Sporophytes mostly with roots (absent in Psilotaceae), stems, and leaves, and with well-developed vascular strands. Stems mostly rhizomes, protostelic, siphonostelic, solenostelic, or dictyostelic, sometimes polystelic, some with limited secondary thickening, articulate in Equisetaceae. Leaves microphylls: scalelike or linear with a single vascular strand and a single axillary sporangium, or fronds (megaphylls): with branched vascular strands, lamina often divided, often compound, with many sporangia on abaxial surface, margin, or specialized sporophore, forked and subtending a 3-lobed sporangium in Psilotaceae. Sporangia thick- or thin-walled, homosporous or heterosporous, sessile or stalked, rarely enclosed within sporocarps. Spores trilete or monolete. Gametophytes filamentous or thalloid, autotrophic or mycotrophic. Male gametes (antherozoids) bi- or multiflagellate. Female gametophytes (egg cells) borne singly within flask-shaped archegonia (largely adapted from Kramer & Green in Kubitzki, *Fam. Gen. Vasc. Pl.* 1: 11. 1990).

Some 265–300 genera and 10,900–11,100 species recognized worldwide (numbers based largely on Smith et al., *Taxon* 55: 705–731. 2006): extant pteridophytes are cosmopolitan but are much better represented in the humid tropics, with only a few families (e.g., Dryopteridaceae) well represented in subtropical and temperate regions and rather few extending into alpine regions (e.g., Woodsiaceae) and more arid regions (most notably Pteridaceae subfam. Cheilantheoideae); 177 genera (three endemic, one introduced) and 2,129 species (842 endemic, four introduced) in China.

Pteridophytes are conventionally divided into four major groups, Psilotatae, Lycopodiatae (lycophytes or club mosses), Equisetatae (horse tails), and Filicatae (ferns) (Kramer & Green, loc. cit.), or five major groups when Isoëtinae/Isoëphytina is also recognized (e.g., Ching, *Acta Phytotax. Sin.* 16(3): 1–19. 1978). Molecular data shows that the lycophytes (Isoëtaceae, Lycopodiaceae, and Selaginellaceae), characterized by microphylls and protostelic or polystelic vascular strands, are sister to all other vascular plants but Psilotatae and Equisetatae, along with the Ophioglossaceae and Marattiaceae, are better regarded as basal relatives of the true ferns (Osmundaceae onwards), forming a monophyletic group, the monilophytes, more closely allied to the spermatophytes, the seed-bearing gymnosperms and angiosperms than to the lycophytes (Pryer et al., *Nature* 409: 618–622. 2001; Smith et al., loc. cit.).

The delimitation of families of extant pteridophytes had been very controversial in the past but a consensus has been emerging on overall relationships, based largely on molecular data from the chloroplast genome. This has shown that traditional characters, particularly those of venation, sori, and indusia, show many parallelisms and convergences such that related genera were placed in different, polyphyletic or paraphyletic, families. This had already been recognized by some botanists who identified many such anomalous genera and placed them within smaller, more homogenous families. The new molecular data showed that some of these families were nested within other families, rendering some families paraphyletic and thus untenable to some modern systematists. Thus, the decision was taken for the *Flora of China* to follow the most recent overall account of the pteridophytes at family level, that of Christenhusz et al. (*Phytotaxa* 19: 7–54. 2011), which is largely based on Smith et al. (loc. cit.). Christenhusz et al. proposed the recognition of 48 families, 38 of which occur within China. At generic level, various genera are recognized for *Flora of China* based on molecular and/or morphological evidence.

Pteridophytes were dominant land plants during the Carboniferous era and a major source of today's coal and oil. Extant pteridophytes are cosmopolitan but are much better represented in the humid tropics, with only a few families (e.g., Dryopteridaceae) well represented in subtropical and temperate regions and rather few extending into alpine regions (e.g., Woodsiaceae) and more arid regions (most notably Pteridaceae subfam. Cheilantheoideae).

In contrast to the 177 genera and 2,136 species recorded from China, the *Flora of North America*, covering a similar area, has only 96 genera and 554 species. This illustrates the size and importance of the pteridophyte flora of China, which is much richer than that of other comparable temperate areas and is probably the most species-rich country in the world.

Detailed citations for the corresponding volumes of *Flora Reipublicae Popularis Sinicae* (FRPS), volumes 2 (1959), 3(1) (1990), 3(2) (1999), 4(1) (1999), 4(2) (1999), 5(1) (2000), 5(2) (2001), 6(1) (1999), 6(2) (2000), and 6(3) (2004), are provided under each family in this volume.

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Systematic List of Families, Subfamilies, and Genera

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Glossary of Botanical Terms Used in this Volume

Accepted terms are indicated by **boldface**.

Within the definitions, *italics* (when not names of genera) indicate terms that are defined in this glossary.

(Most definitions have been taken or adapted with permission from Lellinger, D. B. 2002.

