

The East Asiatic genera and endemic genera of the Pteridophytes in China

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China, the largest country in East Asia, has a pteridoflora of over 2000 species, belonging to about 220 genera in 63 families. There are about 28 East Asiatic genera of Pteridophytes and 6 genera specifically endemic to China. Most of these genera are oligotypic or monotypic groups. Five distribution patterns of the East Asiatic genera are distinguished, i.e., I. Sino-Himalayan type, 10 genera; II. Sino-Japanese type, 4 genera; III. Japan-Himalayan type, 6 genera; IV. Temperate East Asiatic type, 3 genera; and V. Tropical East Asiatic type, 5 genera. The Chinese endemic genera are mainly distributed in southwestern China. The distribution, ecology, taxonomy, and systematics of these genera are discussed.

Key words: Pteridophytes; China; distribution; East Asia; endemism; systematics

China is a mountainous country, with a varied topography and diverse physical features, with over two-thirds of its territory covered by hills, mountains and plateaus. The varied and complicated climatic patterns are caused by geographical location, topography and the seasonal monsoon. According to the temperature, from north to south, there are zones of cold-temperate, temperate, warm-temperate, subtropical and tropical. China is the only country in the world that has the continuous gradient of vegetation from that of tropical, subtropical, to temperate forests. Subtropical vegetation is well developed and covers a large proportion of the earth in eastern, southern, southwestern and central China. Moreover, montane

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forests with distinct altitudinal zonation developed in higher mountain ranges, especially in southwestern China and Taiwan Island of China. The Hengduan-Himalaya mountain ranges are the great mountains in East Asia, where evolution of particular groups of plants has been particularly active.

Due to the great diversity in topographic, geographical features, climatic, and ecological conditions, the Chinese flora is the richest in Northern Hemisphere. China, the largest country in East Asia, has a pteridoflora of more than 2000 species, a number up to 2600 has been general known in China (Shing 1972). According to the pteridophyte system of Ching (1978), those plants belong to about 220 genera of 63 families. One of the features of the Chinese pteridoflora is that there are many genera with their distribution concentrated in East Asia or even endemic to China. These genera will be discussed here because they are important in the study of the phytogeography and systematic of the Chinese pteridophytes.

Not all the genera discussed here are universally accepted, some of them are not distinct enough to be recognized at generic level, but they may represent infrageneric groups, and thus also present subjects needed of further systematic studies.

The phytogeographical features of the Chinese pteridoflora has been the subject of many Pteridologists' study. Ching and Wu (1980) discussed the floristic characteristics of the Xizang (Tibet) Pteridophyte flora in relation to the upheaval of the Himalayas. Kuo (1985) dealt with the phytogeography of pteridophytes from Taiwan and found many common species between the alpine flora of Taiwan and the Himalayas. Wu (1987) discussed the phytogeographical affinities of pteridophytes between China and Japan. The Chinese endemic genera and East Asiatic genera were briefly discussed by me (2001) with emphasis on the rare and endangered elements and biodiversity conservation.

In the following enumeration Ching's (1978) Chinese Pteridophyte system is adopted with some modification, genera are by alphabetical order.

EAST ASIATIC ENDEMIC GENERA

East Asiatic endemic genera are those mainly distributed in China, the Himalayas, Mongolia, Korea, Japan and a part of Far East of former Soviet Union (fig. 1), while

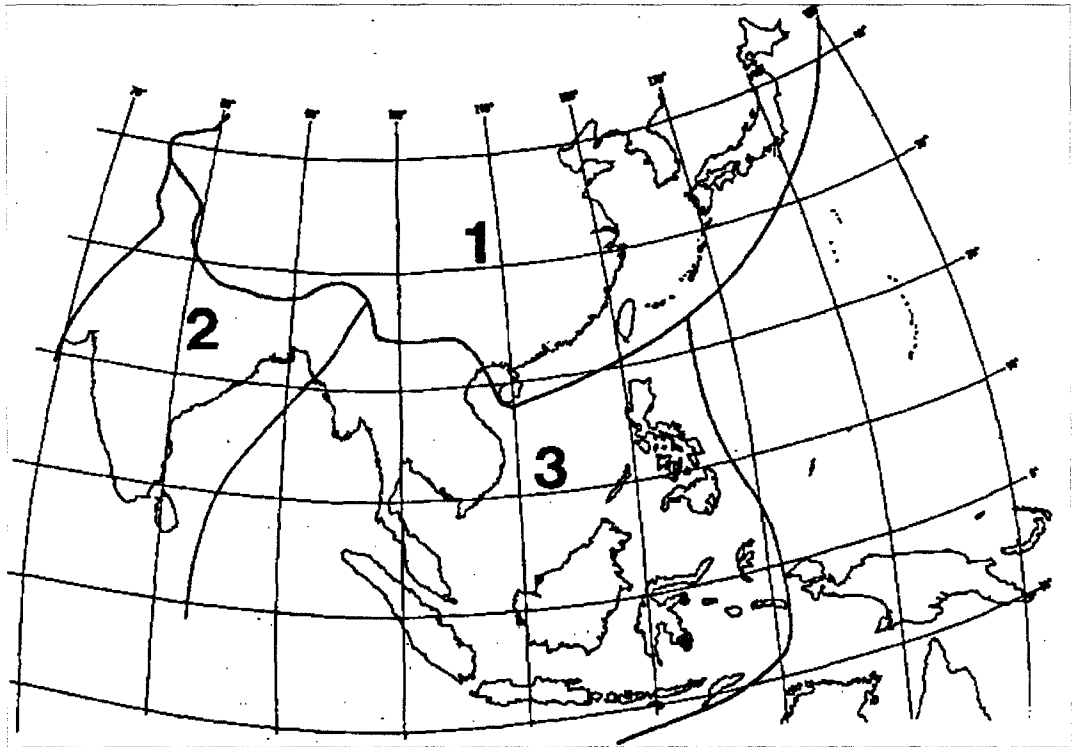


Fig. 1. Geographical position of East Asia. 1: East Asia; 2: South Asia; 3: Southeast Asia

some of them with an extension to the neighboring regions of East Asia, notably to Southeast Asia (Wu 1992, Ying et al. 1993). There are 28 genera in the Chinese pteridoflora belonging to this category, and their distribution patterns show the following five types of distribution, I. Sino-Himalayan type, 10 genera; II. Sino-Japanese type, 4 genera; III. Japan-Himalayan type, 6 genera; IV. Temperate East Asiatic type, 3 genera; and V. Tropical East Asiatic type, 5 genera.

I. Sino-Himalayan Type

1. **Arthromeris** (T. Moore) J. Sm., Hist. Fil. 110. 1875. ----- *Pleopeltis* sect. *Arthromeris* T. Moore, Index Fil. Lxxviii. 1857. TYPE: *Arthromeris wallichiana* (Spreng.) Spring ----- *Polypodium wallichiana* Spreng.

POLYPODIACEAE. The genus occurs from Himalaya to Taiwan, about 15 species in China, mainly from the Hengduan Mountains, a few to east and central China. Usually

epiphytic or epilithic, or terrestrial in forest, alt. 1000-2800 m.

Its affinity with *Phymatopteris* Pichi Serm. is evident. The two genera belong to subfamily Crypsinoideae Nayar of Polypodiaceae. In China, *Phymatopteris*, *Selliguea* Bory and *Christiopteris* Copel. are members of this subfamily, except *Phymatosorus* Pichi Serm. (*Phymatodes* C. Presl), which should be put into subfam. Microsorioideae Nayar, but was wrongly put in this subfamily by Ching (1978). In the Polypodiaceous plants, subfam. Crypsinoideae is close to the Drynarioid ferns, as well as to subfam. Polypodioideae Nayar, while subfam. Microsorioideae is more close to subfam. Lepisorioideae Ching. Nayar (1974) divided the Polypodiaceae into 5 subfamilies, i.e., Platycerioideae, Pleopeltidoideae, Polypodioideae, Microsorioideae and Crypsinoideae. Ching (1978) subdivided the Chinese Polypodiaceae (s.str., excluding *Platycerium* and Drynarioid ferns) into 5 subfamilies, i.e., Polypodioideae, Lepisorioideae, Pyrrosioideae, Crypsinoideae, and Microsorioideae Nayar. Ching and Nayar have consensus on the systematic position of many genera of the Polypodiaceae.

In 1991, Wu and Ching emphasized the soral character, whether it is linear or acrostichoid, created two more superfluous subfamilies, Selliguioidae Ching (Colysioideae) and Leptochilioideae Ching in Polypodiaceae (s.str.), which should belong to Crypsinoideae and Microsorioideae respectively.

2. *Blechnidium* T. Moore, Ferns Great Brit. Nat. Printed 210. 1860; et Ind. Fil. 191. 1860. TYPE: *Blechnidium melanopus* (Hook.) T. Moore ----- *Blechnum melanopus* Hook.

BLECHNACEAE. Monotypic, in China, from NW Yunnan, Xizang, disjunct to Taiwan, also in NE India, and N Myanmar. On cliffs in ravines of dense forest, or epiphyte on mossy tree trunks in dense evergreen forest, alt. 1600-2800 m.

3. *Cheilanthopsis* Hieron., Notizbl. Berlin 7: 406. 1920. TYPE: *Cheilanthopsis straminea* (Brause) Hieron. ----- *Woodsia straminea* Brause (= *Cheilanthopsis indusiosa* (Christ) Ching ----- *Woodsia indusiosa* Christ)

WOODISACEAE. Only 2 species (Wu 1999a). *Cheilanthopsis indusiosa* (Christ) Ching is endemic to NW Yunnan and SW Sichuan, while *C. elongata* (Hook.) Copel. distributed from N India, Sikkim to Xizang and NW Yunnan. Usually on rocks or terrestrial in forest, alt. 2100-3400 m.

