STUDIES IN THE FAMILY THELYPTERIDACEAE. THE GENERA PHEGOPTERIS, PSEUDOPHEGOPTERIS, AND MACROTHELYPTERIS

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INTRODUCTORY

This is the first of an intended series of papers on the family *Thelypteridaceae*, especially in the Old World, based on studies made in preparation for an account of the family for Flora Malesiana. At a later stage I will give a formal statement of the characters of the family, but here I must point out that a former statement of mine (Holttum, 1947, p. 130) needs to be modified as regards characters of scales and hairs.

Scales. These may bear either marginal or superficial unicellular hairs, or both, or perhaps in rare cases none; the hairs may be acicular, or capitate, or spherical and glandular.

Hairs on the frond. These are normally all unicellular, but in some species some hairs are multicellular. Such multicellular hairs may represent intermediate conditions between unicellular hairs and hair-pointed scales (as in the genus *Macrothelypteris*, described in the present paper); but there appear to be other cases (in *Lastrea sensu* C. Chr., both in Asia and America) which are perhaps not thus to be explained, and which need more study.

I hope at a later date also to give a considered summary of my judgement as to the relationship of *Thelypteridaceae* to other ferns. As my ideas on this subject have changed since 1947, I would like here to indicate briefly the ways in which they have changed. In 1947 I referred to Bower's suggestion that *Dryopteris* (in the broad sense of Christensen's *Index Filicum* of 1905, thus including *Thelypteris*) had been derived from *Cyatheaceae*, and argued that the only element of *Dryopteris s.l.* which does show such resemblance is the *Thelypteris* group of genera; further, that *Dryopteris s. str.* shows more resemblance to *Dennstaedtia* and *Culcita* which Bower regarded as related to *Dicksonia* and placed on an evolutionary line distinct from *Cyathea*.

I then referred to Bower's further thesis that *Cyatheaceae* were derived from the same stock as *Gleicheniaceae*, with the corollary that the primitive *Cyatheaceae* (of which Bower cited *Lophosoria* as an example) were exindusiate. This in turn involves the assumption that the indusium of *Cyathea* was a new evolutionary development, and thus not homologous with the indusium of *Dicksonia*. Bower suggested that the indusium in *Cyathea* might have evolved from a scale (the sori of some members of the genus are surrounded by scales; but I later discovered that these scales are always quite distinct from indusia). I accepted Bower's suggestion, postulating the evolution of *Thelypteridaceae*, with *Cyathea*, from *Gleicheniaceae*, or from an allied group of ancient ferns, and followed Bower in assuming an entirely different origin for *Dicksonia*.

In making these suggestions, Bower commented on, and rejected, Goebel's arguments that the indusium of *Hemitelia* (= *Cyathea p.p.*; see Holttum, 1963) may be regarded as homologous with that of *Dicksonia*. When I came to make a detailed study of the family *Cyatheaceae*, and compared *Cyathea* with *Dicksonia*, having the cooperation of U. Sen in dealing with anatomy (Holttum & Sen, 1961) it became gradually clear to me that Bower's rejection of Goebel's thesis was unjustified. Sen's anatomical investigation showed the very close structural relationship between *Cyathea* and *Dicksonia*; it showed also that the development of the sori in *Dicksonia* and in the *Hemitelia* condition of *Cyathea* is essentially similar. I argued that the *Hemitelia* type of indusium was probably primitive in *Cyathea*, the cup-shaped (typical *Cyathea*) form being derivative; in fact, the two indusial forms may be so closely alike that many species with truly *Hemitelia*-type indusia have been described as having cup-shaped indusia (e.g., *C. cunninghami* Hk. *fil.* of New Zealand).

This has a bearing on *Thelypteridaceae* because, if this family is related to *Cyathea*, and if the indusium in *Cyathea* is a new evolutionary development in that genus, then the indusium of *Thelypteris* cannot be homologous with that of *Dryopteris s. str*, the latter being regarded as having a common origin with *Culcita* and *Dennstaedtia*. I was never very happy about this conclusion, and now believe it to have been entirely unwarranted. But I am still convinced that *Thelypteridaceae* is a very natural family, quite distinct from *Dryopteris s. str*; and I still think there is much evidence to relate *Thelypteridaceae* to *Cyathea*, though not to *Culcita*. I hope to set out such evidence in a later paper.

I would thus see *Thelypteridaceae* as one of a series of families originating from the same stock as *Cyatheaceae* (construing that family as in my treatment of 1963), with *Dryopteris*, *Ctenitis*, and *Athyrium* belonging to other such families. These families together constitute the great bulk of terrestrial ferns; *Blechnum*, *Asplenium*, and *Davallia*, though more divergent, appear to me to belong to the same great alliance. It appears to me that the indusia in all these ferns are homologous; the many exindusiate cases, in all families (including *Cyatheaceae*) are to be interpreted as separate evolutionary developments within small groups of species. *Cheilanthes* and many other genera of Copeland's *Pteridaceae* (Copeland, 1947), on the other hand, seem to me more closely allied to *Schizaeaceae*; there is no evidence that they ever had any indusia (*Pteris* itself seems to be a doubtful case). The other great group of existing ferns, *Polypodiaceae s. str.*, are almost entirely epiphytic. Their adaptations to epiphytic life have modified them considerably so that it is difficult to decide to which other group of ferns they are most nearly related.