A modern multilingual glossary for taxonomic pteridology. Pteridologia 3. [Washington, D.C.]: American Fern Society, Inc.)

acroscopic – facing or directed toward the apex of the axis on which the structure is borne; cf. *basiscopic*.

acrostichoid – of *sori*, producing *sporangia* apparently or actually spread across the surface of the fertile *lamina*, usually densely so.

actinostele (adjective **actinostelic**) – a radially arranged, lobed *protostele* (as seen in cross section) associated with *microphylls*, commonly found in the Lycopodiaceae.

aerophore – a spot, swelling, or fingerlike projection of thin-walled cells found along the *stipe* or in the *pinna* or *pinnule* axils of some *ferns*, especially Thelypteridaceae; more prominent on young fronds.

alate – of *spores*, with the outer wall (*exospore* or *perispore*) raised in a pattern of narrow, winglike ridges surrounding depressions.

alete – of *spores*, spherical, lacking a *laesura*, and containing more sets of chromosomes than normal *spores*, found regularly or occasionally in some *apomictic ferns*.

anadromous – with the basal *pinnule* and/or vein group of the *pinna* directed toward the *frond* apex; cf. *catadromous*.

anisophyllous – bearing *fronds* or *microphylls* of unequal size, but of a single shape.

annulus (plural **annuli**, adjective **annular**) – a row or patch of partially or entirely thick-walled cells of the capsule of the *leptosporangium* which contracts and forces the capsule to open and to discharge its *spores*.

antheridium (adjective **antheridial**) – the male sex organ of *pteridophytes* borne on the *gametophyte* and producing *spermatozoids*.

apomixis (adjective **apomictic**) – the formation of a *sporophyte* from a *gametophyte* by direct, asexual development, rather than by fertilization of gametes.

apophysis (plural **apophyses**) – a swelling on which a sorus is located.

archegonium (plural **archegonia**) – the female sex organ of *pteridophytes* borne on the *gametophyte* and producing eggs.

areole (adjective **areolate**) – an area surrounded by anastomosing veins.

baculate – of *spores*, bearing cylindrical projections more than 1 μm long and less in diam., and usually with an obtuse to rounded apex.

basiscopic – facing or directed toward the base of the axis on which the structure is borne; cf. *acroscopic*.

blade – see *lamina*

bud – see *bulbil*

bulbil (adjective **bulbiliferous**) – a small, usually persistent, \pm globose, usually hairy or scaly, asexual propagule borne on a root, *rhizome*, or frond and capable or not capable of forming a plantlet, as in, e.g., certain *Asplenium*, *Bolbitis*, *Diplazium*, *Dryopteris*, *Huperzia*, *Polystichum*, *Tectaria*, and

Woodwardia species; synonyms *bud*, *bulblet*; see also *gemma* and *proliferous*.

bulblet – see *bulbil*

capsule – the part of a *sporangium* that contains the *spores*.

catadromous – with the *basiscopic pinnule* and/or vein group of the *pinna* the first to depart from its axis; cf. *anadromous*.

clypeate – shaped like a rounded shield.

coenosorus (plural **coenosori**) – a compound *sorus* composed of several contiguous *sori* fused end-to-end.

commissure (adjective **commissural**) – place where a commissural vein joins parallel, otherwise free veins along the *lamina* margin and often underlies a continuous, marginal *coenosorus*.

costa (plural **costae**, adjective **costal**, **costate**) – the major axis of a *pinna*; synonyms *midrib*, *midvein*.

costate – of *scales*, with a central line of cells different (usually darker) from the more marginal cells, as in certain Aspleniaceae and Dryopteridaceae; of *spores*, with the outer wall (*exospore* or *perispore*) raised in a pattern of relatively broad ridges with rounded crests.

costule (adjective **costular**, **costulate**) – the major axis of a *pinnule*; synonyms *midrib*, *midvein*, *rachilla*.

crozier – see *fiddlehead*

ctenitoid – of hairs, with adjacent cells collapsed at right angles to each other and often the end walls of the cells thickened or dark-colored, as on some *fronds* of *Ctenitis*.

dictyostele (adjective **dictyostelic**) – a *siphonostele* with more than one parenchymatic gap at a single level (as seen in cross section).

echinate – of *spores*, with the outer wall (*exospore* or *perispore*) raised in a pattern of long spines.

episore – a particular, outer, sporopollenin layer of the *spore* wall that is external to, but partially attached to, the *exospore* in some *heterosporous ferns* and *Equisetum*.

exine – see *exospore*

exospore – the principal sporopollenin layer of the *spore* wall internal to the *perispore*; synonym *exine*.

false indusium – an introrse, reflexed or revolute, often modified *lamina* margin that protects young *sporangia*.

false vein – an elongate series of thickened cells appearing to be a vein, but not connected to true veins and not functioning as a vein; found in the *laminae* of certain Aspleniaceae, Hymenophyllaceae, Marattiaceae, Pteridaceae, and Selaginellaceae.

ferns – the *pteridophytes* excluding the Isoëtaceae, Lycopodiaceae, and Selaginellaceae.

fiddlehead – the young, unexpanded, circinate apex of a *fern frond*; synonym *crozier*.

frond – the photosynthetic organ of *ferns*, usually consisting of a *stipe* and *lamina*; synonyms *leaf*, *megaphyll*.