Emodiopteris Ching & S.K. Wu, Acta Phytotax. Sin. 16: 21. 1978. TYPE:

Emodiopteris appendiculata (Wall. ex Hook.) Ching & S.K. Wu ----- *Dicksonia appendiculata* Wall. ex Hook.

DENNSTAEDTIACEAE. Monotypic, it has been proved a wrong observation of the soral structure, which is the character of *Dennstaedtia* Bernh. The species, *Dennstaedtia appendiculata* (Wall. ex Hook.) J. Sm. is closely related to *D. elwesii* Bedd., both are Himalayan plants, distributed from N India (Khullar 1994) to Xizang and Sichuan (Mt. Emei).

4. *Gymnogrammitis* Griffith, Not. Pl. Asiat. 2: 608. 1849; et Icon. Pl. Asiat. 2: pl. 129, f. 1. 1489. TYPE: *Gymnogrammitis dareiformis* (Hook.) Ching ex Tardieu & C. Chr. ----- *Polypodium dareiforme* Hook.

POLYPODIACEAE. Monotypic, Ching (1966a) realized that *Gymnogrammitis* is not at all a davallioid fern, it is only superficially resembles *Araiostegia* Copel. and its allies in Davalliaceae, without the davallioid indusium and the spores are also quite different. *Gymnogrammitidaceae* was proposed by Ching (1966a), and predicted it is not remote from Polypodiaceae (s. str.). By a new study by Schneider et al. (2002) on molecular evidence that it is a member of Polypodiaceae, this once again tested the correct phylogenetic insight of the late Professor Ching on the morphological basis. The cytology is still unknown. The plants shed leaves in dry season and come up in rain season, epiphytic on mossy tree trunks or epilithic in dense evergreen forest, alt. 1200-2900m. It is almost a tropical genus, distributed from NE India, Sikkim, Bhutan, Nepal, Myanmar, Thailand, Laos, Cambodia, Vietnam, to S & SW China (Hainan, Guangdong, Guangxi, Hunan, Guizhou, Yunnan, and Xizang).

5. *Lithostegia* Ching, Sinensia 4: 2. 1933. TYPE: *Lithostegia foeniculacea* (Hook.) Ching----- *Aspidium foeniculaceum* Hook.

DRYOPTERIDACEAE. Monotypic, from NE India, Sikkim, N Myanmar, to China (Xizang, Yunnan). In evergreen broad-leaved forest or mixed forest, or on cliffs, 2100-3200 m. It may be close to *Arachniodes* Blume.

6. *Metapolypodium* Ching, Acta Phytotax. Sin. 16: 28. 1978. TYPE: *Metapolypodium manmeiense* (Christ) Ching ----- *Polypodium manmeiense* Christ

POLYPODIACEAE. Monotypic, in China (Guizhou, Yunnan, Sichuan), Eastern Himalaya, Myanmar, Thailand, and Laos. Epilithic or epiphytic, alt. 1000–2500 m. Similar to *Polypodiodes* Ching in habit, differs in veins forked but not forming areoles.

7. Paradavallodes Ching, Acta Phytotax. Sin. 11 (1): 17–30. 1966. TYPE: *Paradavallodes multidentata* (Hook.) Ching ----- *Davallia multidentata* Hook.

DAVALLIACEAE. A small genus of 4 species (Ching 1966b, Wu 1999b), all in China, to the west to Nepal, Sikkim and N India (Khullar 2001). Nootboom (1994, 1996) reduced them to 2 species in his broad *Davallia*. Epilithic or epiphytic in forest, alt. 600–2600 m.

8. Platygyria Ching & S.K. Wu, Acta Bot. Yunnan. 2(1): 67. 1980. TYPE: *Platygyria waltonii* (Ching) Ching & S.K. Wu. ----- *Neocheiropteris waltonii* Ching

POLYPODIACEAE. A unique genus in Polypodiaceae. The striking feature of the species is the unusually broad and vertical complete annulus consisting of cells of scarcely incrassate cell-walls and indistinct stomium in the globose sporangium, a very specialized form in Polypodiaceae. 5 species are recognized in this genus (Zhang et al., 2003), i.e. *Platygyria waltonii*, *P. sinuata*, *P. inaequibasis*, *P. variabilis*, *P. soulieana*. Endemic to the Hengduan-Himalayan Mountains, in rocky crevices usually at high elevation, alt. 2500–5000 m. Morphologically and phytogeographically, the genus is closely related to *Lepisorus* (J. Sm.) Ching, especially to the sympatric *Lepisorus clathratus* group. It is descended from species of *Lepisorus clathratus* group during the upthrust of the Himalayas. Fraser-Jenkins (1997a) mistaken the type as a species of *Phymatopteris*, and made the new combination, *Phymatopteris waltonii* (Ching) Fraser-Jenk. He (1997a,b) suspects the soral characters of *Platygyria* and *Sorolepidium* are inconstant and variable even in one species or one collection, which is not on the ground of field observations, and careful herbarium study. In fact, species of *Platygyria* and *Sorolepidium* are very constant in the soral characters. If they are not distinctive enough to be classified as different genera, at least they represent natural subgeneric groups in *Lepisorus* and *Polystichum*.

9. *Sinephropteris* Mickel, *Brittonia* 28: 326, f. 1-2. 1976. TYPE: *Sinephropteris delavayi* (Franch.) Mickel. ----- *Asplenium delavayi* Franch.

ASPENIACEAE. Monotypic genus, distributed in S Gansu (Wenxian), SW Sichuan (Miyi, Yanbian), SW Guizhou (Xingyi), W & NW Yunnan, Myanmar, and India (Sikkim, Manipur). On limestone rocks under shrubs or forest, alt. 200-2000 m. Mickel (1976) divided *Schaffneria* Fée into two genera, disjunctly between Asia and America. But, all the genera of Aspleniaceae are combined together into a single *Asplenium* (Kramer, 1900).

10. *Sorolepidium* Christ, *Bot. Gaz.* 51: 350. 1911. TYPE: *Sorolepidium glaciale* Chrsit

DRYOPTERIDACEAE. One or two species almost endemic to China, also to East Himalaya, mainly in NW Yunnan, W Sichuan, S Gansu and Qinghai, with a disjunct distribution to Taiwan. *Sorolepidium* and *Platygyria* are ferns concentrated in high elevations. Plants live in rigid, cold alpine mountains, in rock crevices (calcareous rocks) up to snow line or by glacier, alt. 2600-4700 m, in the Hengduan-Himalaya Mountains usually at higher elevations over 4000 m. Plants of *Sorolepidium* and *Platygyria* are the best materials for study of speciation in the Himalayan regions. Fraser-Jenkins (1997b) confused *Sorolepidium glaciale* with *Polystichum duthiei*. The affinity of them are obvious close, but the former is completely exindusiate. *Sorolepidium glaciale* was only recently collected from Taiwan and Qinghai.

II. Sino-Japanese Type

11. *Cyrtomidictyum* Ching, *Bull. Fan Mem. Inst. Biol. Bot.* 10: 182. 1940. TYPE: *Cyrtomidictyum lepidocaulon* (Hook.) Ching ----- *Aspidium lepidocaulon* Hook.

DRYOPTERIDACEAE. 4 species (Kung 2001) concentrated in East and East-central China, *C. lepidocaulon* extends to S Korea and Japan. Plants in forest, by ravine or on wet cliffs or crevices, alt. 300-2400 m.

12. *Lepidomicrosorium* Ching & K.H. Shing, *Bot. Res. Inst. Bot. (Beijing)* 1: 1. 1983. TYPE: *Lepidomicrosorium buergerianum* (Miq.) Ching & K.H. Shing -----

Polypodium buergerianum Miq.

POLYPODIACEAE. 18 species are recognized in the flora of China (Lin 2000). But, only 2 species are accepted by Shi and Zhang (1999), dealt in *Microsorium* by Nooteboom (1997). Distributed from Japan to N Vietnam, mainly in areas along the Yangtze River in eastern China and central to southwestern China, north to Qinling mountains. Climbing on tree trunks from ground, or epilithic, usually fertile when clambering on tree trunks, alt. 400-1900 m.

13. *Leptorumohra* (H. Ito) H. Ito in Nakai et Honda, Nova Flora Japonica 4: 118. 1939. TYPE: *Leptorumohra miqueliana* (Maxim. ex Franch. & Sav.) H. Ito ----- *Aspidium miquelianum* Maxim. ex Franch. & Sav.

DRYOPTERIDACEAE. 3 species (Wu 2000) distributed in Japan, S Korea, and China (Taiwan, Hunan, Guangxi, Guizhou, Chongqing, Sichuan, Yunnan). Terrestrial in forest, alt. 800-1800(-3000) m. Its relationship with other Dryopteridaceous plants is unclear, although it was reduced to *Arachniodes* Blume (Kramer, 1990).

14. *Ptilopteris* Hance, Journ. Bot. 22: 138. 1884. TYPE: *Ptilopteris maximowiczii* Hance.

MONACHOSORACEAE. Monotypic, it is very close to *Monochosorum* Kunze, and was reduced to it (Kramer 1990). Distributed from Japan to Taiwan. In mainland of China, distributed in the middle and lower reaches of Yangtze River. In rocky crevices under dense forest, alt. 800-1700 m.

