Volume 36 Number 2 & 3 Apr-June 2009

Fiddlehead forum

Bulletin of The American Fern Society

ISSN 0733-8015

Editors: Joan Nester-Hudson and David Schwartz

Polypods Exposed

by Tom Stuart

What is a polypod?

The genus *Polypodium* came from the biblical source, the *Species Plantarum* of 1753. Linnaeus made it the largest genus of ferns, including species as far flung as present day *Dryopteris*, *Cystopteris* and *Cyathea*. This apparently set the standard for many years as a broad lumping ground.

The family Polypodiaceae was defined in 1820 and its composition has never been stagnant. Now it is regarded as comprising 56 genera, listed in Smith *et al.* (2008). As a measure of the speed of change, thirty years ago about 20 of these genera were in different families, a few were yet to be created or resurrected, and several were often regarded as sub-genera of a broadly defined *Polypodium*. Estimates of the number of species vary, but they are all well over 1000.

The objectives here are to elucidate the differences between the members of the family and help you identify an unknown polypod. First let's separate the family from the rest of the ferns. The principal family characteristics include (glossary at the end):

- a creeping rhizome as opposed to an erect or ascending one
- fronds usually jointed to the rhizome via phyllopodia
- fronds in two rows with a row on either side of the rhizome
  The aforementioned characters define the family with the major exception of the grammitid group.
- mainly epiphytic, occasionally epilithic, rarely terrestrial, never aquatic (unique exception: *Microsorum pteropus*)

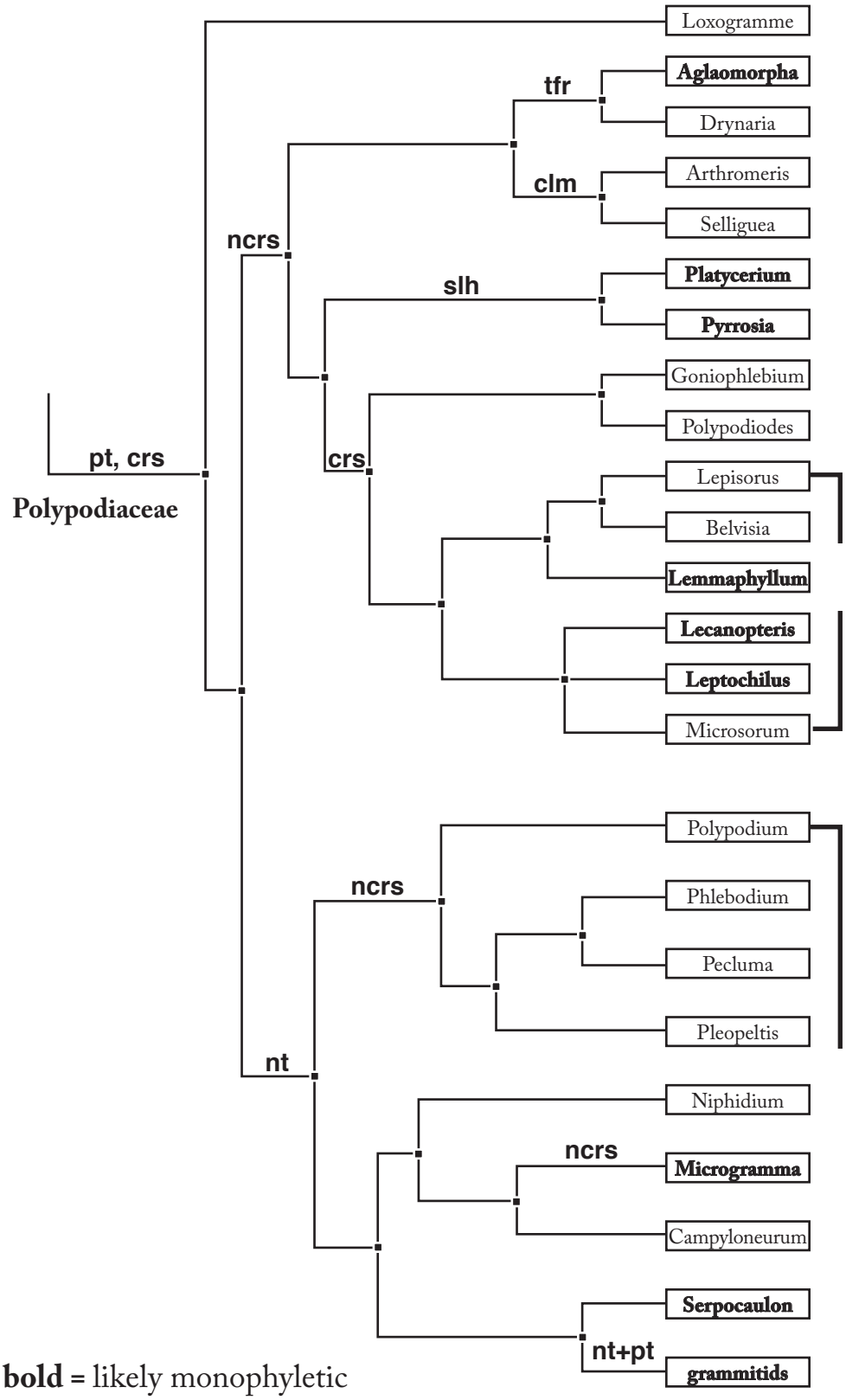
Epiphytic fern groups are few: the families Davalliaceae, Hymenophyllaceae, Vittariaceae, and some *Asplenium* and *Elaphoglossum*. Only the Davalliaceae and a few *Elaphoglossum* meet all three rhizome characters; the qualifying *Elaphoglossum* are also distinguished by prominent aerophores (peg-like protrusions) on the rhizome next to the fronds, a character never found in the Polypodiaceae. The Davalliaceae fail to meet the next character.

- sori often round or elongate, always exindusiate
- lamina simple, lobed, pinnatifid or pinnate, rarely more divided
- largely tropical; *Polypodium* has perhaps 15 temperate species, *Pyrrosia* several, other genera few or none

The focus here is further restricted to the cultivated genera in the family. This eliminates the grammitids–a dozen or so genera, formerly the members of the Grammitidaceae– and another 15-20 monotypic or small genera. What follows embraces 24 genera.

For historical comparison Hoshizaki (1982) keyed and described nine genera of polypods and Hoshizaki and Moran (2001) compared 16 genera with *Polypodium*. The situation has changed. The last five or ten years of molecular studies have built an increasingly sturdy framework.

Phylogeny of Polypods



bold = likely monophyletic
elbow sidebar = paraphyletic
otherwise = insufficient evidence
pt, nt, crs, ncrs, tfr, clm, slh

see text on page 11

We now have a rather good idea of the relationships within and between taxa. A clade is comprised of a parent and its descendants, and is said to be monophyletic. The family Polypodiaceae (as listed by Smith *et al.*, 2008) is monophyletic and most of the genera within it probably are too. This was not so much the case before the Thirty Years War. Generic names that do not fit this description are said to be paraphyletic. They are also not long for this world, at least under their current circumscription and taxonomic practice.

The chart of relationships–the phylogeny–at left tells the tale. Recent phylogenies are based on DNA sequences and consequently built from individuals. We take the liberty of extrapolating to species and genera. Ground-breaker accounts sampling nearly all the genera here would be the papers by Schneider *et al.* (2004a) and Schneider *et al.* (2004b), extending to the details in Scheuttpelz and Pryer (2008). Genera with substantial representation in studies are *Aglaomorpha, Drynaria, Microgramma, Platycerium, Pleopeltis* and *Pyrrosia* (Janssen *et al.*, 2007), *Lecanopteris* (Haufler *et al.*, 2003), *Leptochilus* (Dong *et al.*, 2008), *Microsorum* and *Polypodium* (Schneider *et al.,* 2004b), *Lecanopteris, Lemmaphyllum, Lepisorus, Leptochilus,* and *Microsorum* (Kreier *et al.*, 2008a), *Microgramma* (Salino *et al.*, 2008), *Platycerium* (Kreier and Schneider, 2006) and *Serpocaulon* (Smith *et al.,* 2006). By **substantial** is meant these genera have been sampled enough to test the monophyly. Other genera–including all those treated here–have been sampled to some extent, but perhaps not sufficiently so to draw a conclusion. This family cladogram is a composite of the cited phylogenies.

On the chart I have added characters that are shared–usually not exclusively–above the generic level. The first two have nothing to do with morphology, but sure are interesting.

- pt paleotropical, Old World
- nt neotropical, New World
- crs clathrate rhizome scales
- ncrs non-clathrate rhizome scales
- tfr thick, fleshy rhizomes
- slh stellate laminar hairs
- clm cartilaginous laminar margin

Is this evolutionary development–as reflected in the branching–now final, fixed? No, but it does appear near the end of revisions. Compare it, for example, with the Ranker and Hauffler (2006) Fiddlehead Forum article on polygrammoids (the amalgam of polypods and grammitids). Despite adding considerable data in the last three years, the tree has not changed very much.

Why is this tree important?

The molecular results are welcome because they allow us to hypothesize the relationships before inspecting the morphology. Early pteridologists had no such guidelines. Now how do we decide which polypod we have?

If the world were simple, unique morphological changes would accompany each evolutionary branch, reflecting the phylogeny. However, that's not where we live. In the real world changes are followed by reversals. For example, one of the unifying features of the family is the rhizome indument, almost universally scales in the Polypodiaceae. These scales start out as clathrate (crs on the phylogram), then encounter reversals to non-clathrate (ncrs) and in one case a switch back to clathrate. Moreover, some members of the ant fern genus *Lecanopteris* have the scales reduced to rhizome hairs. Reversals are part of the game.

Several genera do have one or two singular characters, but the rule is that uniqueness is unusual. Though the pteridologist with a laboratory has access to other characters, for our purposes these few (in the gamut of visible features) are totally inadequate to construct a key. If a natural, phylogenetic key is impossible, can we construct an artificial one?

Yes, we can. What you need to use the key is:

- a fertile plant
- a hand lens

Nothing more. The characters used in the following key are fairly easy to see, at least with the hand lens. Underlined terms are expanded in the glossary.

Caveat: given the lack of agreement on generic boundaries and reversals, please do not shoot the messenger when a misfire occurs. Known exceptions are mentioned in the table Characters of Polypods and in the next section, Distinguishing Generic Characters.

