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Taxonomy of the Thelypteroid Ferns, with
Special Reference to the Species of
Japan and Adjacent Regions

III. Classification

by

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It is a matter of common knowledge that the object of modern taxonomy is to investigate the relationship among organisms, and to complete the compilation of their natural system. Valuable contributions under that thesis have been made by many biologists. Nevertheless, there remains a great number of difficult problems to solve concerning all groups of organisms.

The thelypteroid group of ferns has been one of the most problematic and obscure groups among the vascular plants. Although considerable efforts have been made to clarify the natural relationships among the species, we have not been able to arrive at any conclusive system of the thelypteroid ferns.

Thirty-one genera (including those recently added by CHING) have hitherto been proposed to the species of the thelypteroid series circumscribed in the second part of this paper. They are listed below chronologically:

Thelypteris SCHMIDEL, Icon. Pl. ed KELLER 45. 1962.—Type: *Polypodium thelypteris* L., now *Thelypteris palustris* (A. GRAY) SCHOTT.

Meniscium SCHREBER in L. Gen. Pl. ed. 8, II, 757. 1791.—Type: *Polypodium reticulatum* L., now *Meniscium reticulatum* (L.) SWARTZ.

Lastrea BORY, Dict. Class. Hist. Nat. 6: 588. 1824.—Type: *Polypodium oreopteris* EHRH., now *Thelypteris oreopteris* (EHRH.) CHING.

Stegnogramma BLUME, Enum. Pl. Jav. 172. 1828.—Type: *Stegnogramma aspidioides* BLUME.

Cyclosorus LINK, Hort. Berol. 2: 128. 1833.—Type: *Aspidium gongylodus* SCHKUHR, now *Thelypteris gongylodus* (SCHKUHR).

Goniopteris PRESL, Tent. Pterid. 181. 1836.—Type: *Polypodium viviparum* RADDI, now *Meniscium viviparum* (RADDI).

Sphaerostephanos J. SMITH in HOOKER & BAUER, Gen. Fil. 21. 1839.—Type: *Sphaerostephanos asplenioides* J. SMITH, a synonym of *Thelypteris polycarpa* (BLUME).

Mesochlaena R. BROWN ex J. SMITH, Journ. Bot. 3: 18. 1840.—Type: *Sphaerostephanos asplenioides* J. SMITH, a synonym of *Thelypteris polycarpa* (BLUME).

Leptogramma J. SMITH, Journ. Bot. 4: 51. 1841.—Type: *Polypodium tottum* WILLD. non THUNB., now *Stegnogramma pozoi* (LAGASCA) K. IWATS.

Amauropelta KUNZE, Farnkr. 1: 86, 109. 1843.—Type: *Amauropelta breutelii* KUNZE, a synonym of *Thelypteris limbata* (SWARTZ).

Abacopteris FÉE, Congr. Sci. France X, 1: 178. 1843.—Type: *Aspidium lineatum* BLUME, now *Thelypteris lineata* (BLUME).

Amplopteris KUNZE, Bot. Zeit. 6: 114. 1848.—Type: *Amplopteris elegans* KUNZE, a synonym of *Meniscium proliferum* (RETZ.) SWARTZ.

Glaphyopteris PRESL, Abh. Böhm. Ges. Wiss. V, 5: 344. 1848.—Type: *Polypodium decussatum* L., now *Thelypteris decussata* (L.) PROCTOR.

Haplodictyum PRESL, Epim. Bot. 50. 1849.—Type: *Haplodictyum heterophyllum* PRESL, now *Thelypteris heterophylla* (PRESL).

Pronephrium PRESL, Epim. Bot. 258. 1849.—Type: *Aspidium lineatum* BLUME, now *Thelypteris lineata* (BLUME).

Phegopteris (PRESL) FÉE, Gen. Fil. 242. 1852.—Type: *Phegopteris polypodioides* FÉE, now *Thelypteris phegopteris* (L.) SLOSSON.

Oochlamys FÉE, Gen. Fil. 297. 1852.—Type: *Oochlamys revoirei* FÉE, a synonym of *Thelypteris opposita* (VAHL).

Hemestheum NEWMAN, Phytologist 4: app. xxii. 1851.—Type: *Polypodium thelypteris* L., now *Thelypteris palustris* (A. GRAY) SCHOTT.

Dictyocline MOORE, Gard. Chron. 1855. 854.—Type: *Dictyocline griffithii* MOORE, now *Stegnogramma griffithii* (MOORE) K. IWATS.

Pneumatopteris NAKAI, Bot. Mag. Tokyo 47: 179. 1933.—Type: *Aspidium callosum* BLUME, now *Thelypteris callosa* (BLUME).

Steiropteris (C. CHR.) C. CHR. in VERDOORN, Man. Pterid. 544. 1938.—Type: *Polypodium deltoideum* SWARTZ, now *Thelypteris deltoidea* (SWARTZ).

Cyclogramma TAGAWA, Acta Phytotax. Geobot. 7: 53. 1938.—Type: *Thelypteris simulans* CHING, a synonym of *Thelypteris auriculata* (J. SMITH) K. IWATS.

Mensorus ALSTON, Bol. Soc. Brot. 30: 20. 1956.—Type: *Meniscium pauciflorum* HOOKER, now *Thelypteris pauciflora* (HOOKER).

Dimorphopteris TAGAWA et K. IWATS. ex K. IWATS. Acta Phytotax. Geobot. 19: 8. 1961.—Type: *Dimorphopteris moniliformis* TAGAWA et K. IWATS., now *Thelypteris moniliformis* (TAGAWA et K. IWATS.).

Parathelypteris (H. ITO) CHING, Acta Phytotax. Sin. 8: 300. 1963.—Type: *Aspidium glanduligerum* KUNZE, now *Thelypteris glanduligera* (KUNZE) CHING.

Metathelypteris (H. ITO) CHING, Acta Phytotax. Sin. 8: 305. 1963.—Type: *Aspidium gracilescens* BLUME, now *Thelypteris gracilescens* (BLUME) CHING.

Macrothelypteris (H. ITO) CHING, Acta Phytotax. Sin. 8: 308. 1963.—Type: *Nephrodium oligophlebium* BAKER, a synonym of *Thelypteris torresiana* (GAUD.) ALSTON.

Pseudophegopteris CHING, Acta Phytotax. Sin. 8: 313. 1963.—Type: *Polypodium pyrhorhachis* KUNZE, a synonym of *Thelypteris paludosa* (BLUME) K. IWATS.

Glaphyopteridopsis CHING, Acta Phytotax. Sin. 8: 320. 1963.—Type: *Polypodium erubescens* WALL. ex HOOKER, now *Thelypteris erubescens* (WALL. ex HOOKER) CHING.

Pseudocyclosorus CHING, Acta Phytotax. Sin. 8: 322. 1963.—Type: *Aspidium xylodes* KUNZE, now *Thelypteris xylodes* (KUNZE) CHING.

Mesoneuron CHING, Acta Phytotax. Sin. 8: 325. 1963.—Type: *Aspidium classifolium* BLUME, now *Thelypteris classifolia* (BLUME) CHING.

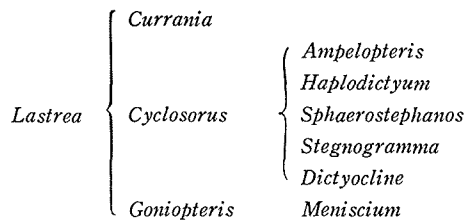
Of these 31 genera, the names, *Mesochlaena*, *Pronephrium* and *Hemestheum* are superfluous in nomenclature, for each of these type species has already been placed under *Sphaerostephanos*, *Abacopteris* and *Thelypteris*, respectively. Therefore,

twenty-eight generic names should here be taken into account, and nomenclatural treatment should be put in order concerning all of these names described up to the present.

Various systems have been proposed to arrange the species and genera in question, even in the last quarter of this century, but each one of them contains a certain problem from the view-point of taxonomy and comparative morphology. I will now summarize some important systems and add brief remarks.

According to the authors, the range of generic conception is various to some extent. MORTON (1958 etc.) and other American and European pteridologists hold the opinion that all the species belonging to the thelypteroid series should be included in a single genus *Thelypteris*. The fundamental basis of their treatment concerns the difficulty to separate the genera even when the venation is applied as an indicator as warranted by the splitters. It is really difficult to subdivide the thelypteroid ferns into smaller groups with suitable and sufficient definitions. However, the universal inclusion of a vast number of species in one genus does not add to the knowledge on the natural relationships among the species. Apart from the problem on nomenclature, our object should be the investigation of phylogenetic relationships traceable among the species or the species groups.

The thelypteroid ferns are usually classified into about ten genera by the fern specialists of the present day. COPELAND (1947) gave a schematic arrangement of genera of *Lastrea* group under his conception:



Regarding the exclusion from this group of *Currania*, as well the inclusion of *Gymnocarpium* in *Lastrea*, no reference will be made here, for they were rather fully discussed in the foregoing second part of this paper. Under this arrangement, COPELAND recognized a group of American ferns having branched or stellate unicellular hairs and placed it on the lowest line of the above scheme: *Goniopteris-Meniscium*. The other genera are divided into two groups: one is the group of the free veined species, and the other of the species having anastomosing venation. All the free veined species are lumped together into a single genus *Lastrea*. The other group is further distinguished into six genera, the five being classified as the derivatives from the mother stock of the other largest genus, *Cyclosorus*. The objectionable point of this arrangement is that the species, or species groups, are divided artificially into two groups by their difference in venation, giving little consideration to the other features. As noted in the papers about the trichomes, it seems to be natural and appropriate to

separate the *Goniopteris-Meniscium* line from the series having none of the stellate or branched unicellular hairs. However, the classification of the species belonging to *Lastrea* and *Cyclosorus* groups are fairly artificial and unnatural. Their arrangement should be revised as has been pointed out rather intensively in the pages of the foregoing parts.

The taxonomical botanists in the Far East are generally fond of splitting the genera. Concerning the classification of the thelypteroid ferns, there are representative works by CHING (1940) and ITO (1939), the latter of which seems to have been largely influenced by the serial works of CHING in 1931-8.

CHING (1940) gave the following enumeration of the thelypteroid genera, excepting *Haplodictyum* in the series of the tectarioid genera :

Fam. 17. Thelypteridaceae CHING

Tribe Thelypterideae....Veins free.

Thelypteris SCHMIDEL—About three hundreds mostly tropical and subtropical species.

Lastreopsis CHING—Four species in Asian Tropics.

Hypodematium KUNZE—Three Old World species.

Glaphyopteris PRESL—About a dozen Tropical American species.