Saxiglossum Ching, Contr. Inst. Bot. Nat. Acad. Peiping 2: 1. 1933. TYPE: *Saxiglossum angustissimum* (Gies.) Ching----- *Niphobolus angustissimus* Gies. (= *Saxiglossum taeniodes* (C. Chr.) Ching ----- *Cyclophorus taeniodes* C. Chr.)

POLYPODIACEAE. Monotypic, it is proved to be a member of *Pyrrosia* Mirbel (Ravensberg et Hennipman 1986). Distributed from Japan to mainland and Taiwan of China, northwards to Henan, Shaanxi, Gansu and Shanxi. Epilithic or epiphytic, alt. 700-2000 m.

III. Japan-Himalayan Type

15. *Cyclogramma* Tagawa, Acta Phytotax. Geobot. 7: 52. 1938. TYPE: *Cyclogramma auriculata* (J. Sm.) Ching ----- *Phegopteris auriculata* J. Sm. (= *Cyclogramma*

simulans (Ching) Tagawa ----- *Thelypteris simulans* Ching)

THELYPTERIDACEAE. About 10 species, 9 in China (Shing 1999), from the Himalayas to S China and Japan. Terrestrial in evergreen broad-leaved forest, alt. 350-2400 m.

16. Dictyocline T. Moore, Gard. Chron. 854. 1855. TYPE: *Dictyocline griffithii* T. Moore

THELYPTERIDACEAE. 4 similar species (Shing, 1999), widely distributed in S China south of Yangtze River, eastwards to Japan, westwards to NE India, southwards to N Vietnam. Terrestrial in forest, alt.100-1400 m.

17. Drymotaenium Makino, Bot. Mag. Tokyo 15: 102, 1901. TYPE: *Drymotaenium miyoshianum* (Makino) Makino ----- *Taenitis miyoshiana* Makino.

POLYPODIACEAE. Monotypic, *Drymotaenium miyoshianum* (Makino) Makino, from Japan to E. Himalayas, occurs in south Japan, east, central, south and south-west China (Lin 2000, Zhang 2000), reported from Arunachal Pradesh of NE India (Dixit 1984). Epiphyte on tree trunks, on rocks, or on roofs of old buildings, alt. 1000-3400 m.

A genus closely related to *Lepisorus*, frond narrow, thick, sori linear covered with scale-like pelate paraphyese at young stage. *Lepisorus eilophyllus* (Diels) Ching from south-west China and the Himalayas perhaps is most close to it. Plant habitat superficially similar to *Vittaria*, as can be seen some misidentification in herbaria as *V. fudzinoi* Makino.

18. Glaphyopteridopsis Ching, Acta Phtotax. Sin. 8: 319. 1963. TYPE: *Glaphyopteridopsis erubescens* (Wall. ex Hook.) Ching ----- *Polypodium erubescens* Wall. ex Hook.

THELYPTERIDACEAE. A few species, *Glaphyopteridopsis erubescens* is widely distributed from N India, Nepal, Bhutan, Sikkim, N Myanmar to SW China and Taiwan, also to S Japan (Yakushima). Large plants terrestrial at margin of forest or in ravine, alt. 500-1800 m.

19. Pentarhizidium Hayata, Bot. Mag. Tokyo 42: 345. 1928.

Onoclea Sect. *Pentarhizidium* (Hayata) M. Kato, Acta Phytotax. Geobot. 31: 137.

1980. TYPE: *Pentarhizidium orientale* (Hook.) Hayata ----- *Struthiopteris orientalis* Hook. (= *P.japonicum* Hayata)

ONOCLEACEAE. *Pentarhizidium* is an east Asia genus separated from *Matteuccia* Todaro by Hayata (1928), with two species, *P. orientale* (Hook.) Hayata, distributed from Korea, Japan to NE Himalayas, *P. intermedium* (C. Chr.) Hayata from Qinling Mountains in China to NW Himalayas. Terrestrial in forest, alt. 2000-3200 m. These two species of *Pentarhizidium* had been traditionally accepted as members of *Matteuccia* before they were transferred from *Matteuccia* to *Onoclea* (Kato et al., 1980, 1991). Based on the rbcL phylogeny tree, Gastony and Ungerer (1997) found that *M. orinetalis* and *M. intermedia* form a nature group in the Onocleoid ferns, coincide with the morphological studies by Hayata (1928), who created the name *Pentarhizidium*. The plants of this genus have dimporphic leaves, with chlorophyllous spores. Chlorophyllous spores occur sporadically in many families of pteridophytes, such as Equisetaceae, Osmundaceae, Hymenophyllaceae, Tectariaceae, Blechnaceae, Onocleaceae, Pleurosoriopsidaceae, Polypodiaceae, Platyceriaceae, and Grammitidaceae. It is interesting that Equisetaceae, Osmundaceae, Hymenophyllaceae, Onocleaceae, Pleurosoriopsidaceae and Grammitidaceae are the families that have all the species bearing green spores, and in other families, some genera or only some species bear green spores. In the pantropical genus *Platycerium*, a group of 15 species, most diversified in Asia where eight species occur, but only one species, I. e. *P. wallichii* Hook. Produces green spores. Therefore, the systematic significance and the ecological importance of the chlorophyllous spores need more studies. In *Pentarhizidium* and *Matteuccia*, the fertile leaves turn brown and black gradually when mature, and the leaves still upright and not fallen down in the winter when the sterile leaves shaded. The dark color fertile leaves still receive sunshine and keep the subterranean robust rhizome warm.

20. Polypodiodes Ching, Acta Phytotax. Sin. 16(4): 26. 1978. TYPE: *Polypodiodes amoena* (Wall. ex Mett.) Ching ----- *Polypodium amoenum* Wall. ex Mett.

POLYPODIACEAE. A genus with about 16 species, of which 11 species and 3 varieties from China (Lin 2000), from Japan to W Himalayas. Most of the species are confined to the Himalayas, few eastwards to Japan and Taiwan. Epiphyte on rocks or tree trunks, alt. 1000-3700 m. *P. niponica* (Mett.) Ching, and *P. amoena* (Wall. ex Mett.) Ching common in subtropical areas, while *P. wattii* (Bedd.) Ching, *P.*

lachnopus (Wall. ex Hook.) Ching. *P. subamoena* (C.B. Clarke) Ching and *P. hendersonii* (Bedd.) S.G. Lu are restricted to the Himalayas, westwards to Kashmir, eastwards to Yunnan, Sichuan, Myanmar and north Vietnam.

Polypodiodes, *Metapolypodium* and *Polypodiastrum* are three new genera separated from the old Linnaeus *Polypodium* by Ching (1978). Rödl-Linder (1990) in her monograph included them in *Goniophlebium* (Blume) C. Presl.

The above East Asiatic genera are normally in subtropical areas. There are some genera distributed in Asia, extend rather to the north, or in the south-west at higher elevations. Those genera are the so-called "Temperate Asia genera".

IV. Temperate East Asiatic Type

21. *Leptolepidium* K.H. Shing & S.K. Wu, Acta Bot. Yunnan. 1: 115, 1979. TYPE: *Leptolepidium dalhousiae* (Hook.) K.H. Shing et S.K. Wu ----- *Cheilanthes dalousiae* Hook.

SINOPTERIDACEAE. A small genus segregated from *Aleuritopteris* Fée, about 4 species, from NE Siberia, Korea, Japan to the Himalayas. Terrestrial, alt. 1000-4400 m.

Neoathyrium Ching & Z.R. Wang, Acta Phytotax. Sin. 20(1): 76. 1982. TYPE: *Neoathyrium crenuloserrulatum* (Makino) Ching & Z.R. Wang. ----- *Athyrium crenuloserrulatum* Makino

ATHYRIACEAE. Monotypic, from NE China disjunctly to Qinling (Tsinling) Mountain ranges, also widely distributed in Korea, north Japan, Ussuri and the Far East. In broad-leaved or mixed forests, alt. 800-950 m, n = 40. It is not accepted and treated as a synonym of *Cornopteris* Nakai by Kato (Kramer 1990). Some of the genera in Athyriaceae form nature groups with different chromosome numbers, n = 40 or n = 41. The n = 40 group includes *Athyrium*, *Anisocampium*, *Athyriopsis*, *Cornopteris*, *Dictyodroma*, *Dryoathyrium*, *Lunathyrium*, and *Pseudocystopteris* n = 41 group includes *Diplazium*, *Allantodia*, *Callipteris*, and *Monomelangium*.

22. *Pleurosoriopsis* Fomin, Bull. Jard. Bot. Kieff 11: 8. 1930, et Fl. Siberia et Orient. Extr. 5: 215. 1930. TYPE: *Pleurosoriopsis makinoi* (Maxim. ex Makino) Fomin ----- *Gymnogramma makinoi* Maxim. ex Makino

PLEUROSORIOPSISIDACEAE. A single species, *P. makinoi* (Maxim. ex Makino) Fomin, from E Siberia, Japan, Korea to NE China, and SW China. Epiphyte on mossy tree trunks or on shaded rocks in dense forest, alt. 1600–2700 m.