Key to Cultivated Polypods

1. Stellate hairs present on lamina	
2. Fronds with both sterile, papery nest fronds and fertile, forked, foliage fronds	*Platycerium*
2. Fronds monomorphic or nearly so (e.g., taller, narrower)	*Pyrrosia*
1. Stellate hairs absent	
3. Rhizomes swollen with hollow interior, blue-green when young, becoming blackish	*Lecanopteris*
3. Rhizomes otherwise	
4. Rhizomes forming globose tubers on short branches	*Microgramma subgenus Solanopteris*
4. Rhizomes otherwise	
5. Some fronds or frond bases dry, papery, brown; foliacious fronds or frond parts leathery; nectaries next to rachis; rhizomes stout, more than 1 cm thick	
6. Terminal pinna present	
7. Separate nest fronds present	*Drynaria*
7. Nest fronds absent or formed from base of foliage fronds	*Aglaomorpha*
6. Terminal pinna absent, abortive	*Drynaria*
5. Fronds and rhizomes without this combination of characters	
8. Fronds comb-like w/ narrow pinnae	*Pecluma*
8. Fronds otherwise	
9. Fronds simple w/ conspicuously constricted tail-like apex	*Belvisia*
9. Fronds otherwise	
10. Lamina margin cartilaginous (inspect closely) OR sparsely notched	
11. Blade pinnate and pinnae jointed to rachis	*Arthromeris*
11. Blade simple OR pinnatifid OR pinnae not jointed to rachis	*Selliguea*
10. Lamina margin not cartilaginous, not notched	
12. Venation: only rachis (and costae if pinnatifid/pinnate) visible, finer veins obscured	
13. Fronds dimorphic	*Lemmaphyllum*
13. Fronds monomorphic or nearly so	
14. Lower lamina surface (excluding the midrib) glabrous or sparsely hairy	*Campyloneurum*
14. Lower lamina surface with scales	
15. Lower lamina surface with peltate scales	*Pleopeltis*
15. Lower lamina glabrous or fugacious, basifixed scales	*Lepisorus*
12. Venation: finer veins visible	
16. Veins free, forking	*Polypodium*
16. Veins netted, forming areolae	
17. Costal areolae uniform, pentagonal-hexagonal; subsequent rows (if present) chevron-shaped	
18. Upper stipe channeled or flattened	*Serpocaulon*
18. Stipe circular in cross-section	
19. Blade pinnate, at least in the lower portion	*Goniophlebium*
19. Blade pinnatifid throughout	*Polypodiodes*
17. Costal areolae irregular or if uniform, not pentagonal-hexagonal; subsequent rows (if present) not chevron-like	
20. Sori acrostichoid or in coenosori or elongate	
21. Rhizome scales peltate	*Leptochilus*
21. Rhizome scales basifixed, not in cultivation	*Loxogramme*
20. Sori round or oblong/oval	
22. Blade pinnatifid or pinnate	
23. Areolae only along costa OR occasional	*Polypodium*
23. Areolae spread over the lamina	
24. Sori in rows on each side of the costa, paraphyses absent	
25. Sori supported by two veinlets	*Phlebodium*
25. Sori supported by one veinlet	*Campyloneurum*
24. Sori scattered or in irregular rows, paraphyses present	*Microsorum*
22. Blade simple	
26. Sori in regular rows	
27. Prominent veins oblique to the rachis, sori between them	
28. Sori in one row between oblique veins	*Niphidium*
28. Sori in two or more rows between oblique veins	*Campyloneurum*
27. No such veins, sori in one row on each side of rachis	*Microgramma*
26. Sori scattered or in irregular rows	
29. Rhizome scales clathrate	*Microsorum*
29. Rhizome scales non-clathrate	*Microgramma microsoroides*

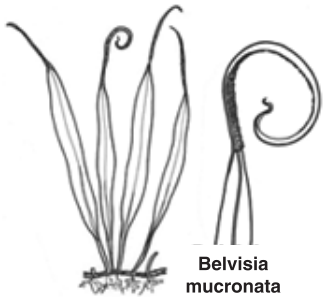
Distinguishing Generic Characters


Aglaomorpha splendens

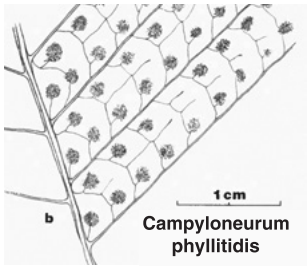
Aglaomorpha, always large ferns with pinnatifid to pinnate fronds from thick, scaly rhizomes, shares these characteristics with *Drynaria,* but is distinguished by its lack of separate base-fronds and the presence of a fully developed terminal pinna. Some species possess a constricted upper, fertile portion (as in the frond on the left in the illustration) though not the extreme tail-like apex of *Belvisia* (fronds always simple, small). Following senescence the bottom part of the frond sometimes persists, turning brown, after the rest of the blade has dropped, so then functions like the sterile base, humus-collecting fronds of *Drynaria*. The base-fronds of *Drynaria* come at emergence; the base-fronds of *Aglaomorpha* develop (if present) with aging. An interesting feature is translucent nectaries near the junction of rachis and costae, also found in some *Drynaria*. The nectaries shut up shop as the frond matures. Purpose unknown. Sounds like a subprime mortgage for ants followed by foreclosure. *Aglaomorpha* are among the largest ferns. *Aglaomorpha heraclea* of Malesia with 2 meter fronds is the largest epiphytic fern. *Aglaomorpha coronans* is encountered most often in commerce.


Arthromeris proteus

Arthromeris, a medium-sized fern, looks like a pinnate *Selliguea* with pinnae jointed to the rachis. It shares the character of a cartillaginous margin with *Selliguea* though the margin is usually more prominent in *Arthromeris.* A couple of *Goniophlebium* species possess these margins as well, but they can be distinguished on other grounds: the irregular areolae cover the entire lamina in *Arthromeris*, the regular areolae next to the costa in *Goniophlebium* become free veining near the margin. Rhizome scales are non-clathrate in *Arthromeris*, clathrate in *Goniophlebium*.


Belvisia mucronata

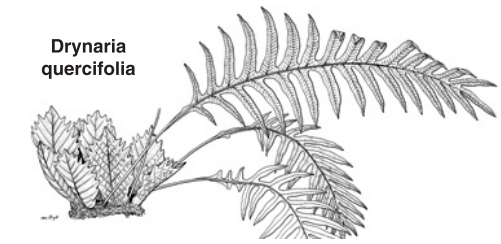
Belvisia, the Rat-tail fern, is quickly recognized by the simple, narrow fronds with an even narrower fertile spike which bears a coenosorus on both sides of the rachis. Native from Africa to Malesia, Polynesia and Australia, it is closest to *Lepisorus*, but the blade tip is not contracted in the latter. *Belvisia mucronata* from Indochina, Malesia, Pacific Islands and Australia is depicted at the left. It is occasionally offered for sale.



Campyloneurum phyllitidis

Campyloneurum, the Strap fern, has small-to-large simple fronds and differs from the closely related *Niphidium* in having two or sometimes more, rather than one, rows of sori between the oblique lateral veins. Also, the secondary veins often arch between the lateral veins in *Campyloneurum*, while the areolae are irregular in shape and placement in *Niphidium*. A few species seemingly lack lateral veins, and these ferns have scattered sori. In either case the sori are borne on a single veinlet within areolae, another distinction from *Niphidium* (at the junction of veinlets). The fronds are either glabrous or sparsely hairy. *Campyloneurum* in cultivation is represented by *C. angustifolium* and *C. phyllitidis*. Both are native to Florida as well as the West Indies, Mexico, Central and South America.

Colysis is a widely used name, sometimes considered a synonym for *Leptochilus, q.v.*, and sometimes applied to the species without highly constricted fertile fronds.


Drynaria quercifolia

Drynaria, Oak leaf fern, has medium to large fronds, and is distinguished by the dimorphism (brown, humus-collecting, base fronds and larger, more divided "fertile" fronds), an abortive terminal pinna, and jointed pinnae. In some species the pinnae fall from senescing fronds and leave a skeletal rachis. The resulting unkemptness is a signature characteristic, not a reflection on the grower. Or some would disagree. "Fertile" is in quotes because cultivated plants infrequently develop sori. *Drynaria quercifolia*, from India to the Philippines to Australia, is one of the two popular in cultivation, the other being *D. rigidula*, restricted to the eastern portion of the same territory.


Goniophlebium persicifolium

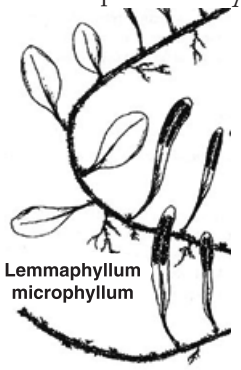
Goniophlebium is a medium or large-sized fern, here pinnate with jointed pinnae. There seems to be no agreement among taxonomists on delimiting the genus. A monograph (Rödl-Linder, 1990) includes 23 species of pinnatifid and pinnate division. The *Flora of China* draft does not recognize *Goniophlebium* and divides the group into several genera. Here we take a simple approach which will satisfy no one, placing the pinnatifid species in *Polypodiodes*. *Goniophlebium*, as here regarded, is mostly a southeast Asian genus; *Polypodiodes* is largely a Himalayan genus. The molecular data (Kreier *et al.*, 2008a) with about half the species sampled appears to give credence to *Goniophlebium* in the larger, Rödl-Linder sense with *Polypodiodes* as a sub-clade. *Serpocaulon* shares the chevron-like areolae, but differs in the grooved or flattened stipe, peltate rhizome scales (basifixed in *Goniophlebium*), and no paraphyses (usually present in *Goniophlebium*). There are other, less accessible, differences. The most commonly cultivated one is *Goniophlebium subauriculatum*.

Grammitis et al. The grammitids, comprising a dozen or more genera, are included in the table because the species number 40% of the Polypodiaceae. They are omitted from the key because they are rarely cultivated. Varied in frond division, they are distinguished by green spores and stiff, upright, reddish-brown hairs–called setae– on the lamina or stipe. Unlike the rest

of the family sometimes they have upright rhizomes and may lack phyllopodia. This group provides many examples of morphological reversals. Also of interest, the gametophyte is initiated with a long-lived, fragmenting, filamentous or ribbon-like phase preceding the usual cordate final form. They are found on the trunks and in the canopies of rain forests in both the Old and New World. *Grammitis* appears in both regions; the rest of the genera are largely restricted to one or the other.