gametophyte – an inconspicuous, non-vascular stage in the life cycle of a *pteridophyte* that bears gametangia with gametes. In *homosporous pteridophytes*, they are either surficial, thin, chlorophyllous, and various in shape (filamentous, ribbonlike, heart-shaped, or somewhat stellate) or subterranean, massive, achlorophyllous, and globose, cylindrical, or branched. In *heterosporous pteridophytes*, they are much reduced structures borne (and partially developing) within *spore* walls; synonyms *prothallium*, *prothallus*.

gemma (plural **gemmae**, adjective **gemmaiferous**) – a structurally specialized, asexual propagule found on some *gametophytes* that detaches and forms a new *gametophyte*; also used in the sense of *bulbil* in some African or European fern literature.

goniopteroid – of veins, a system of excurrent veinlets connected to more distal vein unions, or to a translucent line leading to a sinus, thus forming oblique rhomboid *areoles*.

hemitelioid – shaped like a shallow saucer or fan, usually firm and fully or partially surrounding the *sorus*, typical of certain Cyatheaceae.

heterosporous (antonym **homosporous**) – producing *spores* of two sizes, each of which develops *gametophytes* having gametangia of a single sex.

hydathode – a dark or sometimes pale area of the epidermis on the adaxial surface of the *lamina* that coincides with the endings of the veins and exudes water, salts, etc.

indusium (plural **indusia**, adjective **indusiate**) – a usually thin, often scalelike, epidermal membrane subtending and/or covering the *sorus*, that partially or fully protects the young *sporangia*.

intrastelar canal – a channel occurring within a *stete*.

isodromous – with the basal *pinnales* and/or vein groups of the *pinnae* strictly opposite.

isophyllous – having *fronds* or *microphylls* of a single size and shape.

laesura (plural **laesurae**) – the simple, elongate or triradiate, scar on the surface of *pteridophyte spores*; synonym *suture*.

lamina (plural **laminae**, adjective **laminata**) – the expanded portion of a *frond*, usually consisting of a *rachis* or *costa*, other axes or lateral veins, and expanded *lamina* tissue; synonym *blade*.

leaf – see *frond*

leptosporangium (adjective **leptosporangiate**) – a thin-walled, thin-pedicelled *sporangium* bearing usually 64 *spores* (32 in apomixises of the Dryopteridaceae, 128–512 in the Osmundaceae, and 256 in the Schizaeaceae) and formed usually from a single epidermal initial cell.

ligule (adjective **ligulate**) – a small, tongue-like, often triangular appendage located near the *microphyll* base (just distal to the *sporangium* on the adaxial surface of the *microsporophyll*); it is persistent in *Isoetes*.

lophate – of *spores*, with the outer wall (*exospore* or *perispore*) raised in a pattern of ridges (lophae) surrounding depressions.

lumen (plural **lumina**) – the central cavity of a cell, especially applied to the cells of clathrate *rhizome* scales.

lycophytes – collectively the Isoëtaceae, Lycopodiaceae, and Selaginellaceae.

massula (plural **massulae**) – in *Azolla*, a structure derived from the contents of the *microsporocarp* that contains the *microspores* and has glochidia (minute barbed hairs) protruding from its surface.

megagametophyte – in *heterosporous pteridophytes*, a female *gametophyte* borne within a *megasporangium* and bearing one or more *archegonia*.

megaphyll – see *frond*

megasporangium (plural **megasporangia**) – a *sporangium* bearing *megaspores*.

megaspore – a large *spore* of the *heterosporous pteridophytes* *Azolla*, *Isoetes*, *Marsilea*, *Pilularia*, *Regnellidium*, *Salvinia*, and *Selaginella* that produces a female *gametophyte*.

megasporocarp – a *sporocarp* that bears *megasporangia*.

megasporophyll – a fertile *microphyll* bearing or subtending a *megasporangium*.

microgametophyte – in *heterosporous pteridophytes*, a male *gametophyte* borne within a *microsporangium* and bearing one or more *antheridia*.

microphyll – the photosynthetic organ of the *lycophytes*, Equisetaceae, and Psilotaceae, always lacking a *stipe*, often small and generally supplied with a single vascular bundle; usually associated with a *protostele* or *siphonostele*.

microsporangium (plural **microsporangia**) – in *heterosporous pteridophytes*, a *sporangium* bearing *microspores*.

microsporocarp – a *sporocarp* that bears *microsporangia*.

microsporophyll – a fertile *microphyll* bearing or subtending a *microsporangium*.

midrib, *midvein* – see *costa*, *costule*, and *rachis*

monolete – of *spores*, bilaterally symmetric with a linear, unbranched *laesura*.

murus (plural **muri**, adjective **muriform**) – of *spores*, an elongate, wall-like protuberance.

paraphysis (plural **paraphyses**) – a minute, unicellular or multicellular (resembling a simple hair), usually elongate and sometimes glandular structure borne on the *soral receptacle*, on the *sporangium* capsule or pedicel.

perine – see *perispore*

perispore – the outermost, sporopollenin layer of the *spore* wall that is deposited on the *exospore*; synonym *perine*.