Parapolystichum (KEY.) CHING—About six Tropical American species.

Leptogramma J. SMITH—Seven species in the Old World Tropics.

Tribe Goniopterideae....Venation either of goniopteroid or of meniscioid type.

Cyclosorus LINK—About three hundreds species in warm countries.

Stegnogramma BLUME—Four Tropical Asiatic species.

Goniopteris PRESL—About seventy Tropical American species, and one in Old World Tropics.

Abacopteris FÉE—About thirty Tropical and Subtropical Asiatic species.

Meniscium SCHREBER—About twenty Tropical American species.

Tribe Dictyoclineae....Veins and sori reticulate, areoles hexagonal, without included veinlets.

Dicytcline MOORE—A single species in N. India, China and Japan.

Fam. 18. Sphaerostephanaceae CHING

Sphaerostephanos J. SMITH—Five species in Malaysia-Polynesia regions.

The three tribes of the Family Thelypteridaceae are distinguished from one another by the difference solely in venation. On the other hand, *Haplodictyum* is, in this system, separated from the thelypteroid group and placed next to *Ctenitopsis* in the aspidioid series of genera, based upon the peculiar venation found in the species of *Haplodictyum*. Thus, CHING's classification is largely influenced by such an indicator as easy to be defined as the venation. In the first part of this paper, it has been discussed in detail and concluded that the venation can not stand as a conclusive indicator more valuable than all the other characteristics of the thelypteroid species. Therefore, the arrangement of CHING should be completely revised by taking into consideration the various features as well as the venation.

Before CHING's classification, ITO (1939) arranged the genera and infrageneric groups of Japan and the neighbouring regions. His arrangement in a local flora is concerned only with the species occurring in the regions, the same as what is now under consideration. In spite of that restricted condition, it may be well

to refer to it here. ITO did not give any actual circumscription of the thelypteroid ferns; and he enumerated all the genera and the infrageneric taxa belonging to a part of Polypodiaceae subfam. Dryopteridoideae occurring in Japan and the neighbouring regions. The following list, taken from his arrangement, consists only of the taxa which are considered to constitute a phylogenetic group:

- Gen. *Hypodematium* KUHN—Type: *H. crenatum* KUHN.
 Gen. *Thelypteris* SCHMIDEL—Type: *T. palustris* SCHOTT.
 Sect. *Euthelypteris*.
 Sect. *Parathelypteris* H. ITO—Type: *T. glanduligera* CHING.
 Sect. *Metathelypteris* H. ITO—Type: *T. gracilescens* CHING.
 Sect. *Macrothelypteris* H. ITO—Type: *T. oligophlebia* CHING.
 Gen. *Glaphyopteris* PRESL—Type: *G. decussata* PRESL.
 Sect. *Euglaphyopteris*.
 Sect. *Cyclogramma* (TAGAWA) H. ITO—Type: *G. simulans* H. ITO.
 Gen. *Phegopteris* (PRESL) FÉE—Type: *P. polypodioides* FÉE.
 Sect. *Euphegopteris*.
 Sect. *Lastrella* H. ITO—Type: *P. decursive-pinnata* FÉE.
 Gen. *Gymnocarpium* NEWMAN—Type: *G. dryopteris* NEWMAN.
 Sect. *Eugymnocarpium*.
 Sect. *Currana* (COPEL.) H. ITO—Type: *G. gracilipes* CHING.
 Gen. *Leptogramma* J. SMITH—Type: *L. totta* J. SMITH.
 Gen. *Cyclosorus* LINK—Type: *C. gongylopus* FARW.
 Gen. *Meniscium* SCHREBER—Type: *M. reticulatum* SWARTZ.
 Sect. *Eumeniscium*.
 Sect. *Goniopteridopsis* H. ITO—Type: *M. urophyllum* H. ITO.

I have once referred to the obscurity of the thelypteroid classification and insisted on arranging the smaller groups comprising only the closely related species. Therefore, these split groups should naturally be collected into the groups of higher orders. The arrangement of ITO succeeded in part in making minute groups which contain only a small number of species very closely related to each other. In spite of this success in splitting groups, he united these natural sections into the conventional genera, which were circumscribed in accordance with definability rather than the naturalness. Besides, he treated only with the species in his regions, and made little comparison with the foreign species. Natural system of organisms is, as a matter of course, to be made up by covering the materials, as much as possible, from all over the surface of the earth.

Although I have tried to classify the thelypteroid species on a world-wide scale, those outside the regions under consideration have been less investigated as yet. Here, it will be possible to suggest only the probable relationships among the species and species groups. In the following paragraphs, a brief explanation will be given on the classification in this paper.

There are several thelypteroid genera which are, with little doubt, natural and definable. Almost all of the recent pteridologists enumerated in their arrangement such distinct thelypteroid genera as *Dictyocline*, *Sphaerostephanos*,

Stegnogramma, *Haplodictyum*, and some others. They are really 'good' genera as the word goes, being composed of only smaller numbers of the homogeneous species and thus easy to be defined. On the other hand, the great part of species are lumped into the large and heterogeneous genera, *Thelypteris* and *Cyclosorus*. Some recent authors took notice of the fact that a certain species of *Thelypteris* seemed to be related more closely to those of *Cyclosorus* than to the other members of that genus. The distinction of these two genera, also, should be abandoned by the fact that the sole discriminative feature in venation can not stand as a sufficient taxonomic character.

I have tried to trace the relationship between one species and another, and formed a number of definable species groups that can not be unnatural. These natural species groups should be united into the groups of higher order to form the genera in the current conception. More than a dozen groups, however, can not be arranged into several natural groups but into a single large one. There remains, therefore, an alternative problem whether we should collect the vast numbers of species into a single genus or divide these species into more than a dozen of genera. If the latter method is applied, many generic names should newly be added here to the thelypteroid series of ferns. The excessive splitting of taxa, especially of genera, are not well in accordance with the usefulness of the plant taxonomy. These minute genera produce an extraordinary number of genera, which can be recognized only by the specialists concerned. Taking these matters into account, I have preferred to unite the groups into large genera, which are subdivided into a number of subgenera and sections. This conception of naturalness and definability will be used throughout the present systematic arrangement.

All the thelypteroid species belong to only three genera: *Stegnogramma*, *Thelypteris* and *Meniscium*. *Stegnogramma* is the smallest genus of the three, consisting of only a dozen species in the tropic or subtropic regions of the northern hemisphere of the Old World, including one in the New World. However, one paleotropic species, *Meniscium* is restricted to the tropics and the subtropics of the New World, consisting of more than 80 species. The largest genus *Thelypteris* includes more than 800 species found in every section where the ferns are growing. Some diagnostic features defining the structures of these genera will be described in the pages of each respective genus. No sufficient key is given here to discriminate them, for restricted numbers of characteristics often mislead in the determination of generic circumscription. Only the complex combination of features, which can not be written without elaborating, can define accurately the range of genera.

The long exindusiate sori stand as an indicator of *Stegnogramma*. Among the species of the other genera, however, we found members having the linear exindusiate sori. They usually have the meniscioid venation, and the sori are in crescent shape along the excurrent veinlets. The species having such sori are, no doubt, closely related to those with round indusiate sori. Contrary to these, the species of *Stegnogramma* seem to have no close relatives among the

species of *Thelypteris*. Thus, we can not separate *Stegnogramma* by the features found in sori, but only constitute this genus as a group of the allied species which in turn do not relate closely to any of the species belonging to the other genera.

After the preparation of this paper, CHING's publication treating the system of the thelypteroid ferns appeared in *Acta Phytotaxonomica Sinica* 8: 289-335 (1963), in which he splitted the family Thelypteridaceae into numerous taxa. The following is a scheme of his classification.

Thelypteridaceae CHING

Trib. I. Thelypterideae

Subtr. i. Thelypteridinae

Gen. 1. *Thelypteris* SCHMIDEL

Gen. 2. *Lastrea* BORY

Gen. 3. *Parathelypteris* (H. ITO) CHING, st. nov.

Sect. 1. *Parathelypteris*

Ser. 1. *Nipponicae* CHING, ser. nov.

Ser. 2. *Glanduligerae* CHING, ser. nov.

Sect. 2. *Melanostipes* CHING, sect. nov.

Ser. 1. *Japonicae* CHING, ser. nov.

Subser. 1. *Hirsutipedes* CHING, subser. nov.

Subser. 2. *Japonicae* CHING, subser. nov.

Ser. 2. *Castanae* CHING, ser. nov.

Gen. 4. *Metathelypteris* (H. ITO) CHING, st. nov.

Gen. 5. *Hypodematium* KUNZE

Subtr. ii. Phegopteridinae CHING, subtr. nov.

Gen. 6. *Macrothelypteris* (H. ITO) CHING, st. nov.

Gen. 7. *Phegopteris* (PRESL) FÉE

Gen. 8. *Pseudophegopteris* CHING, gen. nov.

Gen. 9. *Cyclogramma* TAGAWA

Gen. 10. *Leptogramma* J. SMITH

Trib. II. Goniopterideae CHING

Subtr. i. Pseudocyclosorinae CHING, subtr. nov.

Gen. 11. *Glaphyopteridopsis* CHING, gen. nov.

Gen. 12. *Pseudocyclosorus* CHING, gen. nov.

Gen. 13. *Mesoneuron* CHING, gen. nov.

Subtr. ii. Cyclosorinae CHING, subtr. nov.

Gen. 14. *Cyclosorus* LINK

Gen. 15. *Stegnogramma* BLUME

Subtr. iii. Goniopteridinae

Gen. 16. *Ampelopteris* KUNZE

Subtr. iv. Menisciinae CHING, subtr. nov.

Gen. 17. *Abacopteris* FÉE

Trib. III. Dictyoclineae CHING

Gen. 18. *Dictyocline* MOORE

This system is, in its main course, the same with that of ITO (1939), though the sections of the latter are raised to the status of genus. No repetition may be needed here on this classification, though some additional mentions will be made in the pages of the problems concerned.

Still later, a brief comment by MORTON appeared in *Amer. Fern Journ.* 53: 149-154 (1963).

The classification in this paper is not particular than that already discussed by him in various publications. The nomenclatural treatment arranged in this system will be summarized in the further pages of the present paper.

Genus *Stegnogramma* BLUME

Stegnogramma BLUME, Enum. Pl. Jav. 172. 1828; K. IWATS. Acta Phytotax. Geobot. 19: 113. 1963.——Type: *Stegnogramma aspidioides* BLUME.

Leptogramma J. SMITH, Journ. Bot. 4: 51. 1841.——Type: *Polypodium tottum* WILLD. non THUNB.