Lecanopteris carnosa

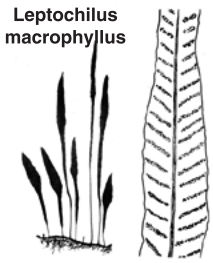
Lecanopteris, the Ant fern, is an Old World group with hollow rhizomes that serve as ant-domatia. It is only distantly related to the New World Potato fern, *Microgramma* subgenus *Solanopteris*. The large (a few cm.), hollowed out or stacked, flattened, and clumped rhizomes are the signature item. Other unique characters are hard to find, and Haufler *et al.* (2003) describes it as "systematically intractable". The case is made that "an ant/plant association may result in a relaxation of selective pressure on some morphological features. With less pressure to eliminate morphological variants, new lineages may arise quickly". For example, species closest to the root of the polypod phylogeny have rhizome scales; the later-evolving *Lecanopteris* species have hairs. The bottom line is that without the hollow rhizomes, these species are very difficult to place. *Lecanopteris* is immersed phylogenetically in the sprawling *Microsorum*. Several *Lecanopteris* species are in commerce.


Lemmaphyllum microphyllum

Lemmaphyllum has a thick, succulent lamina found otherwise among family members only in a few species of *Pyrrosia*; the latter is distinguished by its stellate scales, absent here. Always a small fern with simple fronds, its dimorphy (taller, narrower fertile blades) ranges from obvious to slight. Sori appear in a single row between the rachis and the margin. With its closest relative *Lepisorus* it shares the fugacious scales covering the immature sorus, but not the thinner (<2mm) rhizome, the dimorphism and the succulent blade. *Lemmaphyllum microphyllum*, shown here, is the species common in cultivation.


Lepisorus thunbergianus

Lepisorus, meaning scaly sorus, sports large, clathrate scales that arise within or from the edge of the sorus; these scales fall off at maturity. The two sori here show considerable variation in the density of the scales; the lower example completely obscures the sorus. A medium-sized Old World fern, it is closest in appearance to the neotropical *Pleopeltis*. which also has a scaly sorus. It can be distinguished by the lamina indument: glabrous or with sparse, basifixed, fugacious scales. *Pleopeltis* nearly always has peltate laminar scales. Though fully netted, the veins are immersed in the lamina and visible only near the rachis. *Lepisorus* is phylogenetically closest to *Belvisia* and *Microsorum* and *Lemmaphyllum*, but can be mistaken for none of them. Except for *Lepisorus thunbergianus*, these species are difficult to grow; in Japan many cultivars, some bearing no obvious resemblance to the original taxon, are prized. This species, widespread in eastern Asia, is also native to Hawaii.

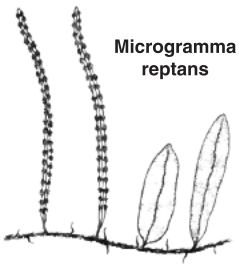

Leptochilus macrophyllus

Leptochilus (syn *Colysis*). Lip fern, is set off by usually having coenosori or elongate sori oblique to the rachis (or in pinnatifid spp. oblique to the costae), sometimes accompanied by a winged stipe. A small number of species have such constricted fertile fronds that they lack any lamina to speak of. Some authors restrict *Leptochilus* to those species with highly constricted, acrostichoid fertile fronds and maintain those with elongate sori in *Colysis*. In any case they are closely related. In a recent analysis Dong *et al.* (2008) found a small clade of *Phymatosorus* and *Microsorum* species as sister to *Leptochilus*, separate from the rest of *Microsorum*. Etymology: sometimes the tips of simple fronds are curled, giving sustenance to the term lip. How common is this? Hard to know, as descriptions rarely note such characters. *Leptochilus wrightii*, more commonly known as *Colysis wrightii*, is now submerged into *L. macrophyllus*. It is also the most available in commerce.

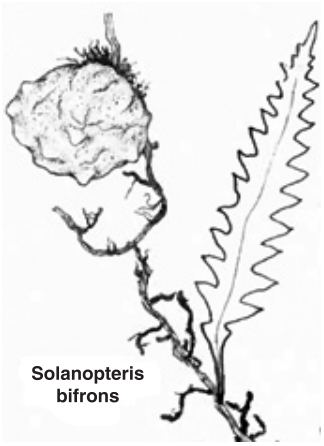
Loxogramme stands to the side of all the other Polypodiaceae. Earlier, many authors (and still in the *Flora of China* draft) placed it in the Loxogrammaceae. Distinguishing characteristics are the fleshy rhizomes and fleshy lamina, basifixed rhizome scales and often green spores. The last character is shared with the grammitids; basifixed (not pseudopeltate) scales are shared with *Pecluma* and a few *Aglaomorpha*. All floras note the numerous spongy roots, an uncommon character. None of these shared characters would leave you undecided, given the other differences. *Loxogramme* lacks the usual supporting tissue (sclerenchyma) in rhizome or rachis and becomes flaccid in dry periods. Not in cultivation, but included due to the size of the genus–30 species–and its position at the base of the phylogeny. *Loxogramme mexicana* from Mexico and Central America is the only species in the New World.


Loxogramme mexicana

Microgramma is a genus of small ferns with simple fronds closely related to *Campyloneurum* and *Niphidium* but lack their usually conspicuous oblique lateral veins. *Microgramma* typically display the sori in one row on each side of the rachis. Some species are also dimorphic (never in *Campyloneurum* and *Niphidium*) with longer, constricted fertile fronds. A flattened rhizome is found in some species. Also, it has non-clathrate rhizome scales, never the case in *Niphidium*, infrequently in *Campyloneurum*. Current evidence places the former genus *Solanopteris* here. Salino *et al.*, 2008 reported a new species, *M. microsoroides*, with scattered, microsoroid-like, sori. *Microgramma vacciniifolia* can be found for sale now and then.


Microgramma reptans

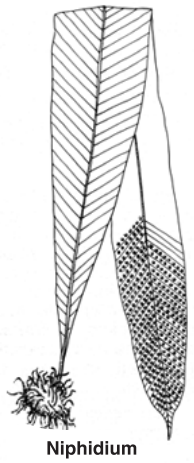
Microgramma subgenus *Solanopteris*, Potato fern, has small fronds and wiry rhizomes with short branches supporting tubers serving as ant domatia. It is not closely related to *Lecanopteris*, where the rhizome itself is swollen; rather it is nested within *Microgramma* and has the lean, sinewy rhizome typical of the genus. Whether there are ants around or not, the tubers still form and do not allow for confusion. The only character beyond the tubers that are helpful in separating it from *Microgramma* is the roundish rhizome scales. By all accounts it is tough to grow. A warm, moist, windy habitat is recommended.


Solanopteris bifrons

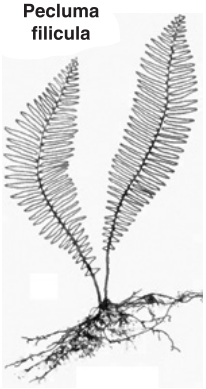

Microsorum punctatum

Microsorum, written *Microsorium* in much of the literature, means *small sorus*. The sori are both small and scattered in most members of the genus. It is a collection of perhaps unrelated species, and represents a taxonomic problem. Some pteridologists place the pinnate species with large sunken sori in *Phymatosorus*. As to whether *Microsorum* will be expanded to embrace *Lecanopteris* and *Leptochilus*, or split into smaller entities, no one is yet certain. Among the species in cultivation, *M. superficiale* is possibly headed for transfer to the resurrected *Neocheiropteris*. Given this state of affairs, is it surprising unique characters are scarce? *Microsorum* is defined by what is left over after others have been segregated. Stay tuned. The more common species in cultivation include *M. musifolium, M. punctatum, M. scolopendria* (*Phymatosorus scolopendria*), *M. grossum* (*Phymatosorus grossus*, often confused with *P. scolopendria*), *M. pustulatum* and *M. thailandicum*. The soral pattern as in *Microsorum punctatum* is common in the genus.

Niphidium usually has large strap-like fronds and differs from *Campyloneurum* in having one rather than two or more rows of sori between the oblique lateral veins. The very large sori are borne at the junction of veinlets, another distinction from *Campyloneurum* (usually borne on free veinlets). While the rhizome and phyllopodia are densely scaly, the lamina is nearly or entirely glabrous save for *N. longifolium* of Ecuador, which is densely scaly. This species was the type for the genus and gave rise to the reference to snow in the etymology of *Niphidium*: the scales on the lower surface have an abundance of hairs at the margins, so many that it was once assigned to the felt ferns. *Niphidium crassifolium* is also sold under the name *Polypodium crassifolium*.

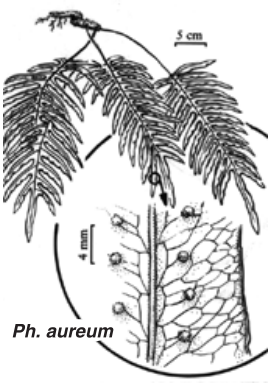

Niphidium crassifolium

Pecluma filicula



Pecluma, Comb fern, usually requires but a glance to identify to genus. The comb like–pectinate–segments, really deeply pinnatifid fronds, are the giveaway. It is also characterized by free, forking veins, sometimes hard to see. The proliferous roots (forming plantlets) are uncommon, the only other ferns among the polypods being in *Platycerium* and among a few grammitids. *Pecluma* is closest to *Phlebodium, Pleopeltis* and *Polypodium*, and has the characters of non-clathrate rhizome scales and round sori in common. It has laminar hairs, also found in a few *Polypodium*. It is possible that the circumscription of *Pecluma* will be expanded (personal communication, Alan Smith) to include non-comb-like species.

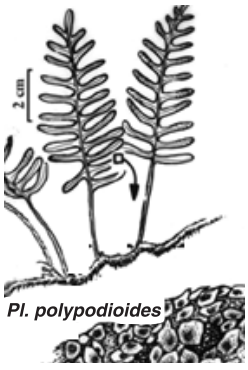
Phlebodium spp. are medium to large pinnatifid ferns closely related to *Polypodium*. Some are glaucous, either the rhizome or the blade. Veins are netted throughout the lamina except at the margins, in contrast to *Polypodium*. A number of cultivars differ in coloration or marginal characteristics, some enough to make them unrecognizable as belonging here. The only other medium or large-sized pinnatifid polypods in tropical or subtropical America are in *Serpocaulon*, distinct in its chevron areolae. *Phlebodium aureum* and *Phlebodium pseudoaureum* are readily available, both sold under the name *Polypodium aureum*.