The genus was subsequently placed in Pteridaceae by Copeland (1947), and Tagawa (1959); in Aspleniaceae by Ching (1940) and Pichi Sermolli (1977); in Gymnogrammaceae by Ching (1954), and in Grammitidaceae by Tryon and Tryon (1982). Kurita and Ikebe (1977) suggested it in a family by itself, which as formally described by Ching (1978). Kramer (1990) treated it as a "incertae sedis". Smith (1995) discussed the systematic position of *Pleurosoriopsis* that the chromosome base number ($x=36$) and spores (bilateral) could indicate Aspleniaceae, but clathrate scales are lacking, spores are green, and gametophytes are gemmiferous, but hairs are unlike those of Grammitidaceae. Hasebe et al. (1995) found that *Pleurosoriopsis* is closely allied to Grammitidaceae and Polypodiaceae based on *rbcl* phylogeny. Therefore a family by itself might be applicable.

23. Pseudocystopteris Ching, Acta Phytotax. Sin. 9: 76. 1964. TYPE: *Pseudocystopteris spinulosa* (Maxim.) Ching.----- *Cystopteris spinulosa* Maxim.

About 7 species, from the Himalayas, Qinghai-Xizang plateau, to north China, Korea, Japan and Far East. Species form large colonies in temperate forests, alt. 800–4500 m. Two forms of rhizome habitat in this genus, *P. atkinsonii* (Bedd.) Ching, *P. spinulosa* (Maxim.) Ching are wide spread species with long creeping rhizome; *P. duthiei* with short erect rhizome much like a typical *Athyrium* species occurs in high elevation in the Himalayas. Ching (1964) believed that this genus is intermediate between *Athyrium* and *Cystopteris*. It is better to recognize it as a distinct genus or as a subgenus of *Athyrium*, this should await more studies of the large genus *Athyrium* concerned, $n = 40$.

V. Tropical East Asiatic Type

In East Asia, there are some genera almost endemic to the tropical regions from S Korea, S Japan, to S China (including Hainan and Taiwan islands), and sometimes to N Vietnam. The following 5 genera in China are classified into this category. These genera are different from the many tropical Asian genera in China, which are widely distributed in Southeast Asia. Recently two interesting new pteridophyte genera,

Mankyua B.-Y. Sun, M.H. Kim & C.H. Kim (2001) and *Caobangia* A.R. Smith & X.C. Zhang (2002) are reported from S Korea and NE Vietnam. The former growing in lowland swampy area of the Cheju Island, belongs to the most primitive eusporangiate fern family Ophioglossaceae, and the latter from the tropical limestone rocky area in NE Vietnam, belongs to the most advanced leptosporangiate fern family Polypodiaceae.

24. Archangiopteris Christ & Gies., Flora 86: 72-85, f. 1-5. 1899. TYPE: *Angiopteris henryi* Christ & Gies.

ANGIOPTERIDACEAE. Ching (1959) recognized 10 species, while Camus (1988) hold the opinion that *Archangiopteris* together with *Protomarattia* Hayata and *Protangiopteris* Hayata are relative advanced members of *Angiopteris* and only 5 species are accepted as good ones. Distributed in Taiwan, Hainan, Yunnan, and Guangxi of China, also to N Vietnam. Terrestrial in rain forest, alt.100-1600 m.

25. Boniniella Hayata, Bot. Mag. Tokyo 41: 709. 1927. TYPE: *Boniniella cardiophylla* (Hance) Tagawa ----- *Micropodium cardiophyllum* Hance(= *Boniniella ikenoi* (Makino) Hayata ----- *Scoropendrium ikenoi* Makino)

ASPENIACEAE. Monotypic, distributed in lowland rain forests in Bonin, Ryukyu of S Japan (Nakaike 1975), from Hainan (Ching et al. 1964), Guangxi (Zhou et al. 1999), alt. 750-850 m. The plant is not distributed in Taiwan although it was mentioned by Wu and Ching (1991). There is no record of it in flora of Taiwan (De Vol et al., 1975).

26. Chieniopteris Ching, Acta Phytotax. Sin. 9(1): 37, pl. 4. 1964. TYPE: *Chieniopteris harlandii* (Hook.) Ching ----- *Woodwardia harlandii* Hook.

BLECHNACEAE. Only two similar species (Wu 1999a), sunken into *Woodwardia* Sm. by Kramer (1990). *Chieniopteris harlandii* from S Japan to S China and N Vietnam, while *C. kempii* (Copel.) Ching from Taiwan, Guangdong, Guangxi and Fujian, also to S Japan. Terrestrial in dense forest, alt. 420-1800 m.

27. Dictyodroma Ching, Acta Phytotax. Sin. 9: 57. 1964. TYPE: *Dictyodroma heterophlebium* (Mett.) Ching ----- *Asplenium heterophlebium* Mett.

ATHYRIACEAE. 2-3 species, from Taiwan, Hainan to S China, westwards to

Nepal (Thapa 2002), southwards to Indo-China, and Thailand, also in S Japan (Kyushu). Terrestrial in evergreen broad-leaved forest, alt. 800–1600 m, n = 40 (Sano et al. 2000). The reticulate venation was believed to be an indication of its affinity with *Diplaziopsis* C. Chr. or *Diplazium* Sw., this is not supported by the *rbcL* trees (Sano et al. 2000), which show it is related with the Deparioid ferns sensu Kato (1984), including *Lunathyrium* Koidz., *Dryoathyrium* Ching, and *Athyriopsis* Ching.

Kuniwatsukia Pichi Serm., *Webbia* 28: 455. 1973. TYPE: *Kuniwatsukia cuspidata* (Mett.) Pichi Serm. ----- *Aspidium cuspidatum* Mett.

ATHYRIACEAE. Monotypic, from N India, Sikkim, Nepal, Bhutan, N Myanmar, to SW China (SE & SW Yunnan, Guangxi and Guizhou), Thailand and Sri Lanka. Terrestrial in evergreen forest at alt. 400–2000 m. It is close to *Anisocampium* and *Athyrium* Roth., n = 40. *Anisocampium* and *Kuniwatsukia* are now regarded as constitutes of *Athyrium*.

Mesopteris Ching, *Acta Phytotax. Sin.* 16(4): 21. 1978. TYPE: *Mesopteris tonkinensis* (C. Chr.) Ching ----- *Dryopteris tonkinensis* C. Chr.

THELYPTERIDACEAE. Monotypic, only imperfectly known from the border regions between Guangxi and N Vietnam. In forest of limestone areas, at lower elevation (110 m in Longzhou of Guangxi). From the type collection in PE it is no much difference from *Cyclosorus* Link or *Christella* H. Lév. in general features. Hence it is not accepted as a good genus here.

28. *Monomelangium* Hayata, *Bot. Mag. Tokyo* 42: 343. 1928. TYPE: *Monomelangium pullingeri* (Baker) Tagawa ----- *Asplenium pullingeri* Baker

ATHYRIACEAE. 2 species (Chu, 1999), from S Japan (Ryukyu islands) to N Vietnam. Terrestrial in ravine of evergreen dense forest or on rocks in wet places, alt. 300–1600 m. It is related with *Diplazium* Sw., n = 41 (Sano et al. 2000).

ENDEMIC GENERA TO CHINA

Chinese endemic is a term strictly used here, which is slight different from the phytogeographical works on Chinese seed plants (Ying et al. 1993). The Chinese endemic genera here circumscribed are those genera whose distributions are not

beyond the boundaries of China, or occasionally to the bordering regions, notably to N. Vietnam, at the border with Yunnan and Guangxi. Six genera in five families are Chinese endemics. *Craspedosorus* Ching & W. M. Chu, *Cystoathyrium* Ching, *Neocheiropteris* Christ, *Phanerophlebiopsis* Ching, and *Sinopteris* C. Chr. & Ching are only in China, *Cyrtogonellum* Ching extended to N Vietnam. Some formerly called endemic genera are more properly referred to Sino-Himalayan genera, such like *Sorolepidium* and *Platygyria*, some are not accepted on the taxonomy ground. As to these Chinese endemic genera different opinions exist, *Sinopteris* is no much difference from *Aleuritopteris* Fée or *Cheilanthes* Sw., *Neocheiropteris* is close to *Microsorium* Link and *Neolepisorus* Ching, *Phanerophlebiopsis* to *Arachniodes* Blume, while *Cystoathyrium* is imperfectly known so far.

Two of the six genera, i.e., *Cyrtogonellum* and *Phanerophlebiopsis* belong to Dryopteridaceae, other four genera belong to Sinopteridaceae, Thelypteridaceae, Athyriaceae, and Polypodiaceae respectively.

29. *Craspedosorus* Ching & W.M. Chu, Acta Phytotax. Sin. 16: 24, 1978. TYPE: *Craspedosorus sinensis* Ching & W.M. Chu.

THELYPTERIDACEAE. Monotypic, only known from NE Yunnan. In shaded place under thickets, alt. 1400–1500 m. *Craspedosorus* is very close to *Cyclogramma* Tagawa or properly belongs to.

30. *Cyrtogonellum* Ching, Bull. Fan Mem. Inst. Biol. Bot. 8: 327, 1938. TYPE: *Cyrtogonellum fraxinellum* (Christ) Ching ----- *Aspidium fraxinellum* Christ.

DRYOPTERIDACEAE. 8 species are recognized in the flora of China (Kung, 2001). Like Similar to *Phanerophlebiopsis* Ching, mainly distributed in the limestone (Karst) areas of Guizhou and adjacent regions, only the type (*C. fraxinellum*) extends to N Vietnam, altitudinal ranges 500–1700 m.

Systematically the genus is closely related to *Cyrtomium* and *Polystichum*.

31. *Cystoathyrium* Ching, Acta Phytotax. Sin. 11: 22, 1966. TYPE: *Cystoathyrium chinense* Ching.