Dictyocline MOORE, Gard. Chron. 1855: 854.——Type: *Dictyocline griffithii* MOORE.

Rhizome short creeping or ascending, dictyostelic, sparsely paleate. Stipes not so remote, terete, densely hairy throughout. Fronds lanceolate or oblong subdeltoid, pinnatifid, pinnate or bipinnatifid in lower portion, the lower pinnae free, sessile or shortly stalked, slightly reduced or not, having no aerophore, the upper pinnae coadnate at base, gradually merging into deeply pinnatifid apical part of frond, hairy on every axis as well as on laminar surfaces, soft herbaceous to soft papyraceous in texture, green or deep green in fields but turning brownish in dried condition. Veins pinnate, free, goniopteroid or copiously anastomosing without included veinlets, the veinlets reaching the very margin of lobes. Scales non-clathrate, setiferous on margin and on surfaces as well; hairs unicellular, or multicellular, patent on stipe and rachis, appressed or patent on laminar surface. Sori elongate along veinlets, hence sometimes reticulate, exindusiate, with numerous setiferous sporangia; spores bilateral, with perispore.

A dozen species belong to this genus. Eleven species enumerated in my recent paper (1963) are the Old World representatives, and a single species is known in Central America. The centre of distribution is in the Sikkim-Himalayan region and none is growing beyond the cold temperate regions.

Among the vast number of the thelypteroid species, those included in this genus may be distinctly distinguished by having the combination of such diagnostic features as the short rhizome with well marked collenchymatous tissues, the pinnate or pinnatifid fronds having the indistinct apical pinnae, the exindusiate sori elongate along the veinlets, the setiferous sporangia, and the simple setose hairs densely throughout the plants.

The twelve species included in this genus had been assigned to three different 'genera' until they were united by me into a single genus. These three 'genera' were distinguished by the different mode of venation: *Leptogramma* with free venation, *Stegnogramma* with goniopteroid venation, and *Dictyocline* with pleocnemioid venation. According to the authors, these three were related to the various genera belonging to the distinctly different phylogenetic lines, for instance DIELS (1899) and CHRISTENSEN (1905-34) included *Dictyocline* in the series of *Tectaria*. Even in the last generation, the component members of the genus

Stegnogramma in the sense of present paper were variously referred to the different groups, or 'genera', of the genus *Thelypteris* in our conception. CHING (1940) distinguished the thelypteroid 'genera' by the mode of venation and recognized three tribes. The twelve species of our *Stegnogramma* were divided into three 'genera' which belonged separately to those three different tribes on the basis of the difference solely in venation. COPELAND (1947) enumerated *Stegnogramma* and *Dictyocline* as to be distinct genera, but reduced *Leptogramma* into the large genus *Lastrea*, which thus become heterogeneous in his sense. In spite of the apparent distinction in venation, the twelve species now under consideration are related more closely to each other than to any of the other genera.

Under the generic rank, we can safely recognize four groups of species, which are distinguished by the diagnostic features summarized in the following key:

- A Veins free, or anastomosing into goniopteroid venation; fronds pinnate.
 - B Veins all free, or very rarely casually anastomosing; hairs unicellular, or with occasional septa. sect. *Leptogramma*.
 - B Venation goniopteroid; hairs unicellular or multicellular.
 - C Conjugated veinlets 1 or 2 pairs; stipes and rachises covered with patent multicellular hairs as well as unicellular hairs. sect. *Haplogramma*.
 - C Conjugated veinlets more than 4 pairs; stipes and rachises covered only with unicellular hairs. sect. *Stegnogramma*.
- A Venation pleocnemoid; fronds pinnatifid or indistinctly pinnate. sect. *Dictyocline*.

Sect. **Leptogramma** (J. SMITH) K. IWATS. Acta Phytotax. Geobot. 19: 116. 1963.
 —*Leptogramma* J. SMITH, Journ. Bot. 4: 51. 1841. Type: *Polypodium tottum* WILLD. non THUNB., now *Stegnogramma pozoi* (LAGASCA) K. IWATS. —*Dryopteris* subgen. *Leptogramma* (J. SMITH) C. CHR. Ind. Fil. xxi. 1905. —*Thelypteris* sect. *Leptogramma* (J. SMITH) MORTON, Amer. Fern Journ. 53: 153. 1963.

Lateral pinnae oblong- or linear-lanceolate, more or less lobed; veins pinnate, veinlets simple or forked, all being free, or in a species (*S. himalaica*) quite rarely anastomosing, sinus membrane being obsolete or none; hairs all unicellular or rarely with occasional septae; sori elongate along the veinlets, seldom reticulate, oblong or linear-straight.

Six species including three subspecies and two varieties are known to this section in the range just the same with that of the genus.

Both ITO (1935) and TAGAWA (1936) once considered that the members now included in *Thelypteris* subgen. *Cyclogramma* were the close relatives of *Leptogramma*. As noted on that subgenus, the gap found between these two groups is so wide that any reference may safely be given on the phylogenetic relationship between these two.

Sect. **Haplogramma** K. IWATS. Acta Phytotax. Geobot. **19**: 116. 1963. Type: *Stegnogramma cyrtomioides* (C. CHR.) CHING.

Lateral pinnae ovate-oblong or oblong, lobed, crenate or almost entire on margin; veins anastomosing to form goniopteroid venation, or in a species (*S. leptogrammoides*) almost free with a few rather irregular anastomosis, conjugated veinlets 1 or 2 pairs, callose membrane being at the bottom of sinus; hairs on main axes long, multicellular and seemingly articulated, patent, or unicellular and stiff; sori elongate along veinlets, seldom reticulate, oblong or linear-straight.

Three species are known in South and West China and in the Himalayan regions.

Stegnogramma leptogrammoides is the species having the venation only casually reticulated. This species is in appearance similar to *S. himalaica* with free or seldom anastomosing venation, but these two are quite different in the characteristics found in trichomes. Therefore, *S. leptogrammoides* seems to be more closely related to the members of this section than to *S. himalaica* and its allies.

As indicated by the trichomes, *Haplogramma* can not be considered as to be placed intermediate between *Leptogramma* and *Stegnogramma*, in spite of the intermediate features found on the venation. Distinguishing *Haplogramma* from the other members of this genus by the trichomes, *Stegnogramma* and *Leptogramma* are safely discriminated from each other.

Sect. **Stegnogramma**.——*Stegnogramma* BLUME, Enum. Pl. Jav. 172. 1828. Type: *Stegnogramma aspidioides* BLUME.

Lateral pinnae oblong or oblong subdeltoid, crenate on margin; venation goniopteroid, anastomosing veinlets 4-jugate or more, obsolete or prominent callose membrane being at the sinus bottom; hairs all unicellular, or rarely having occasional septa, setose; sori elongate along the veinlets, reticulate or straight.

Two species are credited to this section, ranging from South and West China to Malaysia and Taiwan.

Stegnogramma dictyoclinoides resemble, in appearance, *S. griffithii*, though they are distinct from each other by the difference in the mode of venation. On this account, the brief mention has been made in the pages of general part, and nothing is added here.

Sect. **Dictyocline** (MOORE) K. IWATS. Acta Phytotax. Geobot. **19**: 116. 1963.——*Dictyocline* MOORE, Gard. Chron. **1855**: 854. Type: *Dictyocline griffithii* MOORE, now *Stegnogramma griffithii* (MOORE) K. IWATS.

Lateral pinnae few, oblong, subfalcate, subentire on margin, or fronds deeply pinnatifid; veins copiously and irregularly anastomosing with numerous areoles between the costules, included veinlets being absent; hairs all unicellular, or rarely with occasional septae; sori elongate and reticulate along the veinlets.

The type and sole species is divided into two varieties, ranging from the Himalayas to Japan in the north and to Taiwan in the south.

Since COPELAND (1929) appropriately placed *Dictyocline* in the series of *Dryopteris*, no protests were given to the thelypteroid relationship of *Dictyocline*. Many have recognized that this is a relative of *Stegnogramma* by the fact that they bear a number of common characteristics, especially by the similar habits of the plants of these two genera. Nevertheless, these two have remotely separated in formal systems, only because they are distinguishable in words by the difference in the mode of venation. It seems to be rather easily but erroneously considered that the two are directly related, especially when a seemingly intermediate form of venation is found in such species as *S. dictyoclinoides*. As noted in the first part of this paper, the patterns of venation are different between *Dictyocline* and *Stegnogramma*, though their alliances are more close to each other than to any of the other species groups having the same mode of venation.

Genus *Thelypteris* SCHMIDEL

Thelypteris SCHMIDEL, Icon. Pl. ed. KELLER 45. 1762; SCHOTT, Gen. Fil. ad. t. 10. 1834; ALSTON, Kew Bull. 1932: 309; CHING, Bull. Fan Mem. Inst. Biol. 6: 238. 1936; MORTON, Amer. Fern Journ. 53: 153. 1963, p.p. Type: *Acrostichum thelypteris* L.

Lastrea BORY, Dict. Class. Hist. Nat. 6: 588. 1824; COPEL. Gen. Fil. 135. 1947. Type: *Polypodium oreopteris* EHRH.

Cyclosorus LINK, Hort. Berol. 2: 128. 1833; CHING, Bull. Fan Mem. Inst. Biol. 8: 162. 1938; COPEL. Gen. Fil. 140. 1947. Type: *Aspidium gongilodus* SCHKUHR.

Sphaerostephanos J. SMITH in HOOKER et BAUER, Gen. Fil. 21. 1838; CHING, Sunyatsenia 5: 240. 1940; COPEL. Gen. Fil. 144. 1947. Type: *Sphaerostephanos asplenioides* J. SMITH.

Mesochlaena R. BROWN ex J. SMITH, Journ. Bot. 3: 18. 1840. Type: *Sphaerostephanos asplenioides* J. SMITH.

Amauropelta KUNZE, Farnkr. 1: 86, 109. 1843. Type *Amauropelta breutelii* KUNZE.

Abacopteris FÉE, Congr. Sci. France X, 1: 178. 1843; CHING, Bull. Fan Mem. Inst. Biol. 8: 230. 1938. Type: *Aspidium lineatum* BLUME.

Glaphyopteris PRESL, Abh. Böhm. Ges. Wiss. V, 5: 344. 1848; H. ITO in NAKAI & HONDA, Nova Fl. Jap. Polypod.-Dryopt. I, 145. 1939. Type: *Polypodium decusatum* L.

Haplodictyum PRESL, Epim. Bot. 50. 1849; COPEL. Gen. Fil. 144. 1947. Type: *Haplodictyum heterophyllum* PRESL.