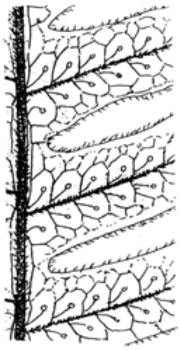
Ph. aureum

Platycerium, Staghorn fern, is very distinct in its dimorphism with base/basket fronds and large foliage fronds. Though a number of genera in the family exhibit dimorphy, only *Drynaria* also has such strong dimorphism. *Drynaria* has pinnatifid or pinnate fertile fronds; *Platycerium* foliage fronds are forking. The schematic at left shows stem parts as you'll never see them with the normally hidden rhizome extended. *Platycerium bifurcatum* is the most readily available, even at Home Depot, and the easiest in cultivation.

Pleopeltis, Scaly polypody, is a small fern with simple, forked or pinnatifid (sometimes more divided) fronds, sometimes with the upper stipe winged. *Pleopeltis* is marked by small peltate scales on the lower blade surface, particularly over the immature sorus. Its closest relatives in *Polypodium* have glabrous or hairy blades. It shares the character of scales over the immature sorus with *Lepisorus*, but differs in the scale persistence and peltate attachment. When fronds exhibit dimorphy, it is with contracted fertile fronds. The key separates *Pleopeltis* partly on the basis of monomorphy; some species are weakly dimorphic and a new discovery, an unnamed species, exhibits strong dimorphy (private communication, R. Moran). A revision of this genus is imminent.



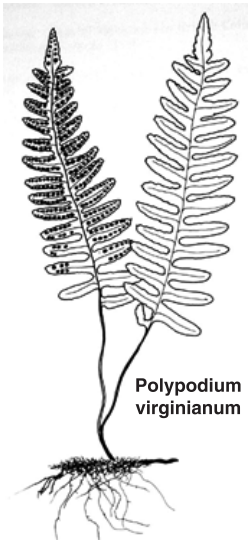
Pl. polypodioides



Polypodiodes formosana

Polypodiodes (spelling correct) shares with some *Polypodium* a single row of areolae next to the rachis and along the costae. *Polypodiodes*, a medium sized fern, is usually pinnatifid, one of the few features distinguishing it from *Goniophlebium*. Another is its lack of chevrons in the venation. Paraphyses are another indication, if not definitive; they are mostly absent in *Polypodiodes* while usually present in *Goniophlebium*. Western writers have mostly subsumed this genus in *Goniophlebium*. Chinese pteridologists have largely done the reverse. *Polypodiodes* is now the home of the glaucous-rhizome Caterpillar fern: *P. formosana*. If the new name disappoints, the alternative would appear to be *Goniophlebium formosanum*.

Polypodium, Polypody, was once a sprawling genus of hundreds; several genera have been stripped out with more excisions likely. In the end this will be a small genus, but precedence guarantees *Polypodium vulgare* will be part of it. Inhabitants of the temperate Northern Hemisphere are allowed to cheer. The three genera *Pleopeltis, Pecluma* and *Phlebodium* each appear to be internally monophyletic, but their boundaries with *Polypodium* await publication. Pressed for a distinguishing character, the free (or mostly free) venation would be the primary candidate; *Pleopeltis* is netted and hidden, *Phlebodium* is mostly netted, and *Pecluma* has few veins beyond the rachis and costae. Nearly all of the temperate species are more common in cultivation than any of the neotropical ones.

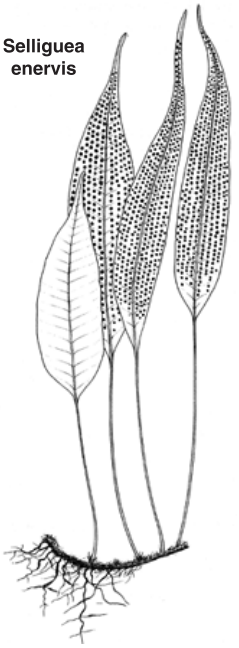


Polypodium virginianum

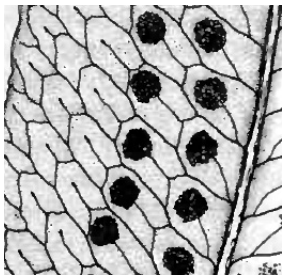
Pyrrosia, Felt fern, usually has small fronds, simple or rarely either hastate or palmate. A diagnostic character is the stellate hairs, often numerous, felty, but always present at least on young fronds. Though the sori are usually round and distinct, some species have sori confluent into coenosori or are seemingly acrostichoid. It is one of the two genera (*Polypodium* the other) with representatives deep in temperate regions. The closest relative, as the key and the cladogram attest, is *Platycerium*. *Pyrrosia confluens* is native to Australia, Tahiti and neighboring islands. Several *Pyrrosia* are in cultivation with *Pyrrosia lingua* and its many cultivars leading the pack.

Pyrrosia confluens

Selliguea is often known as *Crypsinus*, a name sometimes reserved for the simple-fronded species. Its ripe spores are medium brown and frequently there is a cartilaginous margin to the lamina (sometimes difficult to see; more evident in the lower surface), both features it shares with *Arthromeris*. The brown spores are unique to these two genera. Some *Selliguea* species have notches in the margin. *Arthromeris* is pinnate, this genus simple to pinnatifid, but just to complicate matters there are a few pinnate members in this large group. These exceptions appear to have been placed here on the basis of their pinnae **not** jointed to the rachis, a feature of *Arthromeris*. If the few pinnate species might risk confusion with *Goniophlebium*, the non-primary venation (all but the rachis and costae) in *Selliguea* is hidden while in *Goniophlebium* the venation is clear. *Selliguea* are small to medium ferns distributed from India to Japan, Fiji, and Australia. Chinese and some other pteridologists place many of the species in *Phymatopteris* or elsewhere. *Selliguea enervis*, of Indochina, Malesia, Philippines, has more rows of sori than most species; one row is common. *Selliguea feei* and *S. triloba* are the most available species.



Selliguea enervis



Serpocaulon triseriale

Serpocaulon is the newest of these genera, segregated from *Polypodium* in Smith *et al.*, 2006, partly on the basis of the chevron-shaped areolae. It shares with *Goniophlebium* the character of "chevronicity", but is only distantly related with rhizome scales peltately attached versus basifixed–sometimes also pseudopeltate–in *Goniophlebium*. Another difference is the absence of paraphyses in *Serpocaulon* while they are present in *Goniophlebium*. As to which neotropical species it is closest to, the evidence is still out, the phylogenetic contenders now seeming to be *Microgramma, Niphidium,* and the grammitids; however, it is NOT closest to the genus from which it was separated: *Polypodium* is largely free-veined and has non-clathrate rhizome scales vs. clathrate in *Serpocaulon*. A free-veined *Serpocaulon, S. patentissimum* of Ecuador, has been reported in Kreier *et al.*, 2008b. *Serpocaulon triseriale*, venation illustrated, is the most widespread species–Florida and Mexico to Puerto Rico to Paraguay–and sits at the base of the *Serpocaulon* clade. Species here will often be found in the literature under *Polypodium* or in older papers as *Goniophlebium*. *Serpocaulon levigatum*, the only simple-fronded species, may be found for sale.

Species Identification

Once you have the genus, the species will be the next goal. If you have a tentative name, start with Google images, http://images.google.com/

If the fern is in commerce, then it is likely in Hoshizaki and Moran (2001). This predates some name changes, particularly *Pleopeltis* and *Serpocaulon* (segregates from *Polypodium*) and *Polypodiodes* (separated from either *Goniophlebium* or *Polypodium*).

If your fern is not in Hoshizaki and Moran (2001), the next best bet is a regional flora. Of course this supposes you know where it came from, and has the additional requirement of a flora in print. Either lacking, there are some more or less complete accounts:

Polypodiaceae: The family is well represented on a few internet sites.

Neotropics: Due largely to the contributions of Robbin Moran, a key to neotropical ferns (pteridophiliac fun) and numerous images; navigational skills required. http://www.plantsystematics.org/

Southeast Asia: A sumptuous Thai site has keys to the genera and species (in English and Thai) and photos (captions in Thai and Latin) http://www.fernsiam.com/FernWorld/Taxonomy/Polypodiaceae/

Africa has Aluka with digitized texts and images from floras, checklists and herbarium collections: http://www.aluka.org/action/doBrowse?sa=api&t=149986

Australia's government site has the Flora of Australia (keys and descriptions) and a photo gallery: http://anbg.gov.au/cpbr/databases

Aglaomorpha: Roos (1985) contains very detailed descriptions and a key to all the species. A more accessible article with the information in a less accessible format is Janssen and Schneider (2005).

Arthromeris: Lu Shugang, Flora of China, volume 3, has a majority of the species in a draft online at http://flora.huh.harvard.edu/china/mss

Belvisia: Hovenkamp and Franken (1993) has a key and full descriptions of the species.

Campyloneurum: Lellinger (1988) has a key. The center of diversity is the Andes; a key plus descriptions for 40% of the genus by Blanca León (1993) is in the *Pteridophyta of Peru*, online at http://www.archive.org/details/pteridophytaofpe32tryo

Drynaria: Roos (1985) contains very detailed descriptions and a key to all the species. A more accessible article with the information in a less accessible format is Janssen and Schneider (2005).

Goniophlebium: Rödl-Linder (1990) covers all the species and includes a number regarded here as in *Polypodiodes*.

Lecanopteris: Hennipman and Hovenkamp (1998) has all of the species and a key.

Lepisorus: Lin You-xin, *Flora of China*, volume 3, has a majority of the species in a draft online at http://flora.huh.harvard.edu/china/mss

Leptochilus: Nooteboom (1997) is complete with a key and full descriptions.

Microgramma: Salino, *et al.* (2008) recircumscribes the genus after discovery of a new species in Brazil. The most comprehensive account is in Tryon and Stolze (1993) with half the species.

Microsorum: Nooteboom (1997) is complete with a key and full descriptions.