CLASSIFICATION WITHIN THELYPTERIDACEAE

Christensen was the first author to recognize that the Thelypteroid ferns form a distinct natural group within *Dryopteris sensu lato* of his *Index Filicum*, a group not closely related to *Dryopteris s. str.* He came to this conclusion as a result of his study of the tropical American species (1913; summary on pp. 58—60). He subsequently studied many species of the Old World, and published some comments on them (e.g., 1934, pp 240, 247) but did not feel sufficiently satisfied as to the definition of natural genera to adopt any such genera formally in the third Supplement to his Index (he discussed that matter with me when I met him in 1934). R. C. Ching, who worked in Europe with Christensen in the years 1929—1932, applied Christensen's ideas in detail to the species of mainland Asia in monographs published in 1936 and 1938, recognizing the genera *Thelypteris*,

Cyclosorus, *Abacopteris*, *Goniopteris*, *Stegnogramma*, and *Leptogramma*, all of which he discussed and re-defined. In general, I accepted Ching's arrangement in my work on the ferns of Malaya (1954). In 1936 Ching also recognized that the species he included in *Thelypteris* could be regarded as belonging to several distinct groups. H. Ito gave formal generic and infra-generic rank to some of these groups in 1939; Ching raised some others (which he re-arranged) to generic rank in his further monograph of the family in 1963. Iwatsuki published a further series of studies of this family in Asia in 1963—1965, reducing some of Ching's genera to lower rank and re-arranging all of them, with a new commentary.

Neither Ching nor Iwatsuki was able to study the species of Malesia which are more numerous and more varied than those of mainland Asia and Japan. It appears to me that no satisfactory solution of the recognition of natural groups (whether called genera or subgenera or sections) within the family will be possible until the Malesian species, and also those of the Pacific, have been thoroughly re-examined. I have begun such a study, and have made a preliminary survey of the species. The problem is exceedingly complex, and I am not yet ready to define most of the genera. As I pointed out some years ago (1947, p. 132; 1954, p. 236) a separation of species with free veins from those with united veins does not result in a natural subdivision; in other words, anastomosis of veins must have developed on more than one evolutionary line within the family. The problem then is to find other characters by which natural groups can be recognized. Christensen did this with a large measure of success in his treatment of tropical American species, in which he included species with both free and anastomosing veins in his subgenera *Cyclosorus* and *Goniopteris*; but the problem in the Old World is different, and I judge it to be considerably more complex. Only a small minority of species in the New World show close relationships to those of Africa and Asia.

Because genera within *Thelypteridaceae* have in several cases not been clearly defined, C. V. Morton (1963) concluded that the only satisfactory course was to include all members of the family in one genus, and proposed a new scheme of subgenera and sections, based mainly on Christensen's work on tropical American species. This scheme is not satisfactory for the very numerous and varied species of the Old World tropics which certainly need new subdivisions, even if Morton's comprehensive generic concept is accepted.

Another author who considers that all members of the family should be placed in one genus *Thelypteris* is C. F. Reed (1968), but apparently he has made no new taxonomic study. He has transferred to *Thelypteris* all species placed in *Lastrea* and *Cyclosorus* by Copeland and Ching which Iwatsuki had not already dealt with, and also many others, involving at least 300 new combinations among Old World species. In so doing he has transferred to *Thelypteris*, without comment, species belonging to the following genera which in the opinion of most taxonomists do not belong to *Thelypteridaceae*: *Gymnocarpium*, *Acystopteris*, *Ctenitis*, *Dryopteris*, *Cornopteris*, *Diplazium*, and *Anisocampium*. He has also transferred a very peculiar Queensland species (*Polypodium poecilophlebium* Hook.) which I think should be the basis of a new genus allied to *Ctenitis*; its vascular anatomy is quite different from that of any Thelypteroid fern, also its venation. Reed has also needlessly duplicated names for several species and has further complicated an already very complex synonymy by copying previous authors who made erroneous statements through not having seen type specimens.

The most distinct of Ching's genera of 1963 are *Phegopteris*, *Pseudophegopteris*, and *Macrothelypteris*. They comprise only free-veined species, and show no close relationship to any other members of the family. I began my study with these genera, and the

following is an attempt at a conspectus of all known species, including some not known to Ching, and two from Malesia which I regard as new. I have also attempted to characterize the genera more fully and precisely than Ching was able to do. In the case of *Pseudophegopteris*, inadequate collection have been made of some species (especially in Africa) and the present arrangement can only be regarded as tentative; I think, however, it is the best I can make with the available material.

The genus *Phegopteris* (in the strict sense of Ching here adopted) is distributed throughout the north temperate zone, with one species in S.E. Asia; it includes only three known species. *Pseudophegopteris* species are scattered throughout the tropics of the Old World, the extremes of distribution being the island of St. Helena and Hawaii. *Macrothelypteris* has fewer species, with a somewhat less wide distribution; one species is adventive in various places in the New World.