Pronephrium PRESL, Epim. Bot. 258. 1849. Type: *Aspidium lineatum* BLUME.

Phegopteris (PRESL) FÉE, Gen. Fil. 242. 1852; H. ITO in NAKAI & HONDA, Nova Fl. Jap. Polypod.-Dryopt. I, 150. 1939.—Type: *Polypodium phegopteris* L.

Oochlamys FÉE, Gen. Fil. 297. 1852.—Type: *Oochlamys rivoiræi* FÉE.

Hemestheum NEWMAN, Phytologist 4: app. xxii. 1851.—Type: *Acrostichum thelypteris* L.

Pneumatopteris NAKAI, Bot. Mag. Tokyo 47: 179. 1933.—Type: *Aspidium callosum* BLUME.

Steiropteris (C. CHR.) C. CHR. in VERDOORN, Man. Pterid. 544. 1938.—Type: *Polypodium deltoideum* SWARTZ.

Cyclogramma TAGAWA, Acta Phytotax. Geobot. 7: 53. 1938.—Type: *Thelypteris simulans* CHING.

Menisorus ALSTON, Bol. Soc. Brot. 30: 20. 1956.—Type: *Meniscium pauciflorum* HOOKER.

Dimorphopteris TAGAWA et K. IWATS. ex K. IWATS. Acta Phytotax. Geobot. 19: 8. 1961.—Type: *Dimorphopteris moniliformis* TAGAWA et K. IWATS.

Parathelypteris (H. ITO) CHING, Acta Phytotax. Sin. 8: 300. 1963.—Type: *Aspidium glanduligerum* KUNZE.

Metathelypteris (H. ITO) CHING, Acta Phytotax. Sin. 8: 305. 1963.—Type: *Aspidium gracilescens* BLUME.

Macrothelypteris (H. ITO) CHING, Acta Phytotax. Sin. 8: 308. 1963.—Type: *Nephrodium oligophlebium* BAKER.

Pseudophegopteris CHING, Acta Phytotax. Sin. 8: 313. 1963.—Type: *Polypodium pyrhorhachis* KUNZE.

Glaphyopteridopsis CHING, Acta Phytotax. Sin. 8: 320. 1963.—Type: *Polypodium erubescens* WALL. ex HOOKER.

Pseudocyclosorus CHING, Acta Phytotax. Sin. 8: 322. 1963.—Type: *Aspidium xylodes* KUNZE.

Mesoneuron CHING, Acta Phytotax. Sin. 8: 325. 1963.—Type: *Aspidium clasifolium* BLUME.

Rhizome long creeping, short ascending, erect or subarborescent, more or less scaly and hairy. Stipes remote or fascicled, terete, scaly or hairy or both in various degrees, rachis gemmiferous in a few species, aerophores present or absent. Fronds typically bipinnate or bipinnatifid, rarely simple, imparipinnate, or finely decompose, oblong or lanceolate, narrowing towards both ends, rarely subdeltoid, the lower pinnae distinctly reduced in certain species, variously hairy according to species, soft herbaceous to subcoriaceous, pale to dark green, sometimes tinted red. Veins free or anastomosing to form goniopteroid or meniscoid or in two species simple pleocnemoid venation, callose membrane or distinct keels present in some species at the very bottom of sinus. Scales non-clathrate, variable in size and form, setiferous on margin as well as on surfaces. Sori round and indusiate or exindusiate, oblong and indusiate, crescent along excurrent veinlets and exindusiate, or acrostichoid in one species; indusia when present round reniform, or in one species round-peltate; sporangia glabrous or setiferous; spores bilateral, variously tuberculate or reticulate on surfaces.

The genus thus defined becomes very large and the accurate number of the species included is unknown. More than 800 species have already been credited, but the number is still increasing. The range of distribution is also very wide, occurring every land inhabited by the ferns.

Such an expansion of the generic range as in this case makes the definition

of the genus somewhat difficult. By several words alone, the correct circumscription can not be given to this genus. However, the true figure of the genus will be understood when the relationships of the infrageneric groups are fully examined. Natural genus may often offer such difficulty to define in words.

This huge genus is subdivided into the following 14 subgenera, some of which may better be distinguished into sections. Among these 14 subgenera, we may safely recognize two as to be generically distinct. They are *Haplodictyum* and *Cyrtomiopsis*, containing two and one species respectively. As the morphological characteristics are almost unknown concerning the species of these local groups they are restored here as to be the subgenera of this vast genus.

The fourteen subgenera may be distinguished by the features summarized in the following key :

- A Sori indusiate.
 - B Indusia round-reniform or oblong, basifixed or fixed along the receptacle, not peltate.
 - C Veins all free.
 - D Aerophores absent.subgen. *Thelypteris* (p. 26)
 - D Aerophores distinct at bases of pinnae.
 - E A carinate fold below the sinus extending towards costa, parallel to secondary veinlets ; species of the New World..... subgen. *Steiropteris* (p. 31)
 - E No keel below the sinus ; species of the Old World..... subgen. *Glaphyopteridopsis* (p. 29)
 - C Veins anastomosing.
 - D Accessary areoles present, i.e. the veinlets forked and both acroscopic and basisopic branches uniting with their opposites..... subgen. *Haplodictyum* (p. 32)
 - D Accessary areoles absent, venation typically goniopteroid or meniscoid.
 - E Sori elongate, with oblong or linear indusia fixed along the elongate receptacles.....subgen. *Sphaerostephanos* (p. 32)
 - E Sori round, with round reniform, basifixed indusia.
 - F No aerophore at bases of pinnae.
 - G Fronds imparipinnate with subentire pinnae, sinus membrane absent.subgen. *Abacopteris* (p. 34)
 - G Fronds pinnate-bipinnatifid with lobed pinnae, sinus membrane present.
 - H Pinnae deeply lobed with oblong or oblique segments, hirsute on the under surface, texture soft herbaceous..... subgen. *Cyclosoriopsis* (p. 28)
 - H Pinnae not deeply lobed with oblong subdeltoid segments, having acute or apiculate apices, glabrous or subglabrous on the under surface, texture coriaceous or chartaceous. subgen. *Cyclosorus* (p. 31)

- F Aerophores present at bases of pinnae.
 - G Only one pair of basal veinlets anastomosing, lower surface of pinnae not verrucose and glandular, textures chartaceous. subgen. *Glaphyopteridopsis* (p. 29)
 - G One and a half or more pairs of basal veinlets truly anastomosing, lower surface of pinnae verrucose, texture soft herbaceous.subgen. *Pneumatopteris* (p. 33)
- B Indusia round, peltately attached.subgen. *Cyrtomiopsis* (p. 36)
- A Sori naked.
 - B Veins free, or the lowest veinlets excurrent to the sinus bottom.
 - C Aerophores absent. subgen. *Phegopteris* (p. 24)
 - C Aerophores present at base of pinnae or of pinnules.
 - D Aerophores large, at bases of pinnae as well as of pinnules; species of the New World.subgen. *Glaphyopteris* (p. 28)
 - D Aerophores not so large, only at bases of pinnae; species of the Old World.
 - E Lower pinnae distinctly reduced.....subgen. *Cyclogramma* (p. 26)
 - E Lower pinnae not or gradually reduced downwards. subgen. *Glaphyopteridopsis* (p. 29)
 - B Veins anastomosing.
 - C Fronds distinctly dimorphic, the fertile pinnae acrostichoid. subgen. *Dimorphopteris* (p. 35)
 - C Fronds not or slightly dimorphic, sporangia restricted only on the veins.subgen. *Abacopteris* (p. 34)

Subgen. **Phegopteris** (PRESL) CHING, Bull. Fan Mem. Inst. Biol. 6: 250. 1936. —*Polypodium* § *Phegopteris* PRESL, Tent. Pterid. 179. 1836. Type: *Polypodium phegopteris* L.—*Phegopteris* (PRESL) FÉE, l.c.—*Dryopteris* subgen. *Phegopteris* (PRESL) C. CHR. Ind. Fil. 250. 1905.

Pseudophegopteris CHING, l.c. Type: *Polypodium pyrrohorachis* KUNZE.

Rhizome long creeping, short ascending or suberect. Stipes shining, castaneous or rufo-stramineous, variously hirsute. Fronds oblong subdeltoid or oblong, bipinnatifid or more compound. Veins pinnate, veinlets simple or forked, all free. Scales rather dense, sometimes taking an appearance of 'setiferous hairs' on the axes of fronds, setiferous; hairs setose, seldom hooked at apices. Sori round or oblong, exindusiate; sporangia usually setiferous; spores reticulate.

More than fifty species belong to this subgenus, distributing in the temperate and subtropical regions of both the Worlds. They may be distinguished into two distinct sections:

- A Fronds oblong subdeltoid, the lowest pinnae the longest; veinlets terminating on the cartilaginous margin.sect. *Phegopteris*.
- A Fronds oblong lanceolate, the lowest pinnae shorter than the next above; veinlets not reaching the very margin.sect. *Lastrella*.

Sect. **Phegopteris**. Type: *Polypodium phegopteris* L., now *Thelypteris phegopteris* (L.) SLOSSON.

CHING (1936) has separated his subgenus *Phegopteris* into two subgroups; one is the group of *Thelypteris aurita* which is diagnosed by the generally shining, castaneous or rufo-stramineous stipes and rachis, the opposite or subopposite pinnae with dilated base and deeply inciso-serrate segments; the other consists of two species, *Thelypteris phegopteris* and *T. decursive-pinnata*, which are characterized by pinnae adnate to rachis. Among the characteristics arranged by CHING, the adnate pinnae are not the same between those of the two species. In the latter species, only the basal basiscopic segment is decurrent halfway down on rachis between two adjoining pinnae and facing a pinnae on opposite side. In *T. phegopteris*, on the contrary, both the basiscopic and acroscopic basal segments shift down and up respectively on rachis and are adnate to it. Thus, the apparent resemblance in this feature is rather superficial and does not necessarily mean the morphological identity between the two species. Later, Ito (1939) classified the species of *Phegopteris* into two sections: *Euphegopteris*, a monotypic section, and *Lastrella*. He distinguished the two sections by the diagnosis summarized in his key in Japanese:

- A Rhizome long creeping, fronds oblong subdeltoid, spores reticulate by thick tubercles.sect. *Euphegopteris*.
 A Rhizome short, fronds oblanceolate or oblong lanceolate, spores tuberculate. sect. *Lastrella*.

In these features, rhizome is short or long by the species even among the species of *Lastrella*, for instance *T. subaurita* is distinguished from *T. aurita* by short ascending or suberect rhizome. Adding to his discriminative features, on the other hand, the difference in the mode of the termination of veinlets is more characteristic to distinguish the sections.