phyllopodium (plural **phyllopodia**) – in *ferns* with articulate *stipes*, that portion of the *stipe* proximal to the articulation that remains attached to the *rhizome*. Phyllopodia are especially prominent and stipelike in, e.g., *Elaphoglossum* and *Oleandra* but low and more like the *rhizome* and knoblike in *Adiantum*, Davalliaceae, and many Polypodiaceae.

pinna (plural **pinnae**, adjective **pinnate**) – a stalked or sessile, primary division of a compound *lamina* that is at least narrowed at the base.

pinnule – a stalked or sessile division of a *pinna* that is at least narrowed at the base.

plectostele (adjective **plectostelic**) – a vascular cylinder with the vascular tissue appearing to be \pm parallel plates (as seen in cross section), associated with *microphylls*, found in many Lycopodiaceae.

primordium – a part (e.g., a *frond*) in its most rudimentary form or stage of development.

proliferous – forming *bulbils* or plantlets, often on parts that normally have another function such as roots (e.g., *Platycterium*), stems and branchlets (e.g., *Huperzia*), *rachises* (e.g., most *Bolbitis*, *Diplazium*, *Dryopteris*, some Hymenophyllaceae, *Polystichum*, *Tectaria*, and *Woodwardia*) or *lamina* margin (e.g., some *Asplenium*).

prothallium, *prothallus* (plural *prothallia*, *prothalli*) – see *gametophyte*

protostele (adjective **protostelic**) – a simple vascular cylinder that lacks a pith of parenchyma in the center and is without parenchymatic gaps.

pteridophytes – non-seed-bearing vascular plants; *ferns* and *lycophytes* collectively.

pulvinus (plural **pulvini**) – a swollen structure at the base of a *frond* or at the base of *pinnae*, particularly common in the Marattiaceae.

rachilla – see *costule*

rachis – the principal, central axis of a pinnatifid or more compound *lamina*.

receptacle – the point or region of the *lamina* tissue, often thickened and amply supplied by one or more veins, that produces *sporangia* and sometimes *paraphyses* and/or sporangiasters.

rhizoid – an elongate, non-vascularized, uni- or paucicellular structure that serves to anchor the *gametophyte* and to absorb water and nutrients from the substrate.

rhizome – in *pteridophytes*, a scaly or hairy (rarely glandular or glabrous) anchoring stem that bears roots and *fronds*.

rhizophore – a specialized, aerial root of *Selaginella* that arises in the axils of stems and branches repeatedly when in contact with the substrate; it may occasionally differentiate into a stem, rather than a root.

rugate – of *spores*, bearing *muri* that are wide, rounded, and non-anastomosing and that do not form *areoles*.

sinus membrane – an elongate translucent membrane below the sinus in a *pinnule*.

siphonostele (adjective **siphonostelic**) – a vascular cylinder that has a pith of parenchyma in the center and phloem on both the outside and inside of the cylinder, or (in the Osmundaceae) only on the outside of the cylinder.

solenostele (adjective **solenostelic**) – a *siphonostele* with only one parenchymatic gap at a single level (as seen in cross section).

soriferous – bearing *sori*.

sorophore – the gelatinous, *sporangium*-bearing ring produced by *sporocarp* (as in the Marsileaceae) during germination.

sorus (plural **sori**, adjective **soral**) – a cluster of *sporangia*.

spermatozoid – a motile male sex cell (gamete) produced in the *antheridium*.

sporangiophore – a greatly transformed, peltate *sporophyll* bearing a ring of ca. 6 *sporangia* facing the axis of the *strobilus* of *Equisetum*.

sporangium (plural **sporangia**) – the *spore*-producing structure of *pteridophytes*.

spore – a spherical, tetrahedral, or reniform, often elaborately ornamented, reproductive cell that is produced within the *sporangium* and germinates to form a *gametophyte*.

sporocarp – in *Marsilea*, the hard, short- to long-pedunculate, nutlike structure containing the *sporangia*, apparently a highly modified leaflet; in *Azolla* and *Salvinia*, a thin, short-stalked, globose structure containing the *sporangia*, apparently a modified *indusium*.

sporophore – the fertile portions of a hemidimorphic *frond* as in the Ophioglossaceae.

sporophyll – in *ferns*, a *frond* bearing *sporangia*; in the *lycophytes*, Equisetaceae, and Psilotaceae, a *microphyll* subtending a *sporangium*; in *Isoetes*, an elongate *microphyll* bearing a *sporangium* within its base.

stele (adjective **stelic**) – the vascular and associated tissues of a rhizome or other type of stem; see also *dictyostele*, *protostele*, *siphonostele*, and *solenostele*.

stipe (adjective **stipitate**) – the structure of a *frond* that connects the base of the *lamina* to the point of its attachment to the *rhizome*.

stipicel – a term sometimes used for the stalk of a *pinna* or *pinnule*.

stipule – in the Marattiaceae, each one of a pair of lateral, fleshy, starch-bearing, persistent, partially or entirely vascularized outgrowths of the *rhizome* that clasp the base of the *stipe* and that are capable of vegetatively reproducing the plants; in the Ophioglossaceae, merely the remnants of the older *stipe* base that originally enclosed and protected the younger, less developed *fronds*.