If one regards *Thelypteridaceae* as related to *Cyathea*, the genera *Pseuophegopteris* and *Macrothelypteris* may be regarded as showing the most primitive frond-form in the family (one *Macrothelypteris* was originally described as *Alsophila ?* by Hooker). But these ferns all show reduction or absence of indusia, and this must be regarded as a derivative character, as the bulk of species in the family are indusiate. The loss of indusia has occurred as a separate evolutionary development in so many different ferns, including, in my judgement, several others in *Thelypteridaceae* and at least three different lines within *Cyathea* itself (see Holttum, 1964) that it is not a surprising development in this case; but its biological significance is quite obscure.

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CONSPECTUS OF THE THREE GENERA

1. Stipe-scales thin with sparse slender marginal hairs, or firmer with copious rigid marginal hairs; thin narrow hyaline scales with long marginal and apical hairs present on all parts of the lamina; the rachis-wing, connecting each pinna with the next, expanded between adjacent pinnae into small semicircular lobes each with its own veins springing directly from the rachis . . . . . **Phegopteris**
1. Scales on bases of stipes bearing hairs on surface as well as on edges; rachis-wings connecting adjacent leaflets always narrow, lacking separate veins.
   2. Scales on axes of the frond thin, brown, usually sparse (reduced to short hairs with brown cross-walls on smaller axes), never with a long hair-tip; no long slender multiseptate hyaline hairs on axes of frond; sori always exindusiate . . . . . **Pseudophegopteris**
   2. Scales on axes of frond often abundant, usually pale, always with thickened bases and hair-tips, grading to long slender hyaline multiseptate hairs; if scales are lacking on lamina, multiseptate hairs always present; a small indusium usually present . . . . . **Macrothelypteris**

PHEGOPTERIS

Fée, Gen. Fil. (1852) 242, *emend.* Ching, Acta Phytotax. Sinica 8 (1963) 312. — *Polypodium* § *Phegopteris* Presl, Tent. Pterid. (1836) 179, *p. p.* — *Thelypteris* subgen. *Phegopteris* sect. *Phegopteris* Iwatsuki, Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 25 (also sect. *Lastrella p. p.*).

Rhizome long-creeping or short and suberect; *fronds* bipinnatifid with adnate pinnae which are connected with each other by a wing along the rachis (except lowest pair of pinnae in *P. connectilis*), the wing forming, between one pinna and the next, a ± semicircular lobe containing a branched vein arising directly from the rachis; frond-form deltoid with lowest pinnae longest, or lanceolate with lower pinnae gradually reduced; *veins* in pinna-segments simple or branched, tips of distal ones at least reaching the margin; *sori* subterminal on veins or their branches, exindusiate or with a very small indusium, sporangia often bearing either short acicular hairs or capitate hairs; lower surface of *rachis* and *costae* of pinnae copiously scaly, *scales* all (or at least those on the distal parts of pinnae) pale, thin, narrow, bearing many slender spreading unicellular marginal hairs and long hair-tips; larger, darker and often less hairy scales present at base of stipes; *surfaces* bearing unicellular acicular hairs, also sometimes short unicellular capitate hairs, and on costae sometimes slender hairs with multicellular base (transition to scales).

Type species: *Polypodium phegopteris* Linn.

Distribution: throughout North temperate regions; one species in SE. Asia.

Fée and later authors of the 19th century used this genus to include all species of *Dryopteris*-like habit with exindusiate sori and free veins. This was never a very satisfactory arrangement, as in some cases it was difficult to know whether a species was or was not exindusiate (small and fugacious indusia were difficult to detect before good optical equipment was available). The result was clearly an unnatural mixture of diverse elements. As limited by Ching to three species, it becomes a very natural genus, comprising one very widely distributed species and two of more local occurrence. *Phegopteris connectilis* (better known as *P. polypodioides* Fée) is distributed throughout north temperate regions, the similar but larger *P. hexagonoptera* only in eastern North America, and *P. decursive-pinnata* in SE. Asia. Their most distinctive common characters are the peculiar wings on the rachis, and the scales. *P. decursive-pinnata* differs strikingly from the others in the elongate shape of its fronds, and (apparently on that account) was excluded by Iwatsuki (following H. Ito) from close association with the other two. Iwatsuki placed *P. decursive-pinnata* in *Thelypteris* subg. *Phegopteris* sect. *Lastrella*, along with some of the species here included in *Pseudophegopteris*; but he did not give any clear indication of the characters which distinguish his sect. *Phegopteris* from sect. *Lastrella*.

Cytological evidence supports the inclusion of *P. decursive-pinnata* in *Phegopteris*. The first such evidence was that of Manton (1950) who discovered that *P. connectilis* is an apogamous triploid with a somatic chromosome number 90, indicating a base number 30. This was later confirmed by Wagner (1955) who found that *P. hexagonoptera* is a diploid with n = 30. Finally Mitui (1965) has reported that *P. decursive-pinnata* exists in two forms, diploid and tetraploid, the former with n = 30, the latter only known from an approximate count. *P. connectilis* must have had diploid and tetraploid parents; *P. hexagonoptera* may have been the diploid, but where is the tetraploid? And is it possible that *P. connectilis*, over its whole extremely wide range, is the product of a single hybrid origin? Hybridization experiments involving the three known species might give significant information.