In sect. *Phegopteris* thus confined, there are only two species: *T. phegopteris* throughout the cold temperate regions of the northern hemisphere, and *T. hexagonoptera* (MICHX.) WEATHERBY of the temperate North America.

Sect. **Lastrella** (H. ITO) comb. nov.—*Phegopteris* sect. *Lastrella* H. ITO in NAKAI & HONDA, Nova Fl. Jap. Polypod.-Dryopt. I, 152. 1939. Type: *Polypodium decursive-pinnatum* VAN HALL, now *Thelypteris decursive-pinnata* (VAN HALL) CHING. *Pseudophegopteris* CHING, l.c.

In his original publication, Ito enumerated in this section four species from his regions. They are distinguished from the preceding by having the shining, castaneous or rufo-stramineous stipes, the oblong lanceolate or oblanceolate fronds, and the veinlets not reaching the very margin of lobes.

More than 50 species belong to this section, distributing in the temperate to tropical regions throughout the world.

The species of subgen. *Phegopteris* are commonly diagnosed as to be ex-indusiata. However, this condition of sori seems to be derived from the indusiata one by reduction, as indicated by such vestigial indusia as those of *T. decursive-*

pinnata, which will be noted on the pages of this species.

Based on his gametophytic studies, MOMOSE (1942) separated the species of *Phegopteris* into two subgroups: *Lastreopsis* n.n. with *T. decursive-pinnata* and *Phegopteris* with *T. phegopteris* and *T. bukoensis*. He distinguished these two groups by the difference in the nature of gametophytic trichomes: the prothallia of *Lastreopsis* bear only the glands but of *Phegopteris* have the setiferous hairs as well as the glands. This distinction is, however, rather comparative one though definable, and the indicating features found on the sporophytic generation seem to offer the better basis for taxonomic distinction.

Subgen. **Cyclogramma** (TAGAWA) comb. nov. — *Cyclogramma* TAGAWA, l.c. Type: *Thelypteris simulans* CHING, a synonym of *T. auriculata* (J. SMITH) K. IWATS. — *Glaphyopteris* sect. *Cyclogramma* (TAGAWA) H. ITO in NAKAI & HONDA, Nova Fl. Jap. Polypod.-Dryopt. I, 148. 1939.

Rhizome short creeping, rather thick. Fronds oblong-lanceolate, usually narrow at base, bipinnatifid or bipinnate; lower pinnae reduced or not according to the species; aerophores distinct at base of costae. Veins pinnate, veinlets simple, reaching the very margin of segments. Scales sparse at base of stipes, membranous, rather irregular in outline; hairs dense on every portion of plants, pale, needle-like or hooked at apex, unicellular. Sori round, exindusiate; sporangia setiferous with straight or hooked hairs; spores bilateral, with perispore.

This subgenus comprises seven species distributed in the regions from Himalaya to Japan. These species are, in appearance, similar to the members of *Stegnogramma* sect. *Leptogramma*, but these two groups are distinct enough from each other as indicated by such difference found in sori, aerophores and venation. Therefore, these two can not be regarded as to be the closely allied groups. *Cyclogramma* may better be related to such species as those of *Macrothelypteris* having reticulate venation. Another group comparable to *Cyclogramma* is *Neocyclosorus* with which ITO (1939) has united the members of this subgenus.

On the nomenclatorial matter of this group, *Desmopodium* is the earliest name proposed as a generic name. *Desmopodium* J. SMITH msc. was recorded in MOORE, Ind. Fil. 308. 1861, as a synonym of *Polypodium*, though not listed up in the synonymy of *Polypodium* in MOORE's generic enumeration (ibid. lxx. 1857). J. SMITH, Hist. Fil. 233. 1875, recorded the name *Desmopobium* in his first group of the genus *Phegopteris*. He designated *Polypodium decussatum* as the type species of his *Phegopteris* and included this species in the Group I of this genus. Thus, considerable confusions are remained about it. Moreover, *Desmopodium* or *Desmopobium* has not been formally described, even in J. SMITH, l.c. Such an illegitimate name may better be set aside from the nomenclature.

Subgen. **Thelypteris**.

Lastrea BORY, l.c. Type: *Polypodium oreopteris* EHRH. — *Nephrodium* § *Lastrea* (BORY) HOOKER, Sp. Fil. IV, 113. 1852. — *Aspidium* § *Lastrea* (BORY) CHRIST, Farnkr. Erde 250. 1897. — *Dryopteris* subgen. *Lastrea* (BORY) C. CHR. Biol. Arb. tilg. Eug. Warming 79. 1911. — *Thelypteris* subgen. *Lastrea* (BORY) ALSTON, Journ. Wash. Acad. Sci. 48: 232. 1958; MORTON, Amer. Fern Journ. 53: 153. 1963.

Amauropelta KUNZE, l.c. Type: *Amauropelta breutelii* KUNZE.

Oochlamys FÉE, l.c. Type: *Oochlamys rivoirei* FÉE.

Hemestheum NEWMAN, l.c. Type: *Acrostichum thelypteris* L.

Thelypteris sects. *Euthelypteris*, *Parathelypteris*, *Metathelypteris* & *Macrothelypteris* H. ITO in NAKAI & HONDA, Nova Fl. Jap. Polypod.-Dryopt. I, 125, 127, 137 & 141. 1939. Types: see the arrangement of Ito's system.

Rhizome long creeping, short or ascending, scaly. Stipes terete, stramineous or variously coloured, hirsute. Fronds pinnate-bipinnatisect, or more compound, oblong or oblong lanceolate, or broader in some species, herbaceous or soft papyraceous, the basal pinnae slightly reduced or not. Veins in segments pinnate; veinlets simple, forked or pinnate, reaching to or free from the margin of segments, setiferous. Scales various in form and size; hairs unicellular or rarely multicellular, usually setose, dense or sparse on every portion of plants. Sori round or oblong, indusiate, or naked in some American species; indusia round reniform or horseshoe-shaped in some species, variously setiferous; sporangia usually glabrous.

It is impossible at present to count the accurate number of the species belonging to this subgenus. More than 300 species may be included in this, being found on every land where the ferns are growing.

This subgenus is divided into two sections by the features summarized in the following key:

- A Fronds bipinnatifid to tripinnate or more compound; veinlets simple or forked, not reaching the very margin of segments.....sect. *Metathelypteris*.
- A Fronds bipinnatifid to bipinnate; veinlets reaching the very margin of segments.sect. *Thelypteris*.

Sect. **Metathelypteris** H. ITO, l.c. Type: *Aspidium gracilescens* BLUME, now *Thelypteris gracilescens* (BLUME) CHING.

Fourteen species have been known in East Asia. They are discriminated and noted in the pages of the specific enumeration.

ITO (1939), as well as I myself (1960), separated the section into two groups by the degree of pinnation of the fronds. With the intermediate species, such as *T. hattorii*, the pinnation of this group is not a feature sufficient to distinguish the taxa. Even in such bipinnatifid species as *T. laxa* and *T. flaccida*, the segments are variously incised: in some cases, the segments are subentire or very slightly crenate, but in the other cases they are deeply, or in extreme forms almost to the costules, incised and the fronds appear to be once more dissected. In fact, we have sometimes met with the plants, in which it is very hard to determine whether they are *T. laxa* or *T. hattorii*. Except for this group, no tripinnatifid or more compound species has been found in the thelypteroid series. The termination of veinlets is a convenient key character to diagnose this section among the ferns under consideration.

Sect. **Thelypteris**. Type: *Acrostichum thelypteris* L., now *Thelypteris palustris* SCHOTT.

This is the largest group of the thelypteroid ferns of about three hundreds species from every region where the ferns are growing. The present group thus confined is yet rather complex and contains some aberrant species. This group may be divided into subsections, but the boundary is not clear at present. Several species groups may be recognizable among the Oriental species, and will be noted in the pages of specific enumeration. Some of the American species now assigned to this section seem to be distinct sectionally, but no keen discrepancy has been got by the superfluous study made by me.

Subgen. **Cyclosoriopsis** subgen. nov. —Type: *Polypodium dentatum* FORSK., now *Thelypteris dentata* (FORSK.) ST. JOHN.

Pinnis pinnatisectis, inferioribus non vel sensim reductis, segmentis obliquisimis, oblongis, apice rotundatis, hirsutis, tenuiter herbaceis, aerophoris nullis.

Rhizome creeping or erect. Stipes terete, stramineous or pale castaneous, scaly at base or throughout. Fronds pinnate-bipinnatisect, oblanceolate in outline, the lower pinnae not or gradually reduced; segments oblique, oblong, with round apices, laminae hirsute rather densely, texture soft herbaceous; aerophores absent. Veins pinnate, the lower veinlets conjugating to the opposite ones forming the simple goniopteroid venation; veinlets reaching the margins of segments. Sori round, dorsal on veinlets, indusiate; indusia rather large, soft, sometimes fugaceous.

Among the species included in *Cyclosorus* s. lat., about a hundred and fifty species may belong to this subgenus. They are characterized by having the soft texture of fronds, generally densely hairy and glandular, and having no aerophore at base of costae. The range of this subgenus extends to all the tropical regions of both the Old and the New Worlds.

All the members referred to this subgenus have been included in the genus *Cyclosorus* s. lat., chiefly because of having the reticulate venation. In spite of the difference in venation, this subgenus seems to be closer to the subgenus *Thelypteris* than to the other species formerly belonged to *Cyclosorus*. The features found in the presence of aerophores, the trichomes, the soral conditions and the others will indicate the relationships more correctly than the single character in venation. Really, subgenus *Cyclosoriopsis* is distinguished from the group of *T. japonica* only by the difference in venation.

Subgen. **Glaphyopteris** (PRESL) ALSTON, Journ. Wash. Acad. Sci. 48: 234. 1958; MORTON, Amer. Fern Journ. 51: 37. 1961, 53: 153. 1963, ut sectio. —*Glaphyopteris* PRESL, l.c. Type: *Polypodium decussatum* L., now *Thelypteris decussata* (L.) PROCTOR. —*Dryopteris* subgen. *Glaphyopteris* (PRESL) C. CHR. Biol. Arb. til. Eug. Warm. 80. 1911.

Fronds large, bipinnatifid with numerous lateral pinnae, the lower ones either abortive into small tuberculiform or little reduced; segments close, rectangular with entire margin; aerophores at base of costae large, more than 1 cm in length, acute, those at base of costules smaller. Veinlets numerous and close to each other, simple, reaching the margin of lobes, the basal ones running

to the margin above sinus. Hairs variable, simple or branched; glands more or less dense, sessile, red in colour. Sori round or oblong, exindusiate.