ATHYRIACEAE. Monotypic, Ching (1966b) regarded it is an intermediate between *Athyrium* Roth and *Cystopteris* Bernh. Only one locality is known on mountain Erlang in SW Sichuan, alt. 2200 m, by road-side. Two collections have been made,

one in 1950s, another in 1980s. Recently, search of this species without success, perhaps it has already been extinct in wild during the road constriction on the mountain. It may be close to *Cystopteris* in soral and spore characters. If the plant is not of this family. I wonder it may have relations with *Thelypteris* Schmidel and *Lastrea* Bory.

32. *Neocheiropteris* Christ, Bull. Soc. Bot. France 52: 21. 1905. TYPE: *Neocheiropteris palmatopedata* (Baker) Christ ----- *Polypodium palmatopedatum* Baker.

POLYPODIACEAE. Only 2 species in this genus. *Neocheiropteris palamtopedata* (Baker) Chrsit distributed in Sichuan (Shimian, Xichang), Guizhou (Panxian, Weining, Xingren), Yunnan (Dayao, Dengchuan, Eshan, Fumin, Kunming, Luquan, Luxi, Mile, Pingbian, Qiaojia, Qiubei, Shuangbai, Wuding, Yimen, Yongren and Zhaotong). Usually epilithic or terrestrial in evergreen broad-leaved forest, alt. 1500-2700 m. *Neocheiropteris triglossa* (Baker) Ching has a very small distribution area in Central Yunnan (Mile and Luquan).

Neocheiropteris waltoni Ching (Hook., Ic. Pl. t. 3158. 1932), a peculiar Polypodiaceae plant from Tibet has been transferred to *Platygyria*. This species has no relation with the above two, but more close to *Lepisorus clathratus*.

Systematically *Neocheiropteris* is closely related with *Neolepisorus*, and *Microsorium*, less to *Lepisorus*.

33. *Phanerophlebiopsis* Ching, Acta Phytotax. Sin. 10: 115. 1965. TYPE: *Phanerophlebiopsis tsiangiana* Ching.

DRYOPTERIDACEAE. About 4-6 species, known only from Guizhou, Jiangxi, Hunan, Chongqing and SE Yunnan, in limestone area, alt. 450-1600 m.

A genus close to *Arachniodes*, which has some species intermediate between species of *Arachniodes* in division pattern of leaves (Ching 1965; Wu et Ching 1991; Kramer 1990). Kramer went on further to reduce it *Arachniodes*, because species like *Arachniodes assamica* (Kuhn) Ohwi is similar to species of *Phanerophlebiopsis* Ching. Not close to the tropical American *Phanerophlebia* C. Presl, which is more close to *Cyrtomium* (Kramer, 1990).

34. *Sinopteris* C. Chr. & Ching, Bull. Fan Mem. Inst. Biol. Bot. 4: 359. 1933. TYPE: *S. grevilleoides* (Christ) C. Chr. & Ching ----- *Cheilanthes grevilleoides* Christ.

SINOPTERIDACEAE. 2 species (Ching et Shing, 1990) confined to China. *S. grevilleoides* is only known from NW Yunnan and S Sichuan, a rare species; *S. albofusca* is also a rare species, but with a rather wide distribution north from Beijing, Hebei, southward to Gansu, S Hunan, SW Sichuan, Yunnan (SE, Central and NW) and Tibet. On limestone rocks in open place under shrubs, altitudinal ranges 500–3200 m.

It is a unique genus close to *Aleuritopteris* Fée, the sorus is composed by only one single sporangium, a character regarded as primitive (Wu, 1981), which should not be, the annals usually very wide.

Trichoneuron Ching, Acta Phytotax. Sin. 10: 118, pl. 22. 1967. TYPE: *Trichoneuron microlepioides* Ching

TECTARIACEAE (ASPIDIACEAE). Monotypic, from S Yunnan. Ching (1967) realized that the plant is quite different from other Thelypteridaceae, rather similar to plants of *Leptorumohra* and *Lastreopsis* Ching, only tentatively put it as an isolated genus in Thelypteridaceae. It was collected from Dawei Mt. in S Yunnan, alt. 1600 m, under evergreen broad-leaved forest in ravine by Prof. W.M. Chu et al. in 1997 (Chu et al. 2000). Now it is known as *Lastreopsis microlepioides* (Ching) W.M. Chu & Z.R. He, the sole number of the genus in mainland of China.

SYSTEMATICS

Polypodiaceae has as many as seven East Asiatic genera and one Chinese endemic genus; Dryopteridaceae has four East Asiatic genera and two Chinese endemic genera; Athyriaceae and Thelypteridaceae each has three East Asiatic genera and one Chinese endemic genus respectively; Sinopteridaceae has one East Asiatic genus and one Chinese endemic genus; other families do not have Chinese endemic genus, but have one or two East Asiatic genus (genera) are Aspleniaceae (2 genera); Blechnaceae (2); Angiopteridaceae (1); Monachosoraceae (1); Onocleaceae (1); Woodsiaceae (1); Davalliaceae (1), and Pleurosoriopsidaceae (1) (Table 1).

Polypodiaceae, Dryopteridaceae, Athyriaceae and Thelypteridaceae are also the largest families in Chinese pteridoflora. Polypodiaceae is a relatively advanced family and has undergone rapid, recent evolution worldwide, with two distribution centers, one in Asia and another in tropical America. Ching (1979) discussed that the Himalaya as

Table 1. Classification of the East Asiatic genera and Chinese endemic genera

Family	East Asiatic genera	Chinese endemic genera	Number of genera
Polypodiaceae	Arthromeris, Drymotaenium, Gymnogrammitis, Lepidomicrosorium, Metapolypodium, Platygyria, Polypodiodes	Neocheiropteris	8
Dryopteridaceae	Cyrtomidictyum, Leptorumohra, Lithostegia, Sorolepidium	Cyrtogonellum, Phanerophlebiopsis	6
Athyriaceae	Dictyodroma, Monomelangium, Pseudocystopteris	Cystoathyrium	4
Thelypteridaceae	Cyclogramma, Dictyocline, Glaphyropteridopsis	Craspedosorus	4
Sinopteridaceae	Leptolepidium,	Sinopteris	2
Aspleniaceae	Boniniella, Sinephropteris		2
Blechnaceae	Blechnidium, Chieniopteris		2
Angiopteridaceae	Archangiopteris		1
Monachosoraceae	Ptilopteris		1
Onocleaceae	Pentarhizidium		1
Woodsiaceae	Cheilanthopsis		1
Davalliaceae	Paradavallodes		1
Pleurosoriopsidaceae	Pleurosoriopsis		1
13	28	6	34

a center of concentration for the South-Eastern Asiatic Polypodiaceous ferns. Beside the above-mentioned Polypodiaceous genera, *Crypsinus* (*Phymatopteris*) if it is regarded as a genus different from *Selliguea* Bory, also concentrated in East Asia, with an extension to Southeast Asia. Dryopteridaceae, Athyriaceae, and Thelypteridaceae are well represented in Asia, with many genera and species distributed in tropical, subtropical and temperate areas in China. All of the six Chinese endemic genera are distributed mainly in SW China, four of the six are constrained to the limestone areas, where the ancient relics might find refuge areas to survive. These endemic genera are very important groups for the phylogenetic studies of the families that they belong. Perhaps they represent rather isolated primitive groups in these families, belonging to the so-called paleoendemics. Different from these Chinese endemics, some of the Sino-Himalayan genera, like *Cheilanthopsis*, *Metapolypodium*, *Platygyria* and *Sorolepidium*

may belong to neoendemics, which are recently derived endemics. *Platygyria* might be derived from the *Lepisorus clathratus* group of *Lepisorus*, and *Sorolepidium* might be derived from *Polystichum duthiei* group of *Polystichum* with the uplift of the giant Himalayas.

DISTRIBUTION AND ECOLOGY

Distribution

The East Asiatic and endemic genera in China are widely distributed in China, mainly in SW China, south of the Yangtze River, to Hainan and Taiwan islands, also to Tsinling mountains, north and northeast China. The high density areas are in SW China, one in NW Yunnan, SE Xizang and SW Sichuan, another in SE Yunnan. Taiwan is also a high density area with many of those genera. (Table 2, Fig. 2)

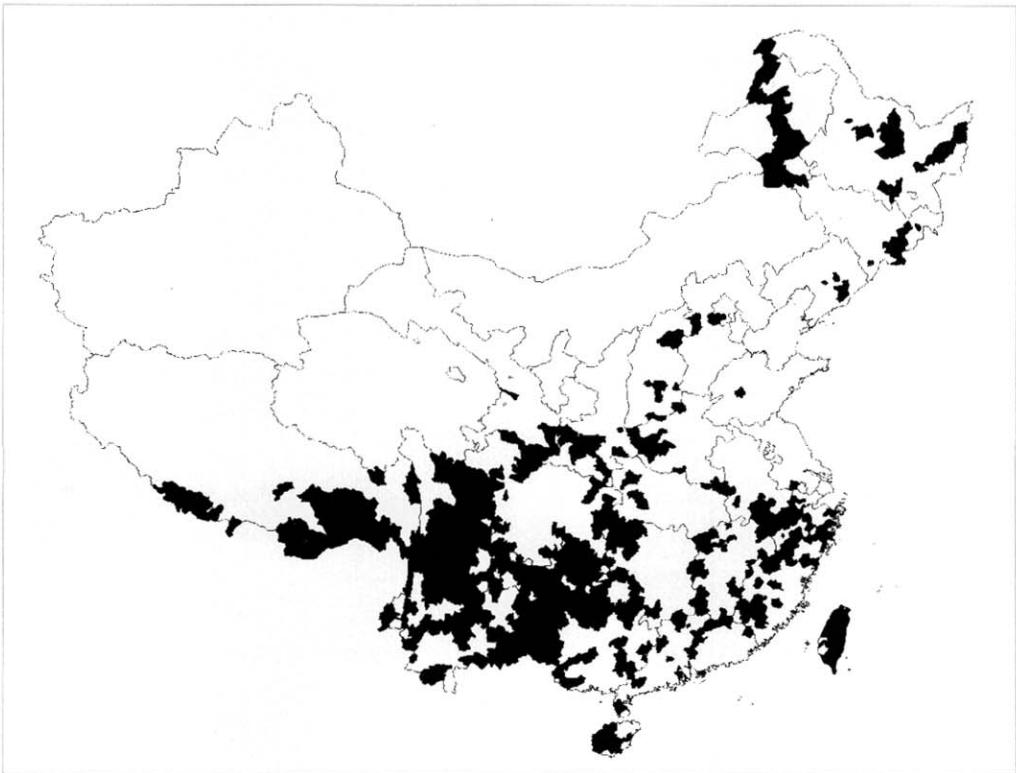


Fig. 2. Distribution of the East Asiatic and endemic genera in China.