strobilus (plural **strobili**) – in the *lycophytes* and Equisetaceae, a compact reproductive structure borne at the tips of branches or axes consisting of a central axis bearing closely spaced, spirally arranged *sporophylls* or *sporangiophores*.

suture – see *laesura*.

synangium (plural **synangia**) – a group of *sporangia* partially or entirely fused laterally, as in *Psilotum* and Marattiaceae.

trilete – of *spores*, radially symmetric (spherical or tetrahedral) with a *laesura* with three radiating branches.

trophophyll – a vegetative, nutrient-producing *frond* or *microphyll*.

trophopod – the enlarged, persistent, basal portion of a *stipe* that functions as a storage organ.

valve – an involucre lobe, especially in *Hymenophyllum* and some Dicksoniaceae and Dennstaedtiaceae; also, each half of a *sporangium* that is divided into halves, as in the Lycopodiaceae and Osmundaceae.

vascular bundle – an elongate strand of conducting cells (xylem tracheids and phloem sieve cells) that serve to conduct water, mineral nutrients, and photosynthetic products.

velum – in *Isoetes*, the membrane covering part or all of the *sporangium*-containing cavity (fovea) in the base of a *microphyll*.

Key to Families

- 1a. Sporangia solitary in axils of simple or once-forked leaves.
- 2a. Plants stemless, leaves all fertile, linear, in dense rosettes from subterranean corm, each with sporangium imbedded in base Isoëtaceae
- 2b. Plants with creeping or ascending stems, sometimes scandent, erect, or plants epiphytic and pendent; leaves small, often overlapping, sporangia superficial, absent on lower leaves.
- 3a. Sporangia 3-lobed, subtended by forked sporophyll; stems with widely spaced, alternate, scalelike leaves Psilotaceae
- 3b. Sporangia not lobed, subtended by simple undivided leaves; stems with closely spaced, \pm overlapping, subulate to ovate leaves.
- 4a. Spores of two kinds: large megaspores and much smaller microspores; vegetative shoots often dorsiventral with leaves in 4 ranks, 2 median, with smaller leaves, and 2 lateral, less often uniform and spirally arranged Selaginellaceae
- 4b. Spores of one kind, always very small; vegetative shoots usually with leaves uniform and spirally arranged, rarely lateral branches obviously flattened but then leaves not in 2 ranks, sometimes fertile leaves reduced Lycopodiaceae
- 1b. Sporangia several to very many together borne directly on surface of fronds or frond axes or on specialized sporophores borne on frond or in achlorophyllous strobili, sometimes enclosed within sporocarp or indusium.
- 5a. Sporangia borne on hexagonal peltate sporophores organized into very distinct terminal achlorophyllous strobili; aerial stems usually hollow, longitudinally ridged, articulate, with base of internode surrounded by tubular sheath, branches absent or whorled, rarely irregular at node Equisetaceae
- 5b. Sporangia borne on fronds, these sometimes modified into sporocarps enclosing sporangia; stems never hollow [rarely with irregular ant-infested chambers outside Flora area], not articulate, branches when present never whorled.
- 6a. Sporangia enclosed within sporocarps; small ferns of very wet situations, often floating in water, pinnae 1–25 mm.
- 7a. Plants rooted in mud; fronds long stipitate, with 4 palmate pinnules [fewer or frond linear outside Flora area] Marsileaceae
- 7b. Plants free floating (sometimes stranded on mud); fronds sessile, usually floating on water surface Salviniaceae
- 6b. Sporangia borne on surface of frond or on specialized sporophore arising from frond; mostly ferns of well-drained situations, if growing in water then fronds much larger, pinnately (or palmately-pedately) divided.
- 8a. Fronds 3-dimensional, divided near base (or middle) into a fertile terminal “panicle” or “spike” and a sterile segment (simple, pinnatifid, or ternate), usually fleshy, vernation usually nodding; caudex subterranean, short, usually erect (horizontal in *Helminthostachys*); apex surrounded by a sheath Ophioglossaceae
- 8b. Fronds and caudex not as above, vernation circinate, rarely hooked in some Pteridaceae; apex not sheathed.
- 9a. Fronds vinelike with a twining rachis Lygodiaceae
- 9b. Fronds not vinelike, sometimes scrambling but never with a twining rachis.
- 10a. Fronds membranous, 1 cell thick, or rarely with 2–4 cell layers without intercellular spaces and stomata; sporangia borne on an extended veinlet (receptacle); indusia tubular or 2-lipped, borne on tips or upper margins of segments Hymenophyllaceae
- 10b. Fronds herbaceous to leathery, several cells thick with intercellular spaces and stomata; sporangia not borne on extended veinlets.
- 11a. Ferns treelike with an erect trunklike rhizome, with large compound fronds in a crown at apex.
- 12a. Fertile pinnae without visible lamina; sporangia in dense clusters directly on rachis and rachillae, not covered by indusium or modified lamina Osmundaceae
- 12b. Fertile pinnae with distinct lamina; sporangia in orbicular or linear sori or along veins and eventually \pm acrostichoid.
- 13a. Stem usually over 8 cm in diam.; sori orbicular or linear along veins and eventually \pm acrostichoid.
- 14a. Sori discrete, orbicular, medial, with cuplike or scalelike indusia or exindusiate Cyatheaceae
- 14b. Sori linear along veins and eventually \pm acrostichoid Blechnaceae (*Brainea*)
- 13b. Stem usually less than 8 cm in diam.; sori linear.
- 15a. Sori parallel to lateral veinlets or costules, indusia often double Athyriaceae (*Diplazium*)
- 15b. Sori parallel to costa, indusia not double Blechnaceae (*Diploblechnum*)
- 11b. Ferns with rhizome short, creeping or climbing, sometimes massive but then prostrate or hardly longer than wide, never treelike.