MORTON (1961) enumerated eleven American species as the relatives of *T. decussata*. ITO (1939) referred some Old World species to the group of that species, only because of the presence of the aerophores. The Old World species of the group of *T. erubescens* have the small aerophores only at base of costae and never at base of costules, and are different in the nature of trichomes and habit of plants from the American members of *Glaphyopteris*.

CHRISTENSEN (1913) divided *Glaphyopteris* into two groups according to the presence or absence of the lower reduced pinnae, figure of venation and trichomes. In the group of *T. thomsonii*, peculiar hairs are found. The costae beneath are shortly and often densely cinereo-tomentose by sessile 2~3-branched hairs, which do not resemble the stalked, branched hairs of *Meniscium*. Such distinct difference may indicate the discrepancy of these two groups, but they are not formally distinguished here, because I have little studied these American species.

Subgen. **Glaphyopteridopsis** (CHING) st. nov. — *Glaphyopteridopsis* CHING, l.c. Type: *Polypodium erubescens* WALL. ex HOOKER, now *Thelypteris erubescens* (WALL. ex HOOKER) CHING.

Glaphyopteris PRESL sensu H. ITO in NAKAI & HONDA, Nova Fl. Jap. Polypod.-Dryopt. I, 145. 1939.

Mesoneuron CHING, l.c.

Pseudocyclosorus CHING, l.c.

Rhizome short creeping. Fronds large, bipinnatifid, oblanceolate in outline; pinnae patent, the lower ones reduced or normal; segments rectangular, oblique, entire or crenate; aerophores distinct at base of costae. Scales rather sparse at base of stipes, large membranaceous, ovate-oblong but sometimes irregular in outline; hairs rather sparse, simple, unicellular, setose, usually pale. Sori round, indusiate or exindusiate; indusia round-reniform, hirsute.

About twenty Old World species belong to this subgenus. The members of this subgenus have been separated into the different genera, *Thelypteris* and *Cyclosorus*, diagnosed by the difference in venation. Here they are combined in a single subgenus, for their close relationships are obvious, even when the difference in venation is taken into account. This subgenus is divisible into the following three sections:

- A Veins all free, the basal veinlets running to margin above sinus or to the bottom of sinus, not actually united with the opposite ones; basal pinnae not or very gradually reduced.
- B Sori naked or with small indusia; basal pinnae not reduced but deflexed.
..... sect. *Glaphyopteridopsis*.
- B Sori indusiate; a few basal pinnae gradually reduced....sect. *Mesoneuron*.
- A Veins anastomosing to form simple goniopteroid venation; a few basal pinnae distinctly reduced into butterfly-shaped auricles.....
.....sect. *Neocyclosorus*.

Sect. Glaphyopteridopsis.

Three species are known from South East Asia.

Iro combined this and the following sections with American *Glaphyopteris* on the basis of the presence of distinct aerophores at base of costae. Real *Glaphyopteris* bears, however, the aerophores of very great length more than 1 cm long at base of costae and also the smaller ones at base of constules. In the present group, on the contrary, the aerophores are at most 0.5 cm in full length even when they are very young, and are found at base of costae only. I will follow to Iro (1939) in part to regard this and the following being closely related to each other. Besides, the group of *Cyclosorus heterocarpus* with reticulate venation and reduced lower pinnae seems to be an ally of these sections.

American species of the group of *Dryopteris patens* (Sw.) O. Ktze. resemble seemingly the members of this section. These American species are sectionally not the same with those of *Cyclosorus* s. lat., and are more properly separated from the group of *C. gongyloides* or of *C. dentatus*. However, it is not certain at present whether the group of *D. patens* may better be included in the present section or not. Only the Old World species are for the present referred here to this section.

Sect. Mesoneuron (CHING) st. nov. — *Mesoneuron* CHING, l.c. Type: *Aspidium classifolium* BLUME, now *Thelypteris classifolia* (BLUME) CHING.

Pseudocyclosorus CHING, l.c.

This is the section similar to the preceding, from which this is distinguished by the persistent indusia and the distinctly (though gradually) reduced lower pinnae. CHING (1936) separated these two groups appropriately, but ITO united them into a single section. HOLTUM (1954) gave valuable references to this group as that of *T. classifolia*.

About ten species are credited to this group from the tropics of the Old World.

Sect. Neocyclosorus sect. nov. Type: *Aspidium heterocarpum* BLUME, now *Thelypteris heterocarpha* (BLUME) MORTON.

Pinnis pinnatifida, segmentis integris, eglandulosus vel glandulosus; pinnis inferioribus abrupte reducti, basi aerophoratis; textra papyracea vel tenuiter chartacea, venulis infimis anastomosantibus. Soris rotundatis, indusiatis; indusiis hirsutis, reniformibus.

Several Old World species belong to this section.

Because of the presence of excurrent veinlets below the sinus membrane, the members of this section have been referred to *Cyclosorus*. In the preceding two groups, veins are free, but the basal veinlets run to the bottom of the sinus membrane. Contrary to this, only one pair of veinlets truly anastomosing in this group of ferns. The difference between this and the preceding two sections is only in venation and is not so vital as that between this and such species groups as *Cyclosoriopsis*, *Cyclosorus* s. str. or *Macrocyclosorus*.

Subgen. **Steiopteris** (C. CHR.) comb. nov. — *Dryopteris* subgen. *Steiopteris* C. CHR. Biol. Arb. til. Eug. Warm. 81. 1911; Monogr. Dryopt. I, 161. 1913. Type: *Polypodium deltoideum* SWARTZ, Prod. 133. 1788, now *Thelypteris deltoidea* (Sw.) comb. nov. — *Steiopteris* C. CHR. l.c. — *Thelypteris* subgen. *Cyclosorus* sect. *Steiopteris* (C. CHR.) MORTON, Amer. Fern Journ. 53: 153. 1963.

Rhizome long creeping. Fronds pinnate-bipinnatifid, deltoid or somewhat narrowing towards base, in one species with reduced auriculiform lower pinnae, firm to rigidly coriaceous, greyish or brownish in colour; aerophores distinct at base of costae. Veinlets simple, raised above, those of the basal pair running out to the sinus, more or less connivent and with a cartilaginous membrane between them, this membrane often folded and forming hairy keel. Scales firm, castaneous or dull-brown, entire, hairy at margin; hairs setose, simple, unicellular or multicellular; glands entirely absent. Sori round, with large indusia; sporangia glabrous.

CHRISTENSEN (1913) enumerated 13 species in this subgenus, two of which were with some doubts. The range is in the neotropics.

CHRISTENSEN (1911) noted that the Oriental species of a group of *T. classifolia* seemed to belong to this subgenus. As COPELAND (1947) referred correctly, however, the two groups, of *T. deltoidea* and of *T. crassifolia*, are doubtlessly distinct in phylogeny. These Oriental species are different from *Steiopteris* in having no multicellular hairs, no characteristic carinate fold below the sinus, oblanceolate outline of fronds, green to dark green colour, no aerophores, and others. Recognizing the distinct features of *Steiopteris*, COPELAND reduced it to a synonym of *Lastrea*, on the basis that it was undefinable on a world-wide scale.

Subgen. **Cyclosorus** (LINK) MORTON, Amer. Fern Journ. 53: 153. 1963. — *Cyclosorus* LINK, l.c. Type: *Aspidium goggilodus* SCHKUHR, Kr. Gew. 1: 193, t. 33 C. 1809, now *Thelypteris gongylodes* (SCHKUHR) comb. nov. — *Dryopteris* subgen. *Cyclosorus* (LINK) C. CHR. Biol. Arb. til. Eug. Warm. 81. 1911; Monogr. Dryopt. I, 174. 1913.

Rhizome long creeping, or rarely short. Fronds oblong-lanceolate, bipinnatifid; pinnae not deeply lobed with oblong subdeltoid segments having acute or acuminate apices, glabrous or subglabrous on the underside, texture coriaceous or rigidly chartaceous, the lower pinnae not or gradually but never suddenly reduced, without aerophore at base of pinnae. Veinlets simple; at least the lowest ones uniting to those of the adjacent groups to form simple goniopteroid venation; sinus membrane present but not so distinct. Scales not so dense on rhizome and at base of stipes, firm to herbaceous, usually hirsute; hairs stiff, all unicellular or with occasional septae. Sori round, indusiate; indusia round-reniform, usually large, persistent; sporangia glabrous.

One hundred or more species are included in this subgenus, the range being in the tropics throughout the world. Several species groups seem to be recognizable among the members of this subgenus, though the keen discrepancy can

not be got in this paper. In the pages of specific enumeration, some Old World species groups will be listed with short notes.

Subgen. **Sphaerostephanos** (J. SMITH) st. nov. — *Sphaerostephanos* J. SMITH, l.c. Type: *Sphaerostephanos asplenioides* J. SMITH, a synonym of *Thelypteris polycarpa* (BLUME, Enum. Pl. Jav. 156. 1828, pro *Aspidio*) comb. nov.

Mesochlaena R. BROWN ex J. SMITH, l.c. Type: *Sphaerostephanos asplenioides* J. SMITH.

Rhizome short, erect or subarborescent. Fronds large, pinnate-bipinnatifid, oblanceolate, the lower pinnae suddenly reduced into auriculiform pinnae; segments numerous, oblique. Veinlets simple, basal two or more veinlets uniting with the opposite ones, forming simple goniopteroid venation; sinus membrane present. Scales rather dense on the base of stipes, firm, dark brown, hairy; hairs setose, pale, unicellular or multicellular, when long seemingly articulated. Sori elongate along veinlets, born laterally on thickened elevated linear receptacle, indusiate; indusia superior, elongate-oblong or horseshoe-shaped, attached to the top of the free linear elevated receptacles; sporangia setiferous; spores bilateral with perispore.

Six species are known in the Malaysian regions

CHING (1940) construed a monotypic family on the basis of this genus. For the diagnostic characters to define this Sphaerostephanaceae, he attached much importance to the feature in reproductive organs: elongate sori with elongate-oblong indusia and having the tetrahedral spores. As noted in the general part, the receptacle of the thelypteroid ferns has the tendency to elongate, thus producing long linear sori. There are several examples of elongate sori among the members of our series, as represented by, for instance, the members of *Stegnogramma*. The tetrahedral spores are described on the basis of the mis-observation of CHING. The species belonging to this subgenus have the bilateral spores with distinct perispores. Therefore, this genus can not be separated from Thelypteridaceae as to be a distinct family.