Table 2. Distribution of the East Asiatic genera

NW Himalaya	E Himalaya	China Japan Korea					
		Mainland China	Hainan	Taiwan			
Arthromeris	Arthromeris	Arthromeris		Arthromeris			
	Blechnidium	Blechnidium		Blechnidium			
	Cheilanthes	Cheilanthes					
	Gymnogrammitis	Gymnogrammitis	Gymnogrammitis				
	Lithostegia	Lithostegia					
	Metapolypodium	Metapolypodium					
Paradavallodes	Paradavallodes	Paradavallodes					
Platygyria	Platygyria	Platygyria					
	Sinephropteris	Sinephropteris					
	Sorolepidium	Sorolepidium		Sorolepidium			
		Cyrtomidictyum			Cyrtomidictyum	Cyrtomidictyum	
		Lepidomicrosorium		Lepidomicrosorium	Lepidomicrosorium		
		Leptorumohra		Leptorumohra	Leptorumohra	Leptorumohra	
		Ptilopteris		Ptilopteris	Ptilopteris		
Cyclogramma	Cyclogramma	Cyclogramma		Cyclogramma	Cyclogramma		
	Dictyocline	Dictyocline		Dictyocline	Dictyocline		
	Drymotaenium	Drymotaenium		Drymotaenium	Drymotaenium		
Glaphyopteridopsis	Glaphyopteridopsis	Glaphyopteridopsis		Glaphyopteridopsis	Glaphyopteridopsis		
Pentarhizidium	Pentarhizidium	Pentarhizidium		Pentarhizidium	Pentarhizidium	Pentarhizidium	
Polypodiodes	Polypodiodes	Polypodiodes	Polypodiodes	Polypodiodes	Polypodiodes		
Leptolepidium	Leptolepidium	Leptolepidium			Leptolepidium	Leptolepidium	
		Pleurosoriopsis			Pleurosoriopsis	Pleurosoriopsis	
Pseudocystopteris	Pseudocystopteris	Pseudocystopteris		Pseudocystopteris	Pseudocystopteris	Pseudocystopteris	
		Archangiopteris	Archangiopteris	Archangiopteris			
		Boniniella	Boniniella		Boniniella		
		Chieniopteris	Chieniopteris	Chieniopteris	Chieniopteris	Chieniopteris	
		Dictyodroma	Dictyodroma	Dictyodroma	Dictyodroma	Dictyodroma	
		Monomelangium	Monomelangium	Monomelangium	Monomelangium	Monomelangium	

Most of the Chinese endemic fern genera are distributed in SW China, including Yunnan, Guangxi, Guizhou, Sichuan, Chongqing, Hunan, and Xizang. No other centers can be assigned to this type of distribution. A few species of the those endemic genera distributed outside of this area, southwards to N Vietnam, northwards to Hebei and Beijing, eastwards to Jiangxi, and disjunct to Taiwan. (Fig. 3)

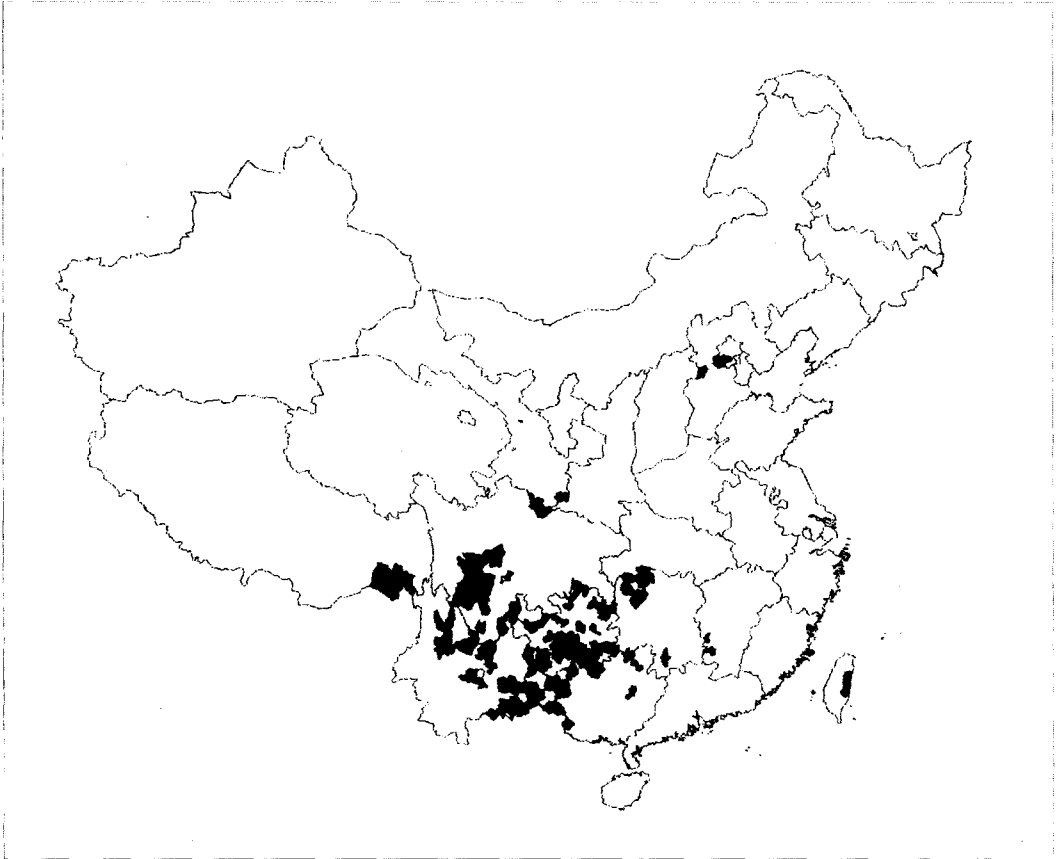


Fig 3. Distribution of the Chinese endemic genera.

Vertical Distribution

Vertical distributions (Fig. 4) of all the above 34 genera are arranged from lower elevations to higher elevations. Most of the Eastern Asiatic and Chinese endemic

genera distributed at medium higher elevations, from 500–2000 m, in the subtropical evergreen forest region. *Platygyria* distributed up to 5029m, which is the highest in Eastern Asia, also the highest in the world. Second to it is the *Sorolepidium*, upto 4700m. The Sino-Himalayan and Temperate Eastern Asiatic genera generally distributed at relatively higher elevations, from 2000–4500 m. Only 4 of 34 genera have species distributed over 4000 m, they are *Platygyria*, *Sorolepidium*, *Leptolepidium* and *Pseudocystopteris*; the former two belong to Sino-Himalayan distribution pattern, the latter two belong to Temperate Eastern Asian distribution pattern. The tropical Eastern Asiatic genera are distributed in tropical or sometimes in subtropical forests at lower elevations.

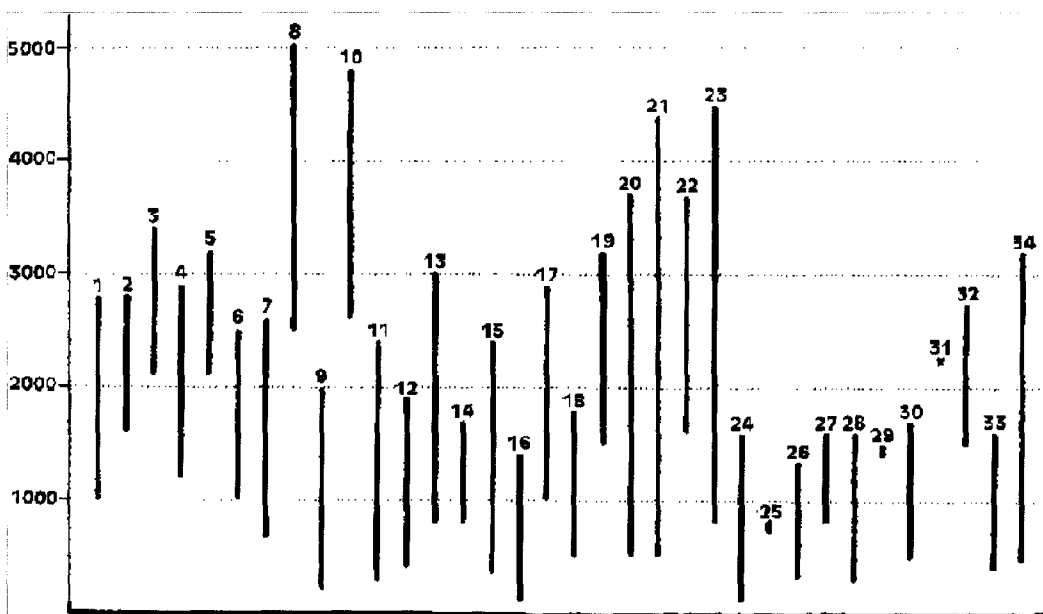


Fig. 4. Altitudinal ranges of the East Asiatic and endemic fern genera in China. The numbers above the bars correspond to the genus numbers in the enumeration.