Niphidium: Lellinger (1972) is complete to 1972, lacks later additions.

Pecluma: Price (1983) is complete to 1983, but there are new species and moves from *Polypodium*.

Phlebodium: Hoshizaki and Moran (2001) has nearly complete coverage.

Platycerium: Hoshizaki and Moran (2001) is thorough. So is Roy Vail (1984).

Pleopeltis: Mickel and Smith (2004) is likely the most comprehensive source with the proviso that a number of species can be found under *Polypodium*, those having a scaly lower lamina.

Polypodiodes: Lu Shugang, *Flora of China*, volume 3, draft online at http://flora.huh.harvard.edu/china/mss has a majority of the species. An alternative is Rödl-Linder (1990) under the name *Goniophlebium*.

Polypodium: The temperate species are well-covered in a few fern books, Hoshizaki and Moran (2001) included. Detailed descriptions for the New Word temperate species are in the *Flora of North America*, Volume 2, online at http://efloras.org/
All of the Old World tropical *Polypodium* have been moved to other genera. In the neotropics the center of diversification was Mexico and Mickel and Smith (2004) is the source of choice.

Pyrrosia: Hovenkamp (1986) is complete with a key and descriptions.

Selliguea: Hovenkamp (1998) in Flora Malesiana has good coverage. Lu Shugang, *Flora of China*, volume 3 has the Chinese spp.; almost all assigned to *Phymatopteris*. Draft online at http://flora.huh.harvard.edu/china/mss

Serpocaulon: Smith, *et al.* (2006) has a generic description and a list of included species. Descriptions of most species can be found in Hensen (1990).

Further Info

Don't have a hand lens? There are 10 x lenses available from $4 to $80, and the $4 ones solve almost as many problems as the budget busters. They are easy to misplace, so get more than one. A source of inexpensive lenses is Indigo Instruments, http://indigo.com.

The tree keeps growing. Each year brings more information on the relationships. If you would like to track the ongoing saga, keep up with the name changes, add characters, or take up lumping and splitting as an avocation, the spreadsheet is available via email, tstuart@westnet.com.

I'd also appreciate hearing of species that fail to key satisfactorily.

Acknowledgements

To Michael Sundue for many comments and particularly improving the clarity.
To Barbara Joe Hoshizaki for help on the key and noting cultivated species.
To Alan Smith who saved me from charges of distorting the facts and advised:
It may take 5--10 years before we really understand what is best to do, classification-wise, and be able to state the morphological characters that will back it up.
Having pressed ahead too soon, the errors are mine.

Drawing Credits

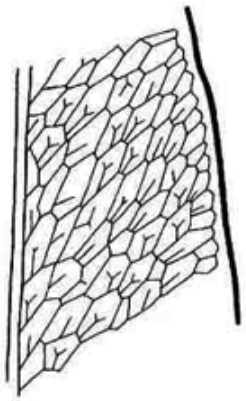
Aglaomorpha splendens, Arthromeris proteus, Drynaria quercifolia, Goniophlebium persicifolium, Lecanopteris carnosa and *Selliguea enervis* by J.H. van Os in *Flora Malesiana*, Volume 3, Leiden, 1998.
Belvisia mucronata and *Pyrrosia confluens* from the New South Wales Flora online, http://plantnet.rbgsyd.nsw.gov.au/search/index.html
Campyloneurum phyllitidus, Microgramma reptans, Pecluma filicula and *Microgramma (Solanopteris) bifrons* by Zorica Dabich from *Fieldiana: Pteridophyta of Peru*, Part V, Field Museum of Natural History, 1993.
Lemmaphyllum microphyllum from the online *Flora of Taiwan*, http://tai2.ntu.edu.tw/fotdv/fotmain.htm
Lepisorus thunbergianus and in the glossary: the areole, the clathrate scale, the peltate scale and the stellate hair illustrations are by Anna Stone from *Hawai`i's Ferns and Fern Allies*, Daniel D. Palmer, Univ. of Hawaii Press, 2003.
Leptochilus macrophyllus, Microsorum punctatum sori and *Polypodiodes formosana* venation by Barbara Joe Hoshizaki in Hoshizaki and Moran, 2001.
Loxogramme mexicana by an unsigned artist and *Serpocaulon triseriale* by Zorica Dabich in *Fieldiana: Ferns and Fern Allies of Guatemala*, Part II Polypodiaceae, Field Museum of Natural History, 1981.
Niphidium crassifolium by Mary Monsma in Lellinger, 1989.
Phlebodium aureum, Pleopeltis polypodioides and *Polypodium amorphum* paraphyses from the *Flora of North America* online, http://efloras.org/
Platycerium bifurcatum schematic by Barbara Joe Hoshizaki in *Baileya*, Cornell University, Ithaca, 1964.
Polypodium virginianum by V. Fulford from *Ferns and Fern Allies of Canada*, William J. Cody and Donald M. Britton, Agriculture Canada, 1989.

Glossary

If the term is not here, visit the Glossary link at the American Fern Society's site, http://amerfernsoc.org/

acrostichoid see **soral forms**

adnate refers to a wide attachment and here to the attachment of a pinna to the **rachis**, not just via the **costa**, but along the width of the pinna, as in *Phlebodium* or in some *Serpocaulon*



areole an area of the lamina enclosed by vein netting; pl. areolae; the areole interior is, depending on genus and species, entered by veinlets; the veinlets may be **excurrent** (pointing towards the margin or the segment apex) or **recurrent** (pointing towards the **midrib**); when the table entry says **yes** both are present; veinlets may also be branched, a detail diagnostically important at the species level; in the illustration only one veinlet is recurrent

articulate jointed, referring to pinnae attachment to the **rachis** or frond attachment to the **rhizome** or **phyllopodium**; after senescence articulate fronds break cleanly at the joint; non-articulate fronds break randomly, leaving a ragged appearance

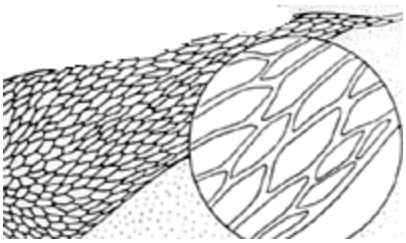
basifixed referring to a scale, attached at the base; see **peltate**

cartilaginous firm, tough, but flexible, here applied to the margins of *Arthromeris* and *Selliguea*

chevron areolae (jargonese: goniophlebioid areolae) angular **areolae** shaped like chevrons, characteristic of two genera: *Goniophlebium* and *Serpocaulon*; when the **areole** is **costal**, it has the base cut off, losing its chevronicity; however, the **areolae** in these two genera are more uniform in shape than the rest of the family

clade a single ancestor and all of its descendents; a **cladogram** is a pictorial representation of clades

clathrate refers to scales with emboldened cell margins, making them reminiscent of stained glass windows; with some scales determining clathratedness is beyond the hand lens



coenosorus fused sori; see **soral forms**

costa in a simple frond synonymous with the **rachis** or **midrib**; in a deeply pinnatifid or pinnate frond it is the principal lateral vein, synonymous with **midrib**

disjuncts long-distance dispersal is thought to be behind the appearance of isolated plants far removed from the main area of distribution; when this is followed by colonization and enough time, a new species results

elongate see **soral forms**

epilithic growing on rock; synonyms: petrophytic, saxicolous, epipetric, rupicolous

epiphytic growing on another plant

excurrent see **areole**

exindusiate an indusium is a pre-maturity covering for a **sorus**; the polypods are exindusiate, though in *Lepisorus* and *Pleopeltis* the prominence of the peltate scales makes it dubious to the casual observer

fugacious deciduous, not persisting, meaning that when you look at a mature frond, the scales or hairs or paraphyses won't be present

glabrous lacking hairs or scales

hair always one dimensional, a linear sequence of one or more cells, sometimes branching

hydathodes excretions of salts, generally calcium carbonate, on the upper surface of the lamina, appearing as white dots

indument hairs or scales or glands

lamina the expanded portion of the frond

medial indicates the position half way, more or less, between the **midrib** and the margin

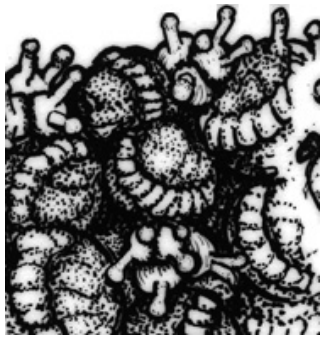
midrib in a simple frond synonymous with the **rachis**; in a deeply pinnatifid or pinnate frond it is synonymous with the **costa**; deliberately ambiguous

monophyletic refers to a taxon and its descendants, a **clade**, here the family Polypodiaceae or most of the genera within it; antonym **paraphyletic**

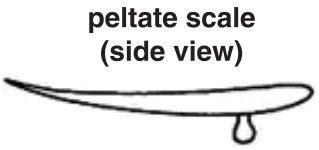
neotropics New World tropics

paleotropics Old World tropics

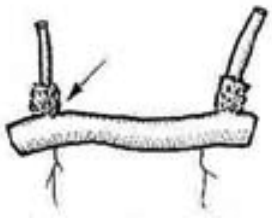
paraphyses scales or hairs or abortive sporangia in the sorus among the normal **sporangia**; glandular hairs are evident among the **sporangia** of *Polypodium amorphum* at right



peltate attached in the center (or at least not at the margin) underside, applied to indusia and scales; see **basifixed**; some writers also intend that the scale/indusium is round, an ambiguity which feeds confusion; in this article it means only the point of attachment



phyllopodium a cylindrical, vertical formation on the rhizome, like a bump on a log, and functioning as the platform for frond attachment



phylogeny the evolutionary history of a taxonomic group, here the Polypodiaceae

paraphyletic refers to a poorly delineated group that excludes related taxa, here at least *Microsorum* and *Polypodium*; see **monophyletic**

pseudopeltate refers to scales attached at the base–**basifixed**–but appearing **peltate** because the basal margin beside the attachment is extended downwards and overlapping, giving the appearance of **peltate**; not easy for the untrained eye to distinguish

rachis the extension of the **stipe**; the main vein in the blade of the frond

recurrent see **areole**

rhizome the part of the fern from which the roots and the fronds arise; in some literature called the stem; in the Polypodiaceae rhizomes are creeping (exceptions: grammitids often erect, *Platycerium* creeping but hidden)

scale a two-dimensional array of cells, found on rhizomes, stipes, veins, lamina, and sori; usually only one cell thick; properties of scales of diagnostic value include their margins, shape, attachment, and colors; the artificial key would be much easier to write if these properties could be cited, but they are at the edge of visibility under a hand lens

sister if A is the sister of B they are descended from a single common ancestor, nearly always an extinct ancestor

soral forms a **sorus** is a round, oblong or sometimes **elongate** collection of **sporangia**; when a sorus is called **elongate**, it denotes a length around twice the width; when sori coallesce linearly beyond that, a **coenosorus** is formed; the soral form becomes **acrostichoid** when sporangia extend in two dimensions over the **lamina**; demarcations are not distinct: writers commonly disagree

sporangium the structure that holds the developing spores and expels them; pl. **sporangia**

stellate hairs hairs that look like May poles if you are a mite on the surface or like a star if you're a human looking down, characteristic of *Platycerium* and *Pyrrosia*

stipe the base of the frond below the **lamina**, in some polypod species absent; some authors use the term petiole; it is never called the stem, a synonym for rhizome; in the table the terms *flattened* and *grooved* describe the upper (adaxial) stipe surface

References

Dong, X.-D., S.-G. Lu and C.-X. Li. 2008. Molecular phylogeny of *Colysis* (Polypodiaceae) based on chloroplast rbcL and rps4-trnS sequences. J. Systematics and Evolution 46: 658-666.