KEY TO THE SPECIES

1. Lower pinnae not gradually reduced; rhizome long-creeping.
   2. Basal pinnae 10—20 cm long, connected to those next above by a wing along the rachis; segments of larger pinnae deeply lobed; veins always forked to pinnate . . . . . **1. P. hexagonoptera**
   2. Basal pinnae 5—10 cm long, separately adnate by narrow bases to rachis; pinna-segments entire or at most toothed; veins in segments of middle pinnae mostly simple. . . . . **2. P. connectilis**
1. Lower pinnae gradually reduced, frond narrowly lanceolate in outline; rhizome short, suberect. **3. P. decursive-pinnata**

1. Phegopteris hexagonoptera (Michx) Fée, Gen. Fil. (1852) 242; Mett., Fil. Hort. Lips. (1856) 83; J. Sm., Ferns Brit. & For. (1866) 170; Small, Ferns S. E. United States (1938) 298; Ching, Acta Phytotax. Sinica 8 (1963) 312. — *Polypodium hexagonopterum* Michx, Fl. Bor. Amer. 2 (1803) 271; Hook. & Grev., Ic. Fil. (1831) t. 210; Hook., Spec. Fil. 4 (1862) 245. — *Nephrodium hexagonopterum* Diels in E. & P., Nat. Pflanzenfam. 1, Abt. 4 (1899) 270. — *Dryopteris hexagonoptera* C. Chr., Ind. Fil. (1905) 270. — *Lastrea hexagonoptera* Nieuwl., Midl. Nat. 2 (1912) 278; Copel., Gen. Fil. (1947) 139. — *Thelypteris hexagonoptera* Weatherby, Rhodora 21 (1919) 179; Wagner, Rhodora 57 (1955) 224 (cytology); Morton, Amer. Fern Journ. 57 (1967) 176. — Type: *Michaux*, Virginia (P.).

Rhizome wide-creeping, to 4 mm diameter, young parts covered with broad, thin, light-brown scales bearing slender marginal hairs; *stipes* 1—2 cm apart on rhizome, to 40 cm long, pale stramineous when dry, persistently scaly near base only; *lamina* broadly deltoid, to *c.* 25 × 25 cm, all pinnae connected by a wing along rachis, all deeply lobed, lobes of largest ones again lobed half-way to costule; *basal pinnae* narrowed to their bases, widest on basiscopic side, longest lobes ⅓ from base; lateral veins in pinna-lobes always forked, in larger lobes pinnate in their lobules; *sori* subterminal on veinlets, exindusiate; sporangia usually bearing short capitate hairs, less often acicular hairs.

Distribution: Eastern North America.

2. Phegopteris connectilis (Michx) Watt, Canad. Nat. (1870) 29; Morton, Amer. Fern Journ. 57 (1967) 177. — *Polypodium connectile* Michx, Fl. Bor. Amer. 2 (1803) 271. — Type: *Michaux*, Canada (P).

Polypodium phegopteris Linn., Sp. Pl. (1753) 1089. — *Lastrea phegopteris* Bory, Dict. Class. 9 (1826) 233; Copel., Gen. Fil. (1947) 137. — *Gymnocarpium phegopteris* Newm., Phytol. 4 (1851) App. xxiii. — *Phegopteris polypodioides* Fée, Gen. Fil. (1852) 243; Manton, Probl. Cyt. & Evol. Pterid. (1950) 82—3; Ching, Acta Phytotax. Sinica 8 (1963) 312. — *Phegopteris vulgaris* Mett., Fil. Hort. Lips. (1856) 83, *nom. illeg.*; J. Sm., Ferns Brit. & For. (1866) 171; Bedd., Handb. Ferns Brit. India (1883) 290. — *Phegopteris phegopteris* Keyserl., Polyp. Cyath. Herb. Bung. (1873) 50, *nom. illeg.*; Small, Ferns S.E. United States (1938)

300. — *Nephrodium phegopteris* Prantl, Exc. Fl. Baiern (1894) 23. — *Dryopteris phegopteris* C. Chr., Ind. Fil. (1905) 284. — *Thelypteris phegopteris* Slosson in Rydb., Fl. Rocky Mts (1917) 1043. — Type: Herb. Linn.

Rhizome wide-creeping, *c.* 2 mm diameter, apex covered with thin light-brown scales bearing sparse slender marginal hairs; *stipes* pale, persistently scaly near base only, commonly to 20 cm long; *lamina* commonly *c.* 15 × 10 cm, exceptionally to 22 × 18 cm, larger scales on rachis and costae sometimes brown and sparsely hairy like those on stipe; *basal pinnae* largest, somewhat deflexed, separately adnate to rachis by a narrow base, narrowed to base on basiscopic side; *all pinnae* deeply lobed, lobes entire except those of basal pinnae of large fronds; lateral *veins* in pinna-lobes (except of largest pinnae) usually simple, with subterminal sori, in largest lobes forked with sorus on acroscopic branch; *sori* exindusiate, sporangia sometimes bearing short capitate or acicular hairs.