Ecology

In the above 34 genera (Table 3), many genera, especially the Polypodiaceous plants, are mainly epiphytic or epilithic, such as, *Arthromeris*, *Blechnidium*,

Tab. 3. Habit of the East Asiatic genera and endemic genera in China

Habit	Family	Genus	Evergreen/ Summer-green
Epiphytic or epilithic	Polypodiaceae	Arthromeris, Drymotaenium, Gymnogrammitis, Lepidomicrosorium, Metapolypodium, Polypodiodes	Summer-green Evergreen Summer-green Evergreen Summer-green Evergreen or Summer-green
	Davalliaceae	Paradavallodes	Summer-green
	Blechnaceae	Blechnidium	Evergreen
	Pleurosoriopsidaceae	Pleurosoriopsis	Winter green, spores green
Mainly lithophytic	Dryopteridaceae	Lithostegia, Sorolepidium	Evergreen Evergreen
	Polypodiaceae	Platygyria	Summer-green
	Monachosoraceae	Ptilopteris	Evergreen
	Sinopteridaceae	Sinopteris	Summer-green
	Aspleniaceae	Sinephropteris	Evergreen
Woodsiaceae	Cheilanthesis	Summer-green	
Mainly terrestrial on rocky places	Dryopteridaceae	Cyrtogonellum, Cyrtomidictyum,	Evergreen Evergreen
	Polypodiaceae	Neochiropteris	Summer-green
Mainly terrestrial	Athyriaceae	Cystoathyrium, Dictyodroma, Monomelangium, Pseudocystopteris	Evergreen Evergreen Evergreen Summer-green
	Thelypteridaceae	Craspedosorus, Cyclogramma, Dictyocline, Glaphyropteridopsis	Evergreen Evergreen Evergreen Evergreen
	Dryopteridaceae	Leptorumohra, Phanerophlebiopsis	Evergreen Evergreen
	Angiopteridaceae	Archangiopteris	Evergreen
	Sinopteridaceae	Leptolepidium	Summer-green
	Aspleniaceae	Boniniella	Evergreen
	Blechnaceae	Chieniopteris	Evergreen
	Onocleaceae	Pentarhizidium	Summer-green, spores green
Total	13	34	

Gymnogrammitis, *Metapolypodium*, *Paradavallodes*, *Lepidomicrosorium*,
Drymotaenium, *Polypodiodes*, and *Pleurosoriopsis*. *Cheilanthesis*, *Lithostegia*,

Platygyria, *Sinephropteris*, *Sorolepidium*, *Ptilopteris*, and *Sinopteris* are mainly lithophytic. *Cyrtomidictyum*, and *Cyrtogonellum* belonging to the Dryopteridaceae, and *Neocheiropteris* of Polypodiaceae are terrestrial plants more often on rocky places. Other genera, *Cyclogramma*, *Dictyocline*, *Glaphyopteridopsis*, *Pentarhizidium*, *Phanerophlebiopsis*, *Leptorumohra*, *Archangiopteris*, *Boniniella*, *Chieniopteris*, *Dictyodroma*, *Monomelangium*, *Pseudocystopteris*, and *Cystoathyrium* are mainly terrestrial plants in forest of acid soil areas, the former three belong to Thelypteridaceae, the last four belong to Athyriaceae. *Leptolepidium* is found both on acid soil and limestone soil.

None of the six Chinese endemic genera is epiphytic, but mainly lithophytic or terrestrial. *Cyrtogonellum* and *Sinopteris* are lithophytes in crevices of limestone rocks. *Neocheiropteris* is usually terrestrial on limestone area in forest, or epilithic. *Phanerophlebiopsis* is also from the limestone areas but terrestrial on acid soil floor in forest. *Craspedosorus*, *Cystoathyrium* are terrestrial in forest.

DISCUSSION

None of the above genera belongs to the fern allies. The modern fern allies are most widespread cosmopolitan groups of ancient origin. The families Gymnogrammitidaceae and Pleurosoriopsidaceae are endemic to Eastern Asian, but the former can not be accepted as a distinct family, it has been proved to be a member of Polypodiaceae (Schneider et al. 2002). Therefore, there is no endemic family in China. *Pleurosoriopsis*, if merit of a family by its own, then the family is an Eastern Asian endemic family.

The East Asiatic genera and endemic genera of the pteridophytes in China are groups of plants have more or less similar distribution. Most are small group of ferns, monotypic or oligotypic. They are not groups necessarily have close phylogenetic relationships, but rather they have similar distribution areas. These genera have their distribution centers in East Asia, mainly in China.

It should be noticed that many large genera, like *Polystichum*, *Dryopteris*, *Arachniodes* and *Cyrtomium* of Dryopteridaceae, *Athyrium* and *Lunathyrium* of Athyriaceae, *Crypsinus*, *Lepisorus*, and *Pyrrosia* of Polypodiaceae, are more widely distributed, but their distribution center are also mainly in China and adjacent regions.

In the flora of East Asia, some fern genera have species mainly in East Asia, or most species are found in China, but with a disjunct distribution pattern between Africa (including Madagascar). *Nothoperanema* (Tagawa) Ching of Dryopteridaceae, all of the five species of this genus are found in China, some westward to N Myanmar, Nepal, and N India; *N. shikokianum* distributed from China to Japan, while *N. squamisetum* is widely distributed from China (Yunnan, Xizang and Taiwan) westward to Sikkim, India, up to Madagascar, Central and South Africa. Similar distribution patterns occurred in *Ceterachopsis* (J. Sm.) Ching, 3 species, 2 in SW China, 1 from NW Himalaya to E Africa, *Hypodematium* Kunze and *Leptogramma* J. Sm., of the Thelypteridaceae, *Cornopteris* Nakai and *Dryoathyrium* Ching of Athyriaceae, *Neolepisorus* Ching of Polypodiaceae.

There are some interesting genera disjunctly distributed between East Asia and North American, such as *Camptosorus* Link (Aspleniaceae), *Onoclea* L. (Onocleaceae), *Lunathyrium* Koidz. (Athyriaceae). The former two genera each has two sister species (or as one species, two subspecies), one in East Asia, one in North America. The latter genus has only one species in North America, but several species in East Asia.

Some genera in the tropical family Thelypteridaceae, such as *Macrothelypteris* Ching, *Metathelypteris* Ching, *Pronephrium* C. Presl, *Pseudophegopteris* Ching, and *Stegnogramma* Blume, are widely distributed from East Asia to Southeast Asia, with their species mainly in China or adjacent regions, but widely extended to tropical Asia.

Some of Eastern Asiatic genera belong to the advanced groups of ferns, especially those genera with a Sino-Himalayan distribution pattern, while some of the Chinese endemic genera may be rather primitive in the families.

Acknowledgments

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Literature cited

- Camus, J. M., 1988. The limits and affinities of Marattialean fern genera in China and the west Pacific. *In*: Shing, K.-H. and Kramer, K.U. (eds.), Proceedings of ISSP, 31-37. Science & Technology Press, Beijing.
- Ching, R.-C., 1940. On natural classification of the family "Polypodiaceae". *Sunyatsenia* 5: 201-268.
- Ching, R.-C., 1954. Systematic arrangements of families and genera of Chinese Pteridophytes with corresponding names in Chinese. *Acta Phytotax. Sin.* 3: 93-99.
- Ching, R.-C., (ed.), 1959. *Flora Reipublicae Popularis Sinicae* 2. Science Press, Beijing.
- Ching, R.-C., C.H. Wang, and S.H. Wu, 1964. Pteridophyta. *In*: Chun et al. (eds.), *Flora Hainanica* 1: 1-266. Science Press, Beijing.
- Ching, R.-C., 1966a. *Gymnogrammitidaceae* Ching, a new fern family. *Acta Phytotax. Sin.* 11: 11-15.
- Ching, R.-C., 1966b. Three new fern genera. *Acta Phytotax. Sin.* 11: 17-30.
- Ching, R.-C., 1978. The Chinese fern families and genera: systematic arrangement and historical origin. *Acta Phytotax. Sin.* 16: 1-19; 16: 16-37.
- Ching, R.-C., 1979. The Himalaya as a center of concentration for the South-Eastern Asiatic Polypodiaceous ferns. *Acta Bot. Yunnanica* 1: 23-31.
- Ching, R.-C., and S.K. Wu, 1980. The floristic characteristics of the Xizang (Tibet) Pteridophyte flora in relation to the upheaval of the Himalayas. *Acta Bot. Yunnanica* 2: 382-389
- Ching, R.-C., Y.-X. Lin, and S.-K. Wu, 1983. A taxonomic revision of *Lepisorus clathratus*(Clarke) Ching complex in the Sino-Himalayan region. *Acta Bot. Yunnanica* 5: 1-23.
- Ching, R.-C., and K.-H. Shing (ed.), 1991. *Flora Reipublicae Popularis Sinicae* 3(1). Science Press, Beijing.
- Ching, R.-C., and S.-K. Wu, 1980. *Platygyria* Ching et S.K. Wu, a unique new genus of the Polypodiaceae from China. *Acta Bot. Yunnanica* 2: 67-74.
- Ching, R.-C., and S.-K. Wu, 1983. Pteridophyta. *In* Wu C-Y (ed.), *Flora Xizangica* 1: 1-355. Science Press, Beijing.
- Chu, W.-M. (ed.), 1999. *Flora Reipublicae Popularis Sinicae* 3. Science Press, Beijing.
- Chu, W.-M., and Z.-R. He, 2000. Taxonomic notes on some pteridophytes from Yunnan (II). *Acta Bot. Yunnanica* 22: 255-262.