Contrary to this, HOLTUM (1954) reduced this group to *Cyclosorus*, but later (1959) he separated this from *Cyclosorus* and treated as a distinct genus, though no comment was given to his later treatment. *Sphaerostephanos* is much similar to *Cyclosorus* in many features, especially in habit and venation. This group of ferns is, however, characterized again by having the seemingly articulated, long, multicellular hairs on the main axes. In account of these facts, I can not refer this group to any one of *Cyclosorus* s. lat.

Subgen. **Haplodictyum** (PRESL) st. nov. — *Haplodictyum* PRESL, l.c. Type: *Haplodictyum heterophyllum* PRESL, Epim. Bot. 51. 1849, now *Thelypteris heterophylla* (PRESL) comb. nov.

Rhizome short, with approximate stipes. Fronds pinnatifid with several free basal pinnae. Like *Cyclosorus* in every feature except venation; veins pinnate, veinlets forked, the basisopic branch anastomosing with a veinlet from the

costa of adjacent segment of the frond or with the secondary veinlet which runs to the sinus, the acroscopic branch anastomosing with the next higher veinlet from the same costa, the effect being that normally four rows of areoles are between the adjacent costae. Scales rather sparse, membranous or soft herbaceous, ovate oblong with long tail, hairy; hairs setose, simple, unicellular, dense throughout the plants. Sori round, indusiate with round-reniform, setiferous indusia.

Two species are known, endemic to the Philippines. They are fairly variable, and the forms may be specifically distinct. I have examined a few specimens only, and am not able to state on the specific taxonomy.

Owing to the seemingly pleocnemoid venation of this genus, CHING (1940) placed this next to *Ctenitopsis* in his ctenitoid series of genera. However, this genus belong doubtlessly to the thelypteroid series by the distinct features found in steler construction, hairiness, frond constitution, soral characters and so on. CHING added to this genus several Asiatic species of *Cyclosorus*, but these species may better be excluded from *Haplodictyum* and placed in the following subgenus.

Among the free veined species of the thelypteroid ferns, forking of veinlets are not the feature of rare occurrence. In reticulate veined species, however, almost all veinlets are simple to form typical goniopteroid venation forming only two rows of areoles between the costules. The venation of this subgenus is distinct enough in appearance, but the pattern of it is not necessarily different from the goniopteroid venation.

Subgen. **Pneumatopteris** (NAKAI) st. nov. — *Pneumatopteris* NAKAI, l.c. Type: *Aspidium callosum* BLUME.

Rhizome short or ascending, thick, sparsely scaly. Fronds usually large, pinnate-bipinnatifid, oblong lanceolate; pinnae falcate, deeply lobed into oblong obtuse segments or only crenate on margin, glabrous or subglabrous on the under side, texture herbaceous or soft herbaceous, the lower ones suddenly or gradually reduced to auricles or not reduced at all; aerophores distinct or obscure. Veinlets reaching the very margin of lobes, the lower several pairs uniting with the opposite ones forming typical goniopteroid venation; callose membrane present at bottom of sinus between the adjacent lobes. Scales not so dense on rhizome and at base of stipes, membranaceous, pale-brown or dull brown, ovate oblong with acuminate apices, sparsely hairy; hairs simple, setose, pale, unicellular. Sori round, indusiate with large, persistent, setiferous or glabrous indusia.

Forty or more species are known in the tropics throughout the world, including such a pantropic species as *T. truncata* (POIR. Enc. Mèth. Bot. V, 534. 1804, sub *Polypodio*) comb. nov. This subgenus consists of the two groups distinct enough from each other, the two being distinguished by the following key:

- A Aerophores present at base of costae; lower pinnae suddenly reduced into mere auricles; pinnae more or less lobed on margin.

- sect. *Pneumatopteris*.
 A Aerophores absent; lower pinnae not suddenly but gradually reduced downwards; pinnae less lobed on margin with numerous anastomosing pairs of veinlets and less developed callose sinus.....sect. *Macrocyclusorus*.

Sect. **Pneumatopteris**. Type: *Aspidium callosum* BLUME, Enum. Pl. Jav. 156. 1828, now *Thelypteris callosa* (BLUME) comb. nov.

More than twenty species are distributed throughout the tropics of both Worlds.

This species group is in appearance distinct from the following section, and is similar to *Cyclosoriopsis* in one hand and to the New World *Glaphyopteris* in the other. Almost glabrous underside of fronds is verrucose and often bears the glands densely. By this feature, as well as by the huge size and the wide distributional range, the species of this group, such as *T. truncata*, may be considered as to be primitive. However, no actual phylogenetic line can be suggested originated from the group of this section.

Sect. **Macrocyclusorus** sect. nov. Type: *Aspidium megaphyllum* METT. Ann. Lugd. Bat. 1: 233. 1864, now *Thelypteris megaphylla* (METT.) comb. nov.

Pinnis inferioribus sursum vel non abbreviatis deflexis, sine aerophoris, membranaceis, hirsutis, margine plus minusque lobulatis, venis haud paucis anastomosis.

This group is represented by the species about twenty in number, distributing throughout the tropics of Asia.

According to the current definition, some species of this group are hardly distinguishable from the members of *Abacopteris*. The most convenient distinction between the two seems to be the presence or absence of the callose membrane at the bottom of sinus between the contiguous segments. In the species of this group, the margins of pinnae are lobed to some extent forming, though often obsolete, sinus membrane. On the contrary, the margins of pinnae are in *Abacopteris* subcrenate and have no callose membrane.

There is a small distinct group of the Philippine species included here in definition. This is the group of *T. canescens* (BLUME, Enum. Pl. Jav. 133. 1828, sub *Polypodio*) comb. nov. CHING (1940) united these species with *Haplodictyum*, on which I gave some notes in a few pages before. COPELAND (1947) adequately separated this group from *Abacopteris*, but did not give any further knowledges about the systematic position of the species group. These species may better be treated as a distinct group, but my present study, only on some herbarium sheets, informs no conclusive result.

Subgen. **Abacopteris** (FÉE) comb. nov. — *Abacopteris* FÉE l.c. Type: *Aspidium lineatum* BLUME, Enum. Pl. Jav. 144. 1828, now *Thelypteris lineata* (BLUME) comb. nov.

Pronephrium PRESL, Epim. Bot. 258. 1849. Type: *Aspidium lineatum* BLUME.

Meniscium sect. *Goniopteridopsis* H. ITO in NAKAI & HONDA, Nova Fl. Jap.

Polypod.-Dryopt. I, 184. 1939. Type: *Polypodium urophyllum* WALL. ex HOOKER.

Menisorus ALSTON, Bol. Soc. Brot. 30: 20. 1956. Type; *Menisorus pauciflorus* HOOKER.

Rhizome long creeping, short or ascending, variously paleate. Fronds simple, trifoliolate or imparipinnate with many lateral pinnae and a distinct terminal pinna, ovate oblong or oblong lanceolate; lateral pinnae broad, subentire or slightly crenate, sinus membrane wholly wanting, herbaceous or soft chartaceous, dark green to pale yellowish green, or sometimes tinted red. Veins with many simple veinlets; lower several pairs of veinlets conjugate with the opposite ones forming a typical goniopteroid venation with a number of quadrangular areoles arranged in two rows between the costules. Scales not so dense on rhizome and at base of stipes, linear subdeltoid with long tails, herbaceous, dark or pale brown, usually densely hairy; hairs rather dense on various portions of plants, setose, simple or hooked, all unicellular. Sori round and indusiate with naked sporangia, or oblong and exindusiate with glabrous or setiferous sporangia, those of two connivent veinlets adhering to form a crescent shaped sori, or in some species forming seemingly acrostichoid condition resulting subdimorphic habit*.

About thirty species belongs to this subgenus, distributing throughout the palaeotropics.

This subgenus is closely related to the preceding one, from which it can be distinguished only by the difference in the absence of sinus membrane. As the pinnae of this genus are little lobed and subentire, no sinus is formed and the callose membrane is not able to be formed. The absence of this membrane should better be regarded as the secondary character which is resulted from the reduction of that.

In sect. *Goniopteridopsis*, Ito combined two species, *M. urophyllum* and *M. proliferum*. He set much importance to the resemblance between these two species of the venation and soral structure. Despite of these similarity, these two species are quite distinct from each other in the trichomes, the frond construction and the habit of plants. It seems to be improbable to unite these two species by the apparent resemblance of definable, not natural, characteristics. *Menisorus* is distinguished from *Abacopteris* by the erect rhizome, which also is not the feature sufficient to indicate the distinctness of a genus. As noted by ALSTON (1956), the species seems to be referred to the members of *Macrocyclusorus*. The relationship should further be studied concerning these species.

Subgen. **Dimorphopteris** (TAGAWA et K. IWATS.) st. nov.—*Dimorphopteris* TAGAWA et K. IWATS. ex K. IWATS. l.c. Type: *Dimorphopteris moniliformis*

* HOLTUM (Blumea 11: 530. 1962) referred *Acrostichum oligodictyon* BAKER to *Cyclosorus*. Although the appearance of sori is acrostichoid in this species, no sporangia are actually produced on any portion of the laminar surface. In spite of the strictly dimorphic habit, therefore, this species may safely be included in this subgenus.

TAGAWA et K. IWATS. ex K. IWATS. Acta Phytotax. Geobot. 19: 8. 1961, now *Thelypteris moniliformis* (TAGAWA et K. IWATS.) comb. nov.

Rhizome long creeping, sparsely scaly. Fronds dimorphic: sterile fronds much similar to those of *Cyclosorus*, pinnate; pinnae slightly lobed on margin, the upper ones gradually adnate and decurrent to rachis; venation simply goniopteroid, the areoles not strictly quadrangular; sinus membrane present though obscure; fertile fronds much taller than the sterile ones, pinnate; pinnae contracted, linear-moniliform; veins forked, the veinlets unite with the adjacent ones, producing free excurrent veinlets; sporangia spreading all over the lower surface of the narrow fertile pinnae. Scales brown or pale brown, membranous, lanceolate with long tail, hairy throughout; hairs simple, setose, pale, unicellular.

Single collection is known from the island of Halmahera in the Molucca Islands.

The dimorphism of fronds is found on certain species of almost every series of the ferns. Among the thelypteroid series of ferns, this is the only representative of the species with strictly dimorphic habit, having the acrostichoid fertile pinnae. Apparent dimorphism is found in some other groups among the thelypteroid ferns, but true acrostichoid condition of fertile fronds is known only in this species.

This species seems to be an ally of some *Cyclosorus* species, but no suggestive ally is found in the series known up to the present, as the dimorphism of our species is so distinct.