Distribution: N. Temperate & Boreal regions, southwards to Himalayas.

On lower surfaces of costae there are often scales like those on the stipe, but smaller, almost lacking marginal hairs, and intermediates between these and the narrow, hyaline, long-fringed scales characteristic of *Phegopteris*; the intermediates have hyaline hairy bases.

3. Phegopteris decursive-pinnata (van Hall) Fée, Gen. Fil. (1852) 242; Ching, Acta Phytotax. Sinica 8 (1963) 312; Mitui, J. Jap. Bot. 40 (1965) 119, 124. — *Polypodium decursive-pinnatum* van Hall, Nieuwe Verh. Kon. Ned. Inst. Wet. 5 (1836) 204; Hook., 2nd. Cent. Ferns (1861) t. 49; Hook., Spec. Fil. 4 (1862) 231. — *Aspidium decursive-pinnatum* Kze, Bot. Zeit. 6 (1848) 555; Mett., Fil. Hort. Lips. (1856) 89. — *Nephrodium decursive-pinnatum* Hook. in Blakiston, Five Months on the Yangtse (1862) 365; Syn. Fil. (1867) 259; Diels in E. & P., Nat. Pflanzenfam. 1, Abt. 4 (1899) 171. — *Lastrea decursive-pinnata* J. Sm., Ferns Brit. & For. (1866) 154; Copel., Gen. Fil. (1947) 138. — *Leptogramma decursive-pinnata* J. Sm., Hist. Fil. (1875) 232. — *Dryopteris decursive-pinnata* O. Ktze, Rev. Gen. Pl. 2 (1891) 812; C. Chr., Ind. Fil. (1905) 261; v. A. v. R., Bull. Jard. Bot. Btzg II, 28 (1918) 23. — *Thelypteris decursive-pinnata* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 275; Iwatsuki, Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 137. — Type: *van Hall* (not seen).

Lastrea decurrens J. Sm., Curt. Bot. Mag. 72 (1846) Comp. 32. — Type: *Cameron*, China (BM).

Rhizome short, suberect, bearing fronds in a close tuft; *stipes* 3—10 cm long, closely scaly and hairy throughout; scales firm, brown, with copious stiff marginal hairs; *lamina* to *c.* 50 cm long, narrowed gradually to apex and base, lowest pinnae 10—15 mm long, middle pinnae 3½—8 cm long and 6—10 mm wide; *pinnae* lobed ½—⅔ towards costa; veins in lobes pinnate, veinlets simple; *sori* subterminal on veinlets, to 8 on larger lobes of pinnae; a very small indusium present, bearing long unicellular hairs and short capitate hairs; sporangia sometimes bearing short acicular or capitate hairs.

Distribution: Central & S.E. China, Tonkin, Taiwan, Korea, Celebes.

Ching called the sori exindusiate, but stated that they have 'a stalked and branched hair in the centre', also that young sori have copious cobwebby hairs in them. Iwatsuki does not consider that a true indusium is present, but that the group of hairs represents a reduction from an ancestral indusiate condition. The indusium seems to me distinct; it was first observed by John Smith when he described *Lastrea decurrens*. Mitui reports both diploid and tetraploid plants of this species, but I know of no morphological characters by which they might be distinguished.

PSEUDOPHEGOPTERIS

Ching, Acta Phytotax. Sinica 8 (1963) 313. — *Thelypteris* group 4 Ching, Bull. Fan Mem. Inst. Biol. Bot 6 (1936) 246. — *Phegopteris sensu* Tagawa, Acta Phytotax. Geobot. 7 (1938) 73. — *Phegopteris* sect. *Lastrella* H. Ito in Nakai & Honda, Nov. Fl. Jap. no. 4 (1939) 152, *excl. P. decursive-pinnata.* — *Thelypteris* subg. *Phegopteris* sect. *Lastrella* Iwatsuki, Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 25, (1965) 137—142, *excl. T. decursive-pinnata.* — *Toppingia* Deg., Deg. & A. R. Smith in Deg. & Deg., Fl. Hawaii (1968) Fam. 17b.

Caudex erect or creeping, in a few cases long-creeping; scales on caudex and bases of stipes thin, medium brown, ± hairy but never with conspicuous marginal hairs nor a long hair-point; *stipes* and rachis glossy, mostly ± deeply flushed with red-brown. *Lamina* usually elongate with lower pinnae ± reduced and spaced; pinnae opposite or nearly so, in *P. rectangulare* mostly adnate to rachis and not deeply lobed, in most species with ± distinct pinnules broadly adnate to pinna-rachis (sometimes contiguous, often connected by a very narrow wing along rachis, rarely quite free and then with adnate tertiary leaflets); tips of veins ± thickened, not running to margin; scales on lower surfaces of rachis and pinna-rachis usually absent at maturity of frond, never with conspicuous marginal hairs nor hair-point, sometimes reduced to a row of short cells with dark cross-walls; hairs on lower surfaces always unicellular, mostly acicular, sometimes short and capitate, never conspicuously gland-like. *Sori* always exindusiate, often spread a little along veins, sometimes much so; sporangia bearing acicular hairs or glabrous; spores usually pale, with a slightly raised reticulum on the surface, lacking a winged perispore.