Haufler, C. H., W. A. Grammer, E. Hennipman, T.A. Ranker, A. R. Smith, and H. Schneider. 2003. Systematics of the ant-fern genus *Lecanopteris*. Systematic Botany 28: 217-227.

Hennipman, E. and P. H. Hovenkamp. 1998. *Lecanopteris* in *Flora Malesiana*, Vol. 3, Leiden.

Hensen, R. V. 1990. Revision of the *Polypodium loriceum* complex. Nova Hedwigia 50: 279-336.

Hoshizaki, B. J. 1982. The genus *Polypodium* in cultivation. Baileya 22: 1-98.

Hoshizaki, B. J. and R. C. Moran. 2001. *Fern Growers Manual*. Timber Press, Portland.

Hovenkamp, P. 1986. *A Monograph of the Fern Genus Pyrrosia*. Leiden University Press, Leiden.

Hovenkamp, P. H. 1998. *Lemmaphyllum in Flora Malesiana*, Vol. 3, Leiden.

Hovenkamp, P. H. and N.A.P. Franken. 1993. An account of the fern genus *Belvisia*. Blumea 37: 511-527.

Janssen, T. and H. Schneider. 2005. Exploring the evolution of humus collecting leaves in drynarioid ferns (Polypodiaceae, Polypodiidae) based on phylogenetic evidence. Plant Systematics and Evolution 252: 175-197.

Janssen, T., H.-P. Kreier and H. Schneider. 2007. Origin and diversification of African ferns with a special emphasis on Polypodiaceae. Brittonia 59: 159-181.

Kreier, H.-P. and H. Schneider. 2006. Phylogeny and biogeography of the staghorn fern genus *Platycerium*. Amer. J. Botany 93: 217–225.

Kreier, H.-P., X.-C. Zhang, H. Muth and H. Schneider. 2008a. The microsoroid ferns: Inferring the relationships of a highly diverse lineage of Paleotropical epiphytic ferns. Molecular Phylogenetics and Evolution 48: 1155-1167.

Kreier, H.-P., M. Rex, K. Weising, M. Kessler, A. R. Smith and H. Schneider. 2008b. Inferring the diversification of the epiphytic fern genus *Serpocaulon* (Polypodiaceae) in South America using chloroplast sequences and amplified fragment length polymorphisms. Plant Systematics and Evolution 274: 1-16.

Lellinger, D. B. 1972. A revision of the fern genus *Niphidium*. Amer. Fern J. 62: 101-120.

Lellinger, D. B. 1988. Some new species of *Campyloneurum* and a provisional key to the genus. Amer. Fern J. 78: 14-35.

Lellinger, D. B. 1989. *The Ferns and Fern-allies of Costa Rica, Panama, and the Chocó*, Part 1, Amer. Fern Society.

León, B. 1993. *Campyloneurum in Fieldiana: Pteridophyta of Peru*, Part V, pp 158-173, Field Museum of Natural History.

Mickel, J. T. and A. Smith. 2004. *The Pteridophytes of Mexico*, The New York Botanical Garden, New York.

Nooteboom, H. P. 1997. The microsoroid ferns. Blumea 42: 261-365.

Price, M. G. 1983. *Pecluma*, a new tropical American fern genus. Amer. Fern J. 73: 109-116.

Ranker, T. A. and C. H. Haufler. 2006. Polygrammoids: ferns that find their "roots" in the trees. Fiddlehead Forum 33: 25-27.

Rödl-Linder, G. 1990. A monograph of the fern genus *Goniophlebium*. Blumea 34: 277-423.

Roos, M.C. 1985. *Phylogenetic Systematics of the Drynarioideae*. Verhandelingen van de Koninklijke Nederlandse Akademie van Wetenschappen, Afd. Natuurkunde, Tweede Reeks, Deel 85.

Salino, A., T. E. Almeida, A. R. Smith, A. Navarro Gómez, H.-P. Kreier and H. Schneider. 2008. A New Species of *Microgramma* (Polypodiaceae) from Brazil and Recircumscription of the Genus Based on Phylogenetic Evidence. Systematic Botany 33:630-636.

Scheuttpelz, E. and K. M. Pryer. 2008. Fern phylogeny. *Biology and Evolution of Ferns and Lycophytes*, pp 417-467, Cambridge University Press.

Schneider, H., E. Schuettpelz , K. M. Pryer, R. Cranfill, S. Magallo and R. Lupia. 2004a. Ferns diversified in the shadow of angiosperms. *Nature* 428: 553-557.

Schneider, H., A. R. Smith, R. Cranfill, T. J. Hildebrand, C. H. Haufler and T. A. Ranker. 2004b. Unraveling the phylogeny of polygrammoid ferns (Polypodiaceae and Grammitidaceae): exploring aspects of the diversification of epiphytic plants. Molecular Phylogenetics and Evolution 31: 1041-1063.

Smith, A. R., H.-P. Krier, C. H. Haufler, T. A. Ranker and H. Schneider. 2006. *Serpocaulon*, a new genus segregated from *Polypodium*. Taxon 55: 919-930.

Smith, A. R., K. M. Pryer, E. Scheuttpelz, P. Korall, H. Schneider and P. G. Wolf. 2008. Fern classification. *Biology and Evolution of Ferns and Lycophytes*, pp 417-467, Cambridge University Press.

Tryon, R. M. and R. G. Stolze. 1993. *Microgramma in Fieldiana: Pteridophyta of Peru*, Part V, pp 148-158, Field Museum of Natural History.

Vail, R. 1984. *Platycerium Hobbyist's Handbook*. Desert Biological Publications (Box 722, Mena, AR 71953).

genus and etymology	near relative	rhizome	rhizome scales	phyllopodia /articulate	stipe	frond
Aglaomorpha Greek *aglaios,* splendid + morphe, shape	***Drynaria***	short to long, very thick, 20-50mm, fleshy	non-clathrate, basifixed, usually pseudopeltate	absent except *A. cornucopia* /not articulate	absent or winged	monomorphic or internally dimorphic with fertile part contracted, pinnatifid to pinnate, the lower part sometimes persisting post senescence
Arthromeris Greek *arthron,* joint + *meris,* part	***Selliguea***	long-creeping, diam. 5-15mm	non-clathrate, peltate	short /articulate	grooved	monomorphic, pinnate, the pinnae articulate to the rachis, margin entire, cartilaginous
Belvisia after Belvisius, who studied grasses	***Lepisorus***	short to long creeping, glaucous, usually wiry, but some thick	clathrate, basifixed-pseudopeltate	present /articulate	circular below, shallowly grooved, sometimes winged above	monomorphic, simple, with a highly contracted, grass-like, fertile apex
Campyloneurum Greek *kampylos,* arched + *neuron,* vein	***Niphidium Microgramma***	short to long, wiry to 8mm, branching or not	usually clathrate, always peltate	present /articulate	grooved or flattened or absent	monomorphic, simple except *C. decurrens* and *C. magnificum* pinnate
Drynaria Greek *dryinos,* of oaks	***Aglaomorpha***	long-creeping, very thick, 20-30mm, fleshy	non-clathrate, usually peltate	absent / not articulate	absent in sterile fronds, winged in fertile fronds	dimorphic: humus-collecting, entire to pinnatifid base fronds and pinnatifid to pinnate "fertile" fronds
Goniophlebium Greek *gonia,* angle + *phlebos,* vein	***Polypodiodes***	long-creeping, often glaucous, ~5mm or less, brown or white-waxy	clathrate, basifixed-pseudopeltate	present /articulate	circular	usually pinnate, some authors include pinnatifid, pinnae articulate to the rachis
Grammitis *et al.* Greek *gramme,* line	sister to ***Serpocaulon?***	erect or short-creeping	non-clathrate, rarely absent	not articulate	wiry or absent	simple to pinnate
Lecanopteris Greek *lekanê,* dish + *pteris,* fern	***Microsorum***	hollow or overlapping platelets, blue-green young, black w/ age, much-branched, clumping	sparse scales or hairs	present /articulate	absent or not	monomorphic, simple to pinnatifid
Lemmaphyllum Greek *lemma,* sheath + *phyllon,* leaf (paraphyses)	***Belvisia Lepisorus***	long-creeping, slender, diam. < 2mm	clathrate, peltate	present /articulate	sterile fronds very short, fertile sometimes winged above	dimorphic, simple, succulent, the fertile blades longer, narrower; *L. rostratum* monomorphic
Lepisorus Greek *lepis,* scale + *soros,* urn	***Belvisia***	short to long, diam. 4-8mm thick	clathrate, basifixed-pseudopeltate or peltate	present /articulate	short, sometimes winged above	monomorphic, simple, stipe often winged
Leptochilus Greek *lepto,* slender + *cheilos,* lip	***Microsorum***	long or short-creeping, often flattened	clathrate, pseudopeltate or peltate	sometimes obscure /articulate	circular, often winged, sometimes absent	mono- or dimorphic, simple, pinnatifid, palmate or basally pinnate
Loxogramme Greek *loxsos,* oblique + *gramma,* line	sister to the rest of the polypods	short or long creeping, fleshy, thin, roots massive	clathrate, basifixed	present /not articulate	short or absent	mono- or dimorphic, simple, thick, fleshy