- 16a. Fronds erect, linear or dichotomously divided into linear lobes with sporangia borne on terminal tufts of linear lobes (“sorophores”); sporangia flask-shaped with subapical annulus Schizaeaceae
- 16b. Fronds various, if with linear lobes then sporangia borne on surface of lamina; sporangia not flask-shaped, annulus vertical or oblique.
- 17a. Fronds pseudodichotomously branched, with a dormant bud in axils of regularly dichotomous forks; ultimate branches pinnate or bipinnatifid; sori orbicular, exindusiate, sporangia few Gleicheniaceae
- 17b. Fronds simple, pinnate, palmate, or pedate, never with buds in axils of branch forks (ignore budlike bulbils along costa or rachis, not associated with branching).
- 18a. Fertile fronds or pinnae ± without visible lamina; sporangia in dense clusters directly on rachis and rachillae, not covered by indusium or modified lamina.
- 19a. Fronds simple, fertile lamina ± reduced to single costa Polypodiaceae (*Leptochilus*)
- 19b. Fronds compound.
- 20a. Climbing, later epiphytic, ferns with long rhizomes and widely spaced fronds Dryopteridaceae (*Lomagramma*, *Teratophyllum*)
- 20b. Terrestrial ferns with stout erect rhizomes and clustered fronds.
- 21a. Stipe with enlarged base; rachis with cushionlike or long and hornlike aerophores at bases of pinnae Plagiogyriaceae
- 21b. Stipe without enlarged base; rachis without aerophores.
- 22a. Sporangia opening by an apical slit, annulus lateral; spores green Osmundaceae
- 22b. Sporangia opening by a lateral tear, annulus vertical; spores not green Dryopteridaceae (*Bolbitis*)
- 18b. All pinnae with lamina, sporangia borne on abaxial surface or at margin, sometimes pinnae very narrow with lamina inrolled to cover sporangia.
- 23a. Fronds with brown leathery stipules at base of swollen stipe, and a pulvinus at base of each pinna; sporangia in synangia or ± free, without annulus Marattiaceae
- 23b. Fronds with neither stipules nor pulvini (Plagiogyriaceae with swollen aerophores at base of pinna); sporangia not fused into synangia, with obvious annulus of thick-walled cells.
- 24a. Sporangia acrostichoid, uniformly covering abaxial side of lamina.
- 25a. Lamina with stellate hairs or scales on one or both surfaces.
- 26a. Fronds lobed to deeply divided, sterile fronds sessile, base deeply asymmetrically auriculate, strongly adpressed to substrate and hiding rhizome, fertile fronds ± stipitate, dichotomously lobed, not adpressed Polypodiaceae (*Platyserium*)
- 26b. Fronds entire or 1-pinnate, sterile and fertile fronds stipitate, or if sessile then base attenuate to cuneate, not adpressed to substrate, rhizome not hidden; fertile fronds or pinnae similar to sterile fronds but longer and narrower Dryopteridaceae (Subfam. Elaphoglossoideae)
- 25b. Lamina with simple hairs or glabrous.
- 27a. Sterile fronds without a distinct costa, lamina simple, bifid, or palmatifid with 3–5 main longitudinal veins Dipteridaceae (*Cheiropleuria*)
- 27b. Sterile fronds or pinnae each with a distinct costa.
- 28a. Stipe with enlarged base; rachis with cushionlike or long and hornlike aerophores at bases of pinnae; scales absent Plagiogyriaceae
- 28b. Stipe without enlarged base; rachis without aerophores; scales present.
- 29a. Rhizome scales clathrate; lamina simple; fronds remote Polypodiaceae (*Leptochilus*)
- 29b. Rhizome scales not clathrate; lamina pinnate to pinnatifid or pinnatilobed; fronds often clustered.
- 30a. Plants epiphytic or epilithic, with creeping or climbing rhizomes; pinnae articulate at base.
- 31a. Veins free Lomariopsidaceae (*Lomariopsis*)
- 31b. Veins anastomosing Dryopteridaceae (*Lomagramma*)
- 30b. Plants terrestrial or epilithic in forests, with erect or creeping rhizomes; pinnae not articulate.
- 32a. Fronds clearly dimorphic (except *Tectaria coadunata*) Tectariaceae (*Tectaria* s.l.)
- 32b. Fronds ± monomorphic, fertile pinnae only slightly smaller.
- 33a. Pinna margin entire, crenate, or lobed, with or without teeth or spines, rachis usually with bulbils; growing in forests, often on rocks near streams, often over 100 m Dryopteridaceae (*Bolbitis*)