- Copeland, E.B., 1947. Genera Filicum. The genera of ferns. *Chronica Botanica. Annales Cryptogamici et Phytopathologici* no. 5. Waltham.
- De Vol, C.E., et al., 1975. Pteridophyta. In: H.L. Li et al. (eds.), *Flora of Taiwan* 1: 19-492. Epoch Publishing Co., Ltd. Taipei.
- Dixit, R.D., 1984. A census of the Indian pteridophytes. *Flora of India series IV. Botanical Survey of India*, Deep Printers, New Delhi.
- Fraser-Jenkins, C.R., 1997a. New Species Syndrome in India Pteridology and the Ferns of Nepal. International Book Distributors, Dehra Dun.
- Fraser-Jenkins, C.R., 1997b. Himalayan Ferns, a guide to *Polystichum*. International Book Distributors, Dehra Dun.
- Gastony, G.J., and M.C. Ungerer, 1997. Molecular systematics and a revised taxonomy of the onocleoid ferns (Dryopteridaceae: Onocleaceae). *Amer. J. Bot.* 84: 840-849.
- Hayata, B., 1928. On the systematic importance of the stelar system in the Filicales, III. *Bot. Mag. Tokyo* 42: 334-348.
- Kato, M., and N. Sakahashi, 1980. Affinities in the Onocleoid ferns. *Acta Phytotax. Geobot.* 31: 127-138.
- Kato, M., 1984. A taxonomic study of the Athyrioid fern genus *Deparia* with main reference to the Pacific species. *J. Fac. Sci. Univ. Tokyo Sect. III.* 13: 371-430.
- Kato, M., R. Suzuki, and N. Nakato. 1991. The systematic status of *Matteuccia intermedia* (Woodsiaceae: Pteridophyta). *Fern Gazette* 14: 65-71.
- Khullar, S.P., 1994. An Illustrated Fern Flora of the West Himalaya Vol. 1. International Book Distributors, Dehra Dun.
- Khullar, S.P., 2000. An Illustrated Fern Flora of the West Himalaya Vol. 2. International Book Distributors, Dehra Dun.
- Kramer, K.U., 1990. In: Kubitzki, K. (ed.), *The Families and Genera of Vascular Plants Vol. I. Pteridophytes and Gymnosperms* (Vol. eds. by Kramer K.U. and Green P. S.). Springer-Verlag, Berlin.
- Kung, H.-S. (ed.), 2001. *Flora Reipublicae Popularis Sinicae* 5(2). Science Press, Beijing.
- Kurita, S., and C. Ikebe, 1977. On the systematic position of *Pleurosoriopsis makinoi* (Maxm.) Fomin. *Journ. Jap. Bot.* 52: 39-49.
- Kuo, C.M., 1985. Taxonomy and phytogeography of Taiwanese pteridophytes.

- Taiwania 30: 5-100.
- Lin, Y.-X. (ed.), 2000. Flora Reipublicae Popularis Sinicae 6(2). Science Press, Beijing.
- Mickel, J. T., 1976. *Sinephropteris*, a new genus of scolopendrioid ferns. Brittonia 28: 326-328.
- Nakaike, T., 1975. Enumeratio Pteridophytarum Japonicarum, Filicales. University of Tokyo Press, Tokyo.
- Nayar, B.K., 1974. A classification of homosporous ferns. In Nayar B K and S. Kaur, Companion to Beddome's Handbook to the Ferns of British India, part II. 111-198.
- Nooteboom, H.P., 1994. Notes on Davalliaceae II. A revision of the genus Davallia. Blumea 39: 151-214.
- Nooteboom, H.P., 1996. Davalliaceae of China. Acta Phytotax. Sin. 34: 162-179.
- Nooteboom, H.P., 1997. The microsorioid ferns. Blumea 42: 261-395.
- Pichi Sermolli, R.E.G., 1977. Tentamen Pteridophytorum genera in taxonomicum ordinem redigendi. Webbia 31: 313-512.
- Ravensberg, W. J., E. Hennipman, 1986. The *Pyrrosia* species formerly referred to *Drymoglossum* and *Saxiglossum*. Leiden Bot. Ser. 9: 281-310.
- Rödl-Linder, G., 1990. A monograph of the fern genus *Goniophlebium* (Polypodiaceae). Blumea 34: 277-423.
- Sano, R., M. Takamiya, M. Ito, S. Kurita, and M. Hasebe, 2000. Phylogeny of the lady fern group, tribe Physematieae (Dryopteridaceae), based on chloroplast *rbcl* gene sequences. Molec. Phylog. Evol. 15: 403-413.
- Schneider, H., A.R. Smith, R. Cranfill, C.H. Haufler, T.A. Ranker and T. Hildebrand, 2002. *Gymnogrammitis dareiformis* is a polygrammoid fern (Polypodiaceae) Resolving an apparent conflict between morphological and molecular data. Plant Syst. Evol. 234: 121-136.
- Shi, L., and X.-C.Zhang. 1999. Taxonomic studies of the fern genus *Lepidomicrosorium* Ching et Shing (Polypodiaceae). Acta Phytotax. Sin. 37: 509-522.
- Shing, K.-H., 1972. Pteridophytes. Iconographia Cormophytorum Sinicorum, vol. 1. Science Press, Beijing.
- Shing, K.-H. (ed.), 1999. Flora Reipublicae Popularis Sinicae 4(1). Science Press, Beijing.
- Shing, K.-H., and K.U. Kramer (eds.). 1989. Proceedings of the ISSP. China Sci. &

Tech. Press, Beijing.

- Smith, A.R., 1995. Non-molecular phylogenetic hypotheses for ferns. *Amer. Fern Journ.* 85: 104-122.
- Smith, A.R., and X.-C.Zhang, 2002. *Caobangia*, a new genus and species of Polypodiaceae from Vietnam. *Novon* 12: 546-550.
- Sun, B.-Y., M. H. Kim, C. H. Kim, and C.-W. Park. 2001. *Mankyua* (Ophioglossaceae): a new fern genus from Cheju Island, Korea. *Taxon* 50: 1019-1024.
- Thapa, N. 2002. Pteridophytes of Nepal. *Bull. Dept. of Plant Resources* No. 19. Nepal.
- Tagawa, M. 1959. *Coloured Illustrations of the Japanese Pteridophyta*. Osaka: Hoikusha.
- Tryon, R.M., and A.F. Tryon, 1982. *Ferns and Allied Plants, with special reference to tropical America*. Springer-Verlag, Berlin.
- Wu, P.-C., 1992. The East Asiatic genera and endemic genera of the bryophytes in China. *Bryobrothera* 1: 99-117.
- Wu, S.-H., and R.-C. Ching, 1991. *Fern Families and Genera of China*. Science Press, Beijing.
- Wu, S.-H. (ed.), 1999a. *Flora Reipublicae Popularis Sinicae* 4(2). Science Press, Beijing.
- Wu, S.-H. (ed.), 1999b. *Flora Reipublicae Popularis Sinicae* 6(1). Science Press, Beijing.
- Wu, S-K, 1981. A study of the genus *Aleuritopteris* Fée in China. *Acta Phytotaxonomica Sinica* 19: 57-74.
- Wu, S-K, 1987. The phytogeographical affinities of pteridophytes between China and Japan. *Acta Bot. Yunnanica* 9: 167-179.
- Wu, S-K (ed.), 2000. *Flora Reipublicae Popularis Sinicae* 5(1). Science Press, Beijing.
- Ying, T.-S., Y.-L. Zhang, and D.E. Boufford, 1993. *The Endemic Genera of Seed Plants of China*. Science Press, Beijing.
- Zhang, X.-C., and K.-H. Shing (eds.), 1999. *Ching Memorial Volume*. China Forestry Publishing House, Beijing.
- Zhang, X.-C., 2000. Pteridophytes. *In* C.-W. Chen (ed.). *Biodiversity Research and Conservation in Dujiangyan*. Sichun Sci. & Tech. Press, Chengdu.
- Zhang, X.-C., 2001. Endemic, rare and endangered ferns in China. *Plants* 2001-4: 1, cum photo.
- Zhang, X.-C., Q.-R. Liu, and J. Xu, 2003. Systematics of *Platygyria* (Polypodiaceae).

- Acta Phytotax. Sin. 41: 401-415.
- Zhou, H.-G., H. Li, Y.-Y. Huang, and Y.-L. Xie, 1999. The pteridophyte flora from limestone area of Guangxi, China. *J. Guangxi Agric. Biol. Sci.* Vol. 18, suppl. 82-128.