blade indument	venation	areole veinlets	hydathodes	soral shape	soral position	paraphyses	spore color	distribution
scattered hairs, scaly on veins, nectaries along the rachis	netted	yes	yes	round or elongate or coenosori	when round/ elongate, in one or more medial rows	absent	yellowish or brown	paleotropics
glabrous or sparingly hairy	netted throughout the lamina, irregular areolae	yes	yes	round	in one row on each side of the costa or appearing scattered	absent	brown	tropical and subtropical Asia
scattered, deciduous scales	netted, often obscured	mostly recurrent	yes	coenosori	on both sides of the apex, with peltate scales	present	white or yellowish	paleotropics extending to warm-temperate
sparse, fugacious scales on midrib, glabrous lamina or sparingly hairy lower side	netted, secondary veins arching between the primary, lateral veins	excurrent	yes/no	round	often in 2-4 rows between lateral veins, but sometimes scattered, on free veinlets within areolae	absent	yellow	neotropics and subtropics
glabrous, nectaries along the rachis	netted	yes	yes/no	round	in 1 or 2 rows on either side of main or secondary veins, sometimes irregularly	present	yellow or brown	paleotropics
glabrous (finely hairy in juvenile plants)	netted, chevron areolae	excurrent	yes	round	in a single row either side of the costa, terminal on the included veinlets	present usually	yellow or brownish	India to Japan, Australia and Pacific Islands
stiff, upright, reddish-brown hairs	free or netted		yes/no	round to elongate	various	present or absent	green	*Grammitis* is pantropical, other genera mainly confined to either the Old or the New World
glabrous	netted	yes	no?	round to oblong	in rows, medial or marginal	present	orange or translucent	southern Indochina, Malesia
glabrous or a few scales	netted, obscured	yes	no?	round to elongate or coenosori	in rows or lines parallel to the margin	present, fugacious	yellow	India to Malesia to Japan
usually glabrous but sometimes clathrate, basifixed, fugacious scales on lower surface	netted, obscured	yes	yes/no	round to elongate	one row on each side of costa, with fugacious, conspicuous, peltate, clathrate scales	present	yellow	paleotropics to Korea, Hawaii
glabrous or sometimes needle-like hairs	netted, irregular areolae	yes	yes	elongate in a row or coenosori or acrostichoid	between adjacent secondary veins oblique to the midrib or on a contracted blade	present	translucent to yellowish or lt. brown	paleotropics extending to warm-temperate
glabrous	netted, obscured	yes or no	no	elongate or coenosori	rows on both sides of lateral veins oblique to midrib	present or absent	green, drying to yellow	paleotropics, 1 species disjunct in Mexico, Central America

underlined terms are expanded in the Glossary

genus and etymology	near relative	rhizome	rhizome scales	phyllopodia /articulate	stipe	frond
Microgramma Greek *mikros,* small + *gramma,* line	***Campyloneurum***	long-creeping, branched, wiry, flattened slightly or greatly	non-clathrate, peltate, sometimes with a hair-like apex	short or absent/ articulate	somewhat flattened, sometimes winged or absent	mono- or dimorphic (fertile blade longer, constricted), simple
Microgramma subgenus **Solanopteris** from *Solanaceae* (potato) + *pteris,* fern	***Microgramma***	long-creeping, slender, w/ attached tubers	peltate, non-clathrate, usually round	absent /articulate	absent	dimorphic, simple or pinnatifid, fertile fronds longer, narrower
Microsorum Greek *mikros,* small + *soros,* urn	***Leptochilus, Lecanopteris***	short to long, sometimes with a bluish waxy surface	clathrate, usually pseudopeltate, sometimes peltate	present /articulate	usually circular, sometimes flattened or grooved, rarely absent	monomorphic, simple or pinnatifid or pinnate
Niphidium Greek *nipha,* snow + *eidos,* like	***Campyloneurum***	short to long, thin to thick	clathrate	present but absent in *N. longifolium* / articulate	flattened or grooved	monomorphic, simple
Pecluma Latin *pectinata,* combed + *pluma,* feather	***Phlebodium*** *and some* ***Polypodium***	short-creeping, thin to thick, unbranched, often with proliferous roots	non-clathrate, basifixed, not pseudopeltate; a few spp. glabrous	short /articulate	circular	monomorphic, deeply pinnatifid, comb-like, usually more than 25 segments; curling in response to drought
Phlebodium Greek *phlebos,* vein	***Polypodium***	long-creeping, glaucous, branched, thick, diam. 10mm to 30 mm	non-clathrate, peltate	short /articulate	circular below, flattened or winged at the top	monomorphic, large, deeply pinnatifid with adnate segments
Platycerium Greek *platys,* flat + *keras,* horn	***Pyrrosia***	short-creeping, hidden inside the base or shield fronds, most w/ proliferous roots	entirely hidden	hidden, foliage fronds articulate, base fronds not	absent or hidden, circular	dimorphic with papery base/shield fronds forming a basket, "fertile" foliage fronds forking
Pleopeltis Greek *pleos,* abundant + *pelte,* shield	***Polypodium***	long-creeping, wiry, diam. <2mm thick	usually non-clathrate, sometimes weakly clathrate at the center, peltate	short or absent/ articulate	circular or flattened, sometimes winged above, sometimes grooved below	monomorphic or nearly so *(P. wiesbaurii)* or dimorphic (unpublished); simple, forked, pinnatifid or more divided
Polypodiodes like *Polypodium*	***Goniophlebium***	long-creeping, diam. 2-7mm thick, densely scaly or whitish bloom with sparse scales	clathrate, peltate	prominent/ articulate	circular	monomorphic, deeply pinnatifid
Polypodium Greek *poly,* many + *pod,* foot	ambiguous	short to long creeping, sometimes glaucous, usually branching	mostly non-clathrate, peltate	present /articulate	grooved or somewhat flattened, sometimes winged above	monomorphic or nearly so, pinnatifid to pinnate
Pyrrosia Greek *pyr,* fire	***Platycerium***	short to long creeping, diam. 7mm or less	non-clathrate, peltate or basifixed, occasionally pseudopeltate	present /articulate	somewhat flattened or grooved or absent	mono- or dimorphic, simple or palmate
Selliguea Monsieur de Selligue, microscope designer	***Arthromeris***	long-creeping, many wiry, others thick	non-clathrate	present /articulate		mono- or dimorphic, simple or pinnatifid or rarely pinnate, margin cartilaginous, usually minutely notched
Serpocaulon Greek *serp,* crawl + *caulon,* stem	ambiguous	long-creeping, sometimes glaucous, thin to thick	clathrate (at least in the center), peltate, occasionally entirely black	present /articulate	circular below, flattened or grooved above	monomorphic, pinnatifid to pinnate except *S. levigatum* simple

blade indument	venation	areole veinlets	hydathodes	soral shape	soral position	paraphyses	spore color	distribution
glabrous or scaly	netted	yes	yes/no	round or rarely elongate	1 row on each side of rachis (except *M. microsoroides,* scattered sori) on the end of veinlets or at junction of veinlets in areolae	present, inconspicuous	yellowish to lt. brown	neotropics, *M. mauritiana* disjunct in Africa
glabrous or scaly	netted	yes	no?	round to elongate	in 1 row on both sides of midrib	present	yellow	neotropics
glabrous	netted	yes	yes	round or oblong, small (often 1-2 mm)	in multiple irregular rows, even scattered, sometimes sunken	present	transparent to lt. brown or yellow-brown	paleotropics to warm-temperate
glabrous, but *N. longifolium* densely scaly	lateral veins oblique to rachis; secondary netted	yes	yes/no	round to oblong, large (3-5 mm)	in one row between lateral veins, at the junction of veinlets in areolae	absent but present in *N. crassifolium*	transparent	neotropics
hairs on the lamina, hairs or scales on the rachis	free-veined, casually netted	no	no?	round	in 1 medial row on each side of the segment vein	present or absent	yellowish to lt. brown	neotropics
glabrous or hair-like scales	netted	excurrent but absent in costal areolae	no?	round	usually at the tip of 2 veinlets in the areolae	absent	yellow	neotropics and subtropics
stellate hairs	netted, main veins in foliage fronds forking	yes	no?	acrostichoid	apex of blade or part of or entire blade	present or absent	yellow, but green in *P. wallichii*	paleotropics, 1 species disjunct in Bolivia, Peru
small peltate scales, sparse or dense, except *P. ensiforme* glabrous	netted, obscure	sometimes	yes/no	round to oblong	in 1 row on either side of midrib, at the junction of included veins, with fugacious, peltate scales over the immature sorus	present	yellowish to lt. brown	neotropics, a few disjuncts in the Old World
glabrous or soft hairs or scales below	areolae in one row alongside rachis, 1 or 2 rows along costa, otherwise free-veined	yes, sometimes obscure	no?	round	in one row on each side of costa, terminal on veins	absent or fugacious	yellowish to lt. brown	Himalayas to Japan
glabrous or hairy	free or a single netted row	if areolae present, yes	yes/no	round to oblong	in 1 or more rows on both sides of the costa	present or absent	yellow to lt. brown	temperate Northern Hemisphere and neotropics
stellate hairs	netted	yes	yes/no	round to elongate or acrostichoid	in 1 or more rows, parallel or oblique to the costa	present	yellow	paleotropics to warm-temperate
near glabrous but with inconspicuous, sparse, glandular hairs	netted, sometimes obscured	yes	often	round to linear, sometimes coenosori	in 1 or more rows on both sides of midrib	present, fugacious	brown	tropical and warm-temperate Asia
glabrous or hairs or a few clathrate scales (on the costa, main veins)	netted, chevron areolae; free-veined exceptions: *S. patentissimum, S. funckii*	excurrent	no?	round	one to many rows on both sides of costa, on free veins within areoles	absent or insignificant	whitish to lt. yellow	neotropics and subtropics

underlined terms are expanded in the Glossary

TREASURER'S REPORT FOR 2007

TO AFS MEMBERS,

I received the following financial report for 2007 from Dr. Caponetti in 2008. With the excellent contributions submitted by our members, the financial report was overlooked. I apologize for this late publication.