- 33b. Pinna margin entire; bulbils absent; growing in coastal areas, often in mangrove forests, below 100 m Pteridaceae (*Acrostichum*)
- 24b. Sporangia distributed along veins, discrete sori or coenosori on abaxial side of lamina or along margin (not acrostichoid).
- 34a. Aquatic ferns; fronds 2- or 3-pinnatifid; sori marginal, covered by reflexed lamina margin Pteridaceae (*Ceratopteris*)
- 34b. Terrestrial, epiphytic, or epilithic ferns; fronds and sori often not as above.
- 35a. Sori exindusiate, superficial, or sometimes sunken or borne in grooves, not covered by a reflexed lamina margin.
- 36a. Lamina narrowly linear, grasslike, erect or pendent; sporangia in coenosori, borne in strictly marginal grooves, in 2 submarginal lines, or a single line along costa Pteridaceae (Subfam. Vittarioideae p.p.)
- 36b. Lamina not grasslike, sori not as above.
- 37a. Sporangia in indefinite sori, scattered along veins, not parallel to costa.
- 38a. Epiphytic ferns; fronds simple, elliptic or oblanceolate, with linear or clavate paraphyses interspersed with sporangia Pteridaceae (*Antrophyum*)
- 38b. Terrestrial ferns; fronds pinnatifid to pinnately compound.
- 39a. Fronds dimorphic, fertile fronds with much-reduced lamina Tectariaceae (*Tectaria* s.l.)
- 39b. Fronds \pm monomorphic, fertile frond sometimes with lamina slightly reduced but not conspicuously so.
- 40a. Fronds 2–4-pinnate, sometimes also simple or pinnatifid, abaxially glabrous, farinose, densely covered with a mass of brown hairs, or sparsely covered with scales; typically ferns of exposed and/or dry situations Pteridaceae (Subfam. Cheilantheoideae, *Pityrogramma*)
- 40b. Fronds 1- or 2-pinnate or pinnatifid, or simple, abaxially hairy or glabrous; typically ferns of forest understory, often along streams.
- 41a. Lamina rough, with dense hooked thick hairs on both surfaces; veinlets reticulate, areoles in 3 or 4 rows Thelypteridaceae (*Dictyocline*)
- 41b. Lamina glabrous or with hairs on one or both surfaces; veins free or rarely anastomosing near midrib, then free Pteridaceae (*Coniogramme*)
- 37b. Sporangia in definite sori, or coenosori.
- 42a. Fronds fan-shaped, deeply cleft into 2 halves, each half dichotomously divided into linear lobes; sori many, small, orbicular Dipteridaceae
- 42b. Fronds not as above.
- 43a. Fronds simple, pinnatifid, or 1-pinnate, rarely pedately lobed Polypodiaceae
- 43b. Fronds bipinnatifid to decompound.
- 44a. Rhizome, stipe, and lamina without scales or ordinary hairs; lamina delicate, with blunt, yellow, glandular hairs Dennstaedtiaceae (*Monachosorum*)
- 44b. Rhizome, stipe, and/or lamina with scales and/or hairs; lamina hairs when present not all blunt, yellow, and glandular.
- 45a. Fronds hairy or scaly, especially on abaxial side of costae.
- 46a. Plants epiphytic or epilithic, often in moss; lamina 8–25 cm Polypodiaceae
- 46b. Plants terrestrial; lamina (25–)50–100+ cm.
- 47a. Fronds with scales Cyatheaceae
- 47b. Fronds with hairs Thelypteridaceae
- 45b. Fronds glabrous or with sparse hyaline or pale yellow glands.
- 48a. Pinnae not articulate; fleshy hornlike processes borne in grooves at base of costae and costules Athyriaceae (*Cornopteris*)
- 48b. Pinnae articulate to rachis; fleshy hornlike processes absent.
- 49a. Plants terrestrial; lateral veins simple or occasionally forked, terminating at margin Cystopteridaceae (*Gymnocarpium*)
- 49b. Plants epiphytic; veins in ultimate lobes simple, not reaching margin Polypodiaceae (*Gymnogrammitis*)
- 35b. Sori with a true indusia, or covered by \pm modified reflexed lamina margin (false indusium).