Type species: *Polypodium pyrrhorhachis* Kunze.

Distribution: Islands of St Helena and S. Thomé (Atlantic), wetter parts of tropical and subtropical Africa and Asia, Malesia, Polynesia, Hawaii.

This genus is very near to *Macrothelypteris*, with which it agrees in ± bipinnate fronds with adnate pinnules, and in a base chromosome number 31 [found in *P. aurita*, *P. cruciata* (West Africa) *P. cyclocarpa*, and *P. pyrrhorhachis*]. *Pseudohegopteris* differs in its scales, in never having slender multiseptate hairs, in spore-characters, and in the sori always being exindusiate. The ultimate divisions of the frond in *Pseudophegopteris* are usually larger than in *Macrothelypteris*, often coarser in texture, and the lower pinnae are in nearly all cases more or less reduced; frond-axes are usually rather deeply flushed red-brown, at least in the basal part, but vary much in this, even within plants of one species growing in the same locality.

Information about some species is incomplete, and I am by no means sure that I have characterized all of them correctly. Rhizome-characters are often important, and not often well shown by herbarium specimens. Another difficulty is that young plants in this genus are often fertile before they have attained their full size, and it is sometimes not possible to be sure whether a young plant and a much larger one, both fertile, belong to the same species. More field observation is needed.

A few species certainly have a wide distribution, notably *P. aurita* and *P. paludosa*. Others certainly have a very restricted one, including *P. dianae* (St Helena), *P. henriquesii* (San Thomé), *P. persimilis* (Samoa), and *P. keraudreniana* (Hawaii).

KEY TO THE SPECIES

1. Rhizome slender (under 4 mm diam.), wide-creeping with well-spaced fronds.
   2. Sori distinctly elongate; hairs on lower surfaces of pinna-rachis short, stiff, ± antrorse; basal pinnules conspicuously longer than next . . . . . **1. P. aurita**

2. Sori not distinctly elongate; hairs longer, spreading; basal pinnules not conspicuously longer than next.
3. Pinnae of largest fronds 5—8(—10) cm long, broadly deltoid, segments lobed less than half-way to costule; hairs on lower surface all simple . . . . . **2. P. levingei**
3. Pinnae of largest fronds to 14 cm long, ± oblong; many segments lobed half-way to costule; many very small scales, each with a tuft of hairs, on lower surface . . . . . **3. P. bukoensis**

1. Rhizome erect or suberect; or if creeping much thicker, fronds usually not distant.
4. Basal basiscopic pinnules conspicuously longer than next.
5. Hairs on lower surface of pinna-rachis, costae, costules, and veins almost all short with ± swollen apices . . . . . **4. P. henriquesii**
5. Hairs on lower surface all, or nearly all, acicular.
6. One pair basal pinnae reduced; middle pinnae almost at right angles to rachis; basiscopic basal pinnules not more than 1 cm longer than next; sparsely hairy beneath **5. P. cyclocarpa**
6. Three pairs basal pinnae reduced; middle pinnae at 60° to rachis; basal basiscopic pinnule almost twice as long as next; copiously hairy beneath . . . . . **6. P. subaurita**
4. Basal basiscopic pinnules not conspicuously longer than next.
7. Basal pinnae longest (or not such smaller than next); pinnules to 10 cm or more long.
8. Stipe and rachis bearing many persistent small scales (hair-like scales also on pinna-rachis and costae); pinnules of larger pinnae widest at base; hairs on costae beneath rather long and slender, abundant . . . . . **7. P. kinabaluensis**
8. Stipe and rachis not persistently scaly; pinnules of larger pinnae somewhat narrowed to base; lower surface of costae bearing sparse acicular hairs . . . . . **8. P. yunkweiensis**
7. Basal pinnae reduced; pinnules mostly shorter.
9. Basal pinnules of larger pinnae smaller than middle ones.
10. Pinnules all partly adnate to pinna-rachis, to 8 × 2.5 cm, lobed almost to costa. **9. P. aubertii**
10. Pinnules quite free, commonly 15 cm long, bearing adnate deeply lobed tertiary leaflets up to 2½ cm long . . . . . **10. P. procera**
9. Basal pinnules largest, or not shorter than those next to them.
11. Fronds 2—3 m long, pinnae to 60 cm long . . . . . **11. P. keraudreniana**
11. Fronds and pinnae smaller.
12. Pinnae to 6 cm long; most pinnae adnate to main rachis . . **12. P. rectangularis**
12. Pinnae of well-grown plants much larger; most pinnae not adnate.
13. Stipe and rachis stramineous.
14. Pinnules to 10 × 2.5 cm, their segments lobed halfway to costule. **13. P. persimilis**
14. Pinnules smaller, their segments at most crenate.
15. Mascarene Islands and Africa . . . . . **14. P. cruciata**
15. Yunnan . . . . . **15. P. pallida**
13. Stipe and rachis castaneous.
16. Stipe and lower surface of rachis densely and rather persistently scaly. **16. P. dianae**
16. Stipe above base and rachis at most sparsely scaly.
17. Largest pinnules 7½ × 1.7 cm, lobed ¾ or more to costa; lower surface of costa and costules glabrous . . . . . **17. P. sumatrana**
17. Largest pinnules smaller, less deeply lobed; costae and costules variously hairy beneath.
18. Sporangia usually 2 or more setae; hairs on lower surface of costules short and stiff . . . . . **18. P. hirtirachis**
18. Sporangia rarely setose; hairs on lower surface of costules ½—1 mm long.
19. Largest pinnae often over 20 cm long (to 35 cm); costules commonly 10—12(—15) mm apart; pinnules to 4 cm long. **19. P. paludosa**
19. Largest pinnae rarely over 20 cm long; costules commonly 5—8(—10) mm apart; pinnules commonly 1.5—2.5 cm long. **20. P. pyrrhorhachis**