Subgen. *Cyrtomiopsis* subgen. nov.—Type: *Aspidium boydiae* EATON, Bull. Torrey Bot. Club 6: 361. 1879, now *Thelypteris boydiae* (EATON) comb. nov.

Subgen. *Cyclosoro* haud dubie proximum, differt: soris indusiatis, indusiis peltatis, nudis.

Rhizome ascending, paleate. Stipes terete, stramineous, pubescent throughout. Fronds indistinctly imparipinnate, oblong lanceolate; lateral pinnae lobed on margin, lower ones not distinctly reduced. Lower veinlets uniting with the opposite ones resulting a typical goniopteroid venation, though the areoles are somewhat irregular. Scales sparse at base of stipes, ovate oblong with acuminate apices, dull brown, firm, entire, sparsely hairy; hairs simple, pale, setose, all unicellular. Sori round, indusiate; indusia round-reniform, peltately attached; spores bilateral, reticulate on surface, with perispore.

The type and sole species is endemic, with perispore.

On the morphology and the systematic position of this species, a short discussion has been given by me in Amer. Fern Journ. 51: 86-88. 1961, in which the relationship of this species is referred to some species of *Cyclosorus*. Although this subgenus seemingly resembles *Cyrtomium*, the thelypteroid relationship of our species is doubtless. It is, however, not certain at present whether this species is generically distinct from *Thelypteris* or not.

Genus **Meniscium** SCHREBER

Meniscium SCHREBER in L. Gen. Pl. ed. 8, II, 757. 1791. Type: *Polypodium reticulatum* L.

Goniopteris PRESL, Tent. Pterid. 181. 1836. Type: *Polypodium viviparum* RADDI.

Ampelopteris KUNZE, Bot. Zeit. 6: 114. 1848. Type: *Ampelopteris elegans* KUNZE.

Rhizome long creeping, short and ascending, or erect, dictyostelic, rather sparsely paleate. Stipes terete, variously hirsute, rachises like stipes, often proliferous at axils or apex, aerophores present on some species. Fronds oblong, oblanceolate or subdeltoid, simple, pinnate, or bipinnatifid, the terminal pinna distinct or not, more or less hairy on every axis, pubescent or glabrous on the laminar surfaces according to species, soft herbaceous to subcoriaceous in texture, pale to dark green, sometimes tinted red. Veins free or anastomosing to form goniopteroid or meniscoid venation, the excurrent veinlets running from each anastomosis, free or attached to the next higher anastomosis. Scales non-clathrate, setiferous on margin and on surfaces, hairs unicellular, simple, branching or stellate, rather dense on various parts of plants. Sori round or oblong, dorsal on a veinlet, or the two on an anastomosis united into a crescent-shaped sorus, indusiate or exindusiate, indusia and sporangia glabrous or setiferous, spores bilateral, variously tuberculate or reticulate or almost smooth on surfaces, with perispore.

More than 80 species are included in this genus from tropical and subtropical America. One species, *Meniscium proliferum*, is known in the tropics throughout the Old World. Concerning the specific taxonomy, CHRISTENSEN's classical work, *Monograph of Dryopteris* I (1913), is as yet standard one. As I have not extensively investigated on the neotropical species, little mention will be given on this genus.

The most definable discriminative feature of this genus is found in its trichomes, the presence of the branched or stellate unicellular hairs. As noted on my earlier paper (1962), the features of trichomes are as a rule distinct from morphological view, but we must not overlook the fact that the stellate hairs may be extinct on some species. If this occurs, the plants having no stellate hairs can not be decided whether they have no stellate hairs in their nature or they have lost these hairs in the course of evolution. Therefore, we can not rely too much on that single character. The other features should, therefore, be taken into account to diagnose this genus. The combination of characteristics given in the description is the indicator to circumscribe the range of this. MORTON (1963) offered an opinion that *Goniopteris* and *Meniscium* were not distinct generically from *Thelypteris*. Although he took less value on the characteristics found on the trichomes, he separated the species included in the first two genera in the rank of section. This means that MORTON considered that the species included in *Goniopteris* and *Meniscium* are phylogenetically distinct from those included in *Thelypteris* (the species of the other sections of him).

Goniopteris and *Meniscium* have been separated by every taxonomists as to be distinct genera or subgenera (or sections), though most authors seem to consider that they are not distinct at all. These two are distinguished by the difference in venation and soral characteristics. Among the species belonging to *Goniopteris*, we find an unbroken row of species, from free-veined species to such a species as *Meniscium meniscioides* (*Polypodium*, LIEBM. Vid. Selsk. Skr. V, 1: 211. 1849) comb. nov., the venation of which is perfectly meniscioid. Really, there are various types of venation in these species: callose membrane is present or not, the angles of venation are low or high, the numbers of conjugated veinlets are from zero to 10. The venation of *Meniscium* is truly meniscioid, but this typical and ordered venation is not a distinct one but only a particularly arranged one of the goniopteroid venation. Therefore, we have no sound base to separate generically, or subgenerically, the species of this genus into two groups by the difference solely in venation. The other important feature to diagnose *Meniscium* is its confluent sori. In subgen. *Abacopteris* of the preceding genus, we saw the continuous series of the various shapes of sori, from round and distinct one to seemingly acrostichoid condition through confluent and crescent intermediates. Thus, the confluent sori can not stand as a distinct character to indicate the phylogenetic gap between any species groups. From these facts, we can not safely separate *Meniscium* and *Goniopteris* as distinct phylogenetic groups. It may be said that the former is an offshoot of the latter, and the two, or more, groups are recognizable in the latter. The Old World member stands intermediate between *Meniscium* and *Goniopteris*. Four infrageneric groups are, thus, distinguishable in this genus, though tentatively. Further study should be made on these American species to give more natural classification of them.

- A Veins free or anastomosing to form goniopteroid venation; sori round or oblong, indusiate or exindusiate.
 - B Fronds bipinnatifid, gradually narrowed into a pinnatifid apex. sect. *Asterochlaena*.
 - B Fronds pinnate-bipinnatifid with a terminal pinna, which in some species resembles the lateral ones, in others it is larger and often hastate. sect. *Goniopteris*.
- A Venation goniopteroid or typical meniscioid; sori confluent, elongate along uniting veinlets, exindusiate; fronds imparipinnate.
 - B Rachis proliferous; venation goniopteroid; species of the Old World. sect. *Ampelopteris*.
 - B Rachis not proliferous; venation typically meniscioid; species of the New World. sect. *Meniscium*.

Sect. *Asterochlaena* (C. CHR.) comb. nov.—*Dryopteris* subgen. *Goniopteris* sect. *Asterochlaena* C. CHR. Biol. Arb. til. Eug. Warm. 84. 1911. Type: *Polypodium reptans* GMEL. Syst. Nat. 2 (2): 1309. 1791, now *Meniscium reptans* (GMEL.) comb. nov. This is designated here as the type species of this section.

Rhizome short creeping or ascending; fronds simple to bipinnatifid, rachises often proliferous, laminae upwards gradually narrowing into pinnatifid apices, lateral pinnae, if present, variously lobed; veins free, or anastomosing variously to form goniopteroid venation, the numbers of conjugated veinlets, if present, different according to species, callose membranes present or absent at the bottom of sinus between the lobes; sori round, indusiate or exindusiate.

About 50 species are credited to this section, the range of which is in the tropics and subtropics of the New World.

This is the largest and most compound section in this genus. It may contain the species belonging to a certain number of phylogenetic groups. At present, no classification can be made any further.

Sect. **Goniopteris** (PRESL) comb. nov.—*Goniopteris* PRESL, Tent. Pterid. 181. 1826. Type: *Polypodium crenatum* Sw., a synonym of *Meniscium poiteanum* (BORY, Dict. Class. 9: 233, 1826, sub *Lastrea*) comb. nov.—*Thelypteris* subgen. *Cyclosorus* sect. *Goniopteris* (PRESL) MORTON, Amer. Fern Journ. 53: 154. 1963, p.p.

Rhizome short, ascending; fronds pinnate to bipinnatifid, rachis often proliferous or viviparous, terminal pinna distinct, similar to or larger than the lateral ones, lateral pinnae lanceolate or oblong lanceolate, lobed in various degrees on margin; the lowest veinlets running directly to the margin of lobes, connivent at the sinus bottom, or joining to the opposite ones to form excurrent veinlets, callose membrane obsolete or distinct; sori round, indusiate or naked.

About 20 neotropical species belonging to this section. In spite of the various forms of venation, the species included seem to be rather close to each other.

COPELAND (1947) cited *Monogonia* PRESL as a synonym of *Goniopteris*. Although he regarded that the PRESL's figure represented *Goniopteris tetragona*, the systematic position and imperfect description of PRESL were those of *Pteris* group. PRESL's line drawing is so rough that we can refer it to various species. Therefore, *Monogonia* may better be excluded from the generic names among the thelypteroid series.

Sect. **Ampelopteris** (KUNZE) comb. nov.—*Ampelopteris* KUNZE, Bot. Zeit. 6: 114. 1848. Type: *Ampelopteris elegans* KUNZE, a synonym of *Meniscium proliferum* (RETZ.) SWARTZ.

Rhizome creeping; fronds pinnate, growing indefinitely, irregularly proliferous and producing smaller fronds or clusters of fronds in the axils of the pinnae; veins anastomosing in many pairs to form several excurrent veinlets; sori more or less definite, elongate along the veinlets, exindusiate.

Type and a sole species distributes widely in the palaeotropics, from Africa in the west through South Asia to Polynesia and Australia in the east.

Sect. **Meniscium**.—*Meniscium* SCHREBER in L. Gen. Pl. ed. 8, II, 757. 1791. Type: *Polypodium reticulatum* L., now *Meniscium reticulatum* (L.) SWARTZ.—*Dryopteris* subgen. *Meniscium* (SCHREBER) C. CHR. Ind. Fil. xxii. 1905.—*Thelypteris*

subgen. *Cyclosorus* sect. *Meniscium* (SCHREBER) MORTON, Amer. Fern Journ. 53: 154. 1963.

Large ferns; rhizome short creeping; fronds imparipinnate, all pinnae rather broad, entire or serrate, not lobed on margin, axis not proliferous; venation typical meniscioid, conjugated veins many in pairs, excurrent veinlets usually free, sinus membrane absent; sori naked, confluent and crescent-shaped along connivent veinlets.

More than a dozen species are included in this section, distributing in the tropics and subtropics of the New World.

This has been treated as a distinct genus defined by the meniscioid venation. The relationship between this and subgen. *Abacopteris* of the preceding genus is not so close, as noted in the pages of the latter subgenus.