- 50a. Indusia 2-lipped, borne along margins of segments, near their bases; fronds large, tripinnate; rhizome and stipes covered with long golden brown hairs Cibotiaceae
- 50b. Indusia not 2-lipped; rhizome and stipe base without long brown hairs.
- 51a. Sori marginal or submarginal.
- 52a. Rhizome and stipe with unicellular or multicellular hairs or rarely bristles ... Dennstaedtiaceae
- 52b. Rhizome and stipe scaly, at least at base, scales sometimes very narrow.
- 53a. Sori protected by true indusia opening toward margin.
- 54a. Indusia orbicular-reniform; fronds pinnate with pinnae articulate to rachis Nephrolepidaceae
- 54b. Indusia linear, oblong, cup-shaped, or tubular.
- 55a. Stipe not articulate to rhizome; indusia linear or oblong; rhizome scales very narrow Lindsaeaceae
- 55b. Stipe articulate to rhizome; indusia tubular, cuplike, or scalelike; rhizome scales broad Davalliaceae
- 53b. Sori protected by revolute lamina margin.
- 56a. Fronds usually monomorphic, if dimorphic then pinna margin not inrolled to costa Pteridaceae
- 56b. Fronds strongly dimorphic, pinna margin inrolled nearly to costa.
- 57a. Fertile fronds green; sori orbicular or elliptic, confluent when mature; false indusium broad, continuous, covering abaxial surface making fertile segment appear podlike Pteridaceae (*Cryptogramma*)
- 57b. Fertile fronds often becoming purplish brown; sori orbicular, with raised receptacles and indusiate, or confluent into linear coenosori Onocleaceae
- 51b. Sori between costae and margin, occasionally also with a few borne near lamina margin.
- 58a. Sori oblong to linear, straight or curved.
- 59a. Sori parallel to costae and/or costules Blechnaceae
- 59b. Sori parallel to lateral veins, at angle to costa; stipe base with 2 vascular bundles.
- 60a. Veins anastomosing to form 2–4 rows of areoles; indusia sometimes adhering at their margin and rupturing irregularly Diplaziopsidaceae
- 60b. Veins usually free and not forming rows of areoles (anastomosing in some species of *Asplenium*); indusia not adhering at margin and not rupturing.
- 61a. Acroscopic base of pinna and pinnule much larger than basicopic base Rhachidosoraceae
- 61b. Bases of pinna and pinnule equilateral or sometimes inequilateral, or lamina imparipinnate.
- 62a. Scales dull, not finely clathrate; two vascular strands at base of stipe uniting in upper stipe to form a single U-shaped strand; indusia curved, J-shaped, or reniform and crossing a veinlet Athyriaceae
- 62b. Basal stipe scales clathrate; two vascular strands at base of stipe uniting in upper stipe to form a single X-shaped strand; indusia straight Aspleniaceae
- 58b. Sori orbicular or rarely \pm elliptic.
- 63a. Sori long stalked, one per ultimate segment, indusia dark brown to black Dryopteridaceae (*Dryopteris* sect. *Peranema*)
- 63b. Sori sessile, often more than one per segment, indusia paler in color.
- 64a. Indusia completely surrounding receptacle and composed of filaments or scalelike segments forming a cup around sorus or membranous and completely enclosing sorus; costae abaxially without scales Woodsiaceae
- 64b. Indusia attached centrally or laterally, not completely surrounding receptacle; costae abaxially with or without scales.
- 65a. Fronds with stipes articulate to phyllopodia, or fronds 1-pinnate with pinnae articulate to rachis.
- 66a. Fronds simple Oleandraceae
- 66b. Fronds pinnate.

- 67a. Individual pinnae articulate.
 - 68a. Rhizome without stolons; sori in several rows
between midrib and margin Lomariopsidaceae (*Cyclopetlis*)
 - 68b. Rhizome forming stolons; sori in a single row
between midrib and margin Nephrolepidaceae
- 67b. Frond articulate at base of stipe, pinnae not articulate.
 - 69a. Fronds 3- or 4-pinnate; phyllopodia short and
indistinct Hypodematiaceae (*Leucostegia*)
 - 69b. Fronds 1-pinnate; phyllopodia long and stipelike Tectariaceae (*Arthropteris*)
- 65b. Fronds with stipes and pinnae not articulate.
 - 70a. Rachis with an adaxial groove confluent with grooves of rachillae.
 - 71a. Base of stipe with several vascular bundles Dryopteridaceae
 - 71b. Base of stipe with 2 vascular bundles.
 - 72a. Veins free, reaching segment margin; indusia when present
basal, a minute hoodlike scale, arching over sorus, frequently
deciduous Cystopteridaceae
 - 72b. Veins anastomosing or free, usually ending before segment
margin; indusia lateral, vaulted or essentially flat,
opening along lateral margin, usually persistent Athyriaceae (*Anisocampium*)
 - 70b. Rachis without an adaxial groove, or if grooved then
groove not confluent with grooves of rachillae.
 - 73a. Veins anastomosing.
 - 74a. Indusium reniform Tectariaceae
 - 74b. Indusium peltate Dryopteridaceae (*Cyrtomium*)
 - 73b. Veins free.
 - 75a. Fronds 3- or 4-pinnate Hypodematiaceae
 - 75b. Fronds 1- or 2-pinnate.
 - 76a. Stipe, rachis, costae, and veins with multicellular scalelike
or moniliform hairs and/or scales, rarely glabrous and then
lamina simple or pinnatilobate Athyriaceae (*Deparia*)
 - 76b. Costae glabrous or sometimes with sparse short terete
hairs adaxially; lamina 2-pinnatifid Tectariaceae (*Pteridrys*)