1. Pseudophegopteris aurita (Hook.) Ching, Acta Phytotax. Sinica 8 (1963) 314; Holttum & Roy, Blumea 13 (1965) 131. — *Gymnogramme aurita* Hook., Ic. Pl. (1854) t. 974, 989; Spec. Fil. 5 (1864) 141; Bedd., Ferns Brit. India Suppl. (1876) 24; Clarke, Trans. Linn. Soc. II Bot. 1 (1880) 568. — *Grammitis aurita* Moore, Gard. Chron. 1856: 389;

Bedd., Ferns Brit. India (1866) pl. 152. — *Phegopteris aurita* J. Sm., Cat. Cult. Ferns (1857) 17; Hist. Fil. (1875) 234; Mett., Farngat. IV (1858) 15. — *Polypodium auritum* Lowe, Ferns Brit. & Exot. 2 (1858) t. 51. — *Leptogramma aurita* Bedd., Handb. Ferns Brit. India (1883) 377. — *Aspidium auritum* Christ, Bull. Herb. Boiss. II, 4 (1904) 616. — *Dryopteris aurita* C. Chr., Ind. Fil. (1905) 253. — *Nephrodium auritum* Hand.-Maz., Symb. Sin. 6 (1929) 176. — *Thelypteris aurita* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 266. — Type: *Griffith s.n.*, Khasya (K).

Rhizome wide-creeping, 2—3 mm diam. when dry, near apex covered with thin, light-brown, hairy scales 3—4 mm long and with slender hairs 1—2 mm long. *Stipe* dark purplish, glossy, glabrescent, to 60 cm long. *Lamina* 30—70 cm long; pinnae opposite, well-spaced, commonly to 15 cm (rarely to 20 cm or more) long, upper ones adnate to rachis and merging with deeply lobed broadly deltoid apical lamina, lowest 1—2 pairs pinnae reduced; *pinnae* of largest fronds lobed almost to costa, of smaller ones less deeply, acuminate, lobes rounded to acute, basal lobes conspicuously longer than next, basal basiscopic lobes of large pinnae 3—5 cm long, lobed up to half-way to costule; veins pinnate in the pinna-lobes, veinlets simple to forked, in large basal lobes pinnate; *rachis* dark purplish, short-hairy in groove of upper surface, glabrescent beneath; costae densely short-hairy on both surfaces, hairs on lower surface distinctly antrorse; costules more sparsely hairy on both surfaces, lamina glabrous. *Sori* exindusiate, elongate along middle to distal parts of veins; sporangia usually setose; spores with a slightly raised reticulum of large meshes.

Distribution: NE. India, Upper Burma, W. China, Tonkin; in Malesia only known from Mt Kinabalu (*Clemens 40306*; *Molesworth Allen 3234*) and New Guinea (*Millar and Holttum, NGF 18549, 18558, 18589*, open places at 1800—2000 m).

Cytology: Loyal reported n = 31 in India; Holttum & Roy report n = 62 and 2n = 124 for plants from New Guinea cult. Kew.

2. Pseudophegopteris levingei (Clarke) Ching, Acta Phytotax. Sinica 8 (1963) 314, excl. syn. *Dryopteris bukoensis* Tagawa. — *Gymnogramme aurita* var. *levingei* Clarke, Trans. Linn. Soc. II Bot. 1 (1880) 568. — *Leptogramma aurita* var. *levingei* Bedd., Handb. Ferns Brit. India (1883) 377. — *Gymnogramme levingei* Baker, Ann. Bot. 5 (1891) 483; Hope, Journ. Bombay Nat. Hist. Soc. 15 (1903) 99, pl. 35. — *Leptogramma levingei* Bedd., Handb. Suppl. (1892) 99. — *Dryopteris levingei* C. Chr., Ind. Fil. (1905) 273. — *Thelypteris levingei* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 273. — Type: *H. C. Levinge*, Jhelum Valley, Kashmir (K).

Dryopteris purdomii C. Chr., Bot. Gaz. 56 (1913) 335. — Type: *Purdon 44*, Shensi (A).