- Joan Nester-Hudson

APRIL 21, 2008

TO: A.F.S. COUNCIL AND OTHER MEMBERS OF THE SOCIETY

Ladies and Gentlemen:

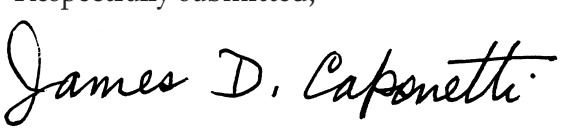
I have the pleasure of presenting to you a report on the financial condition of the American Fern Society, Inc., for the year 2007.

Current receipts amounted to $83,394.35. With $11,528.21 in my checking account and $23,999.76 in the Membership Secretary's savings account at the beginning of the year, the grand total of receipts was $118,922.32. Receipts from the dues category amounted to $24,669.24 from the Membership Secretary. This figure includes dues received from the British Pteridological Society. When the $7,625.62 in AFS dues received from BSA online transactions is included, the total of dues for AFS membership was $32,294.86. There were eight domestic and one foreign life memberships. Gifts were almost double the amount received last year. The society received no bequests this year. The total, net income for the Spore Exchange was $1,042.50. This figure includes the net amount of $547.00 for the year 2006, $488.00 for the year 2007, and $7.50 received by the Membership Secretary. Sales of back issues/ volumes were nil last year, but very good this year. Sales of Pteridologia were almost double the amount for last year, but there was no revenue from page charges. Interest earned from checking and savings bank accounts was about the same as the figures for last year. Revenue sharing from Bio One was a bit less than last year. Publisher pool payment and sales service revenue began this year with JSTOR. Dues received from the Botanical Society of America online transactions was a bit higher this year than last year. A statement on the financial status of the several accounts accompanies the Treasurer's Report along with a statement of assets and liabilities.

Current disbursements amounted to $95,867.50. With $20,368.82 in my checking account and $2,686.00 in the Membership Secretary's savings account at the end of the year, the grand total of $118,922,32 balances with the grand total of receipts. Journal and bulletin printing costs on a per issue basis were about the same as last year's amounts, but journal production expenses were higher than last year because Council appointed an Editor-in-Chief and a Managing Editor for the journal. The journal and bulletin editors did an excellent job in keeping expenses to a minimum. Other Council members' expenses were in the expected range as were other expenses. I am pleased to report that the society is in a sound financial condition, so much so that I was able to add $6,500.00 to the savings certificate in First Tennessee Bank and $6,500.00 to the savings certificate in Home Federal Bank.

I wish to thank the Membership Secretary and Memoir Editor, Dr. George Yatskievych; the outgoing Journal Editor, Dr. James Hickey; the incoming Journal Editor-in-Chief, Dr. Jennifer Geiger; the incoming Managing Editor, Dr. Jill Dill; the outgoing Bulletin Editor, Dr. Robin Halley; the incoming Bulletin Editor, Dr. Joan Hudson; and the Curator of Publications, Dr. James D. Montgomery, for their help in keeping the society treasury accurate.

Respectfully submitted,



James D. Caponetti

TREASURER'S REPORT - 2007

RECEIPTS			
Cash on hand, January 1, 2007			
Treasurer			$11,528.21
Membership Secretary			$23,999.76
TOTAL			$35,527.97
Current Year's Dues		$18,415.94	
Prepayments for Future Years		$44.00	
Current Year's Overpayments		$4.30	
Life Memberships		$2,840.00	
Gifts to the Society		$1,047.30	
British Pteridological Society dues		$3,365.00	
Spore Exchange, Net			
Treasurer	$1,035.00		
Membership Secretary	$7.50		
TOTAL		$1,042.50	
Sales of Back Issues of Journal		$563.48	
Sales of Pteridologia		$1,276.60	
Savings Interest from Memb. Sect. Bank		$110.10	
Checking Interest from Treasurer's Bank		$48.02	
Page Charges		$0	
Transfer from Treasurer's Savings to Checking Account		$0	
Funds Received by Treasurer from Membership Secretary		$39,000.00	
Bio One Revenue Sharing		$5,021.00	
JSTOR Publisher Pool Payment		$2,951.95	
JSTOR Sales Service Revenue		$38.54	
BSA Botany 2007 Meeting Income		$0	
Outreach Fund Contributions		$0	
Dues from BSA to Treasurer from Online Transactions		$7,625.62	
2007 Checks Outstanding		$0	
CURRENT RECEIPTS			$83,394.35
GRAND TOTAL			$118,922.32

DISBURSEMENTS			
American Fern Journal (Allen Press)			
Vol. 96, No.3	$2,842.46		
Vol. 96, No. 4	$3,508.33		
Vol. 97, No. 1	$3,179.83		
Vol. 97, No. 2	$4,780.47		
Vol. 97, No. 3	3,554.13		
TOTAL		$17,865.22	
Fiddlehead Forum Printing (Print-O-Mat)			
Vol. 33, No. 5	$1,345.43		
Vol. 33, No. 1	$1,312.71		
Vol. 33, No. 2	$1,368.34		
TOTAL		$4,026.48	
Treasurer's Expenses		$166.60	
Blanket Fidelity Bond		$170.10	
Membership Secretary's Expenses		$259.16	
Memoir Editor's Expenses		$81.13	
President's Expenses		$0	
President-Elect's Expenses		$0	
Secretary's Expenses		$435.55	
Publications Curator's Expenses		$295.74	
Journal Editor-in-Chief's Expenses		$4,000.00	
Journal Managing Editor's Expenses		$2,000.00	
Web Server Maintenance		$95.40	
Domain Name Renewal		$0	
Webmaster's Expenses		$0	
Bulletin Editor's Expenses		$160.00	
Fern Foray Expenses		$150.00	
A.I.B.S. Dues		$125.00	
Refunds to Agencies and Members		$33.00	
British Pteridological Society Dues		$2,530.03	
Addition to CD in First Tenn. Bank		$6,500.00	
Addition to CD in Home Federal Bank		$6,500.00	
Funds Transferred from Checking to Savings		$0	
Funds Transferred from Savings to Checking		$0	
Botany 2007 Meeting Expenses		$2,000.00	
Outreach Coordinator's Expenses		$1,306.19	
Funds Transferred to Treasurer by Membership Secretary		$39,000.00	
BSA Online Transactions held by Membership Secretary		$8,147.90	
Bank Charges (Treasurer)		$20.00	
Bad Checks		$0	
CURRENT DISBURSEMENTS			$95,867.50
Cash on Hand, January 1, 2008			
Treasurer			$20,368.82
Membership Secretary			$2,686.00
GRAND TOTAL			$118,922.32

STATEMENT OF AFS ASSETS AND LIABILITIES AS OF DECEMBER 31, 2007	
Assets	
Cash in Treasurer's Checking Account	$20,368.82
Cash in Membership Secretary's Savings Account	$2,686.00
Cash in Treasurer's Savings Account	$9,141.23
Savings Certificate in First Tennessee Bank	$30,000.00
Savings Certificate in Home Federal Bank	$50,164.13
Journal Inventory	$16,022.50
TOTAL	$128,382.68
Liabilities	
Prepayments for Future Years	$44.00
Current Year's Overpayments	$4.30
Savings Certificates	$80,164.13
General Fund	$48,170.25
TOTAL	$128,382.68

STATEMENT OF AFS BANK ACCOUNTS BALANCE OF FUNDS AS OF DECEMBER 31, 2007, AND INTEREST EARNED DURING 2007

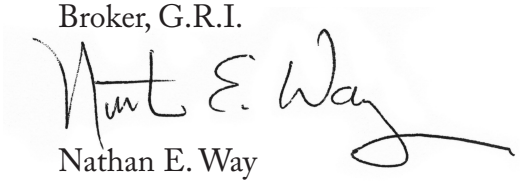
BANK ACCOUNTS	BALANCE OF FUNDS	INTEREST EARNED
Membership Secretary's Savings Account in Commerce Bank	$2,686.00	$110.10
Treasurer's Savings Account in First Tennessee Bank	$9,141.23	$8.54
Treasurer's Checking Account in First Tennessee Bank	$20,368.82	$48.02
Treasurer's Savings Certificate in First Tennessee Bank	$30,000.00	$1,111.85
Treasurer's Savings Certificate in Home Federal Bank	$50,164.13	$1,838.91
TOTALS	$112,360.18	$3,117.42

April 21, 2008

REPORT OF THE AUDITOR

I hereby certify that I have seen the books and accounts of James D. Caponetti, Treasurer of the American Fern Society, Inc., and have obtained confirmation of the correctness of the Society's balance on hand as set forth in detail in the accompanying report of the Treasurer.

Broker, G.R.I.



Nathan E. Way

Dr. Joan E. N. Hudson
Sam Houston State University
Department of Biological Science
Box 2116
Huntsville, TX 77341-2116

Correction:

In the Vancouver Fern Foray 2008 article (Vol 35, number 5, 2008) Recent revision work has changed the name of *Gymnocarpium dryopteris* to *Gymnocarpium disjunction*.

Blog about Rainforest Ferns:

Deedra McClearn, Director of the OTS La Selva Biological Station in Costa Rica, has started a blog about the rainforest ferns found at La Selva, and many of which she has cultivated in her back yard. So far, three videos are posted, each about five minutes long. Here is the URL: http://fern-laselva.blogspot.com/ *submitted by Robbin Moran*

New Fern Guide Available:

There have been very few pictorial guides published for ferns in the neotropics, but happily this situation is beginning to change. A recent example is the excellent "Guide to the Ferns and Lycophytes of REBIO Uatumã, Central Amazonia," by G. Zuquim, F. R. Costa, J. Prado, and H. Tuomisto (INPA, 2008, ISBN 9788599387085; 315 pp, hardbound). This new guide allows identification of 120 species that inhabit the rainforest in a nearly 10,000 square kilometer biological reserve in Amazonian Brazil. There are several exquisite photographs for each fern and lycophyte, and the text is in both English and Portuguese. The book will be useful for both professional botanists and amateurs interested in neotropical ferns. The Missouri Botanical Garden Press (www.mbgpress.onfo) has arranged to make a limited quantity of copies available for $50.00 plus shipping. *submitted by George Yatskievych*