Rhizome long-creeping, slender, as *P. aurita*. *Stipe* 15—28 cm long, stramineous, glossy apart from scales and hairs near base. *Lamina* to 50—60 cm long, with many pairs of opposite pinnae; lower pinnae gradually shorter (3rd or 4th from base longest) and more spaced, upper ones adnate to rachis and merging with lobed triangular apical lamina. *Largest pinnae* to 8 cm long (rarely to 10 cm), deltoid, lobed almost to costa, 2—5 cm wide at base, basal pair of segments subequal and not greatly longer than next, not quite free; larger segments or larger pinnae deeply lobed, distal ones (all of smaller pinnae) entire; veins as *P. aurita*; costae, costules, and veins beneath bearing spreading slender hairs, a few hairs also on lamina between veins; on upper surface antrorse hairs abundant on costae, scattered on costules and veins. *Sori* round or ± elongate along veins; sporangia with slender setae; surface of spores with distinct slightly raised reticulum of small meshes.

Distribution: Kashmir to West China; in wet open or lightly shaded places.

3. Pseudophegopteris bukoensis (Tagawa) Holttum, *comb. nov.* — *Dryopteris bukoensis* Tagawa, Acta Phytotax. Geobot. 1 (1932) 89. — *Thelypteris bukoensis* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 272; K. Iwats., Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 140. — *Phegopteris bukoensis* Tagawa, Acta Phytotax. Geobot. 7 (1938) 75. — *Lastrea bukoensis* H. Ito *ex* Ohwi, Fl. Jap. Pterid. (1957) 95. — Type: *Koidumi & Tagawa s.n.*, Mt Buko, Prov. Musari, Honshu (KYO, not seen).

Pseudophegopteris levingei (Clarke) Ching, Acta Phytotax. Sinica 8 (1963) 314, *p. p. excl. type.*

Rhizome wide-creeping, 3—4 mm diameter. *Stipe* 25—40 cm long, stramineous, glossy, dark and scaly near base. *Lamina* to 60—70 cm long; pinnae opposite, 3rd or 4th from base longest. Pinnae lobed almost to costa, almost all segments deeply lobed, texture thin; lowest pinnae 6—10 cm long, deltoid, with basal acroscopic segment longest; longest pinnae to 14 cm long, 4—5 cm wide, for the greater part oblong, short-acuminate, basal segments not or hardly longer than next; largest segments slightly separated from next and joined by a narrow wing along costa, lobed half-way to costule; lower surfaces of costae and costules bearing many very small scales each with several hairs (which thus appear in tufts), also simple hairs; simple slender hairs present on lower surface between veins; upper surface of costae and costules with antrorse simple hairs. *Sori* mostly almost round; sporangia bearing slender setae; spores with slightly raised surface reticulum, meshes of moderate size.

Distribution: Central Japan, in forest.

4. Pseudophegopteris henriquesii (Bak.) Holttum, *comb. nov.* — *Polypodium henriquesii* Bak., Bol. Soc. Brot. 4 (1886) 154, t. 1. — *Dryopteris henriquesii* C. Chr., Ind. Fil. (1905) 270; Exell, Cat. Vasc. Pl. S. Tomé (1944) 62. — *Thelypteris henriquesii* Tard., Not. Syst. 14 (1952) 344; Mem. Inst. Franc. Afr. Noire no. 28 (1953) 119, pl. xx, f. 10, 11.— *Macrothelypteris henriquesii* Pichi Sermolli, Webbia 23 (1968) 179. — Type: *A. Moller* 45 (June 1885), S. Thome, 1250 m (K, *ex* Herb. Jard. Bot. Univ. Coimbra).

Caudex not shown by type specimen; *stipe* 30 cm or more long, scaly throughout; scales to 7 × 1½ mm, thin, with short marginal hairs, brown acuminate, base thickened so that old stipes are copiously warty. *Main rachis* reddish at base, stramineous distally, bearing hair-like scales on lower surface near base, short capitate hairs distally. *Lowest pinnae* a little shorter than next; longest pinnae 20—35 × 6—15 cm, bearing broadly adnate pinnules which are connected by a narrow wing, basal basiscopic or acroscopic pinnules (or both) distinctly longer than next; *pinnules* at right angles to pinnarachis, to 8 × 1.7 cm, lobed up to ¾ towards costule, apex bluntly pointed, veins pinnate in pinnule-lobes, veinlets simple or forked; *lower surface* of pinna-rachis, costules, and veins, and of lamina between veins, bearing short hairs with rounded apices which are ± swollen (neither conspicuously spherical nor yellow); a few acicular hairs on costules and veins. *Sori* medial on veins, round; sporangia not setose.

Distribution: Island of S. Thome.

5. Pseudophegopteris cyclocarpa Holttum, Blumea 13 (1965) 131. — Type: cult. *Hort. Bot. Kew., 578/63, no. 57*, origin above Mt Hagen, Western Highlands, NE. New Guinea, *c.* 2000 m, coll. Holttum (K).

Caudex branching; branches short, suberect, each with a tuft of fronds. *Stipe* to 60 cm long, dark purplish-brown, glossy (except near base), scaly and hairy near base, scales to 6 × 1 mm, thin, hairy. *Lamina* to 80 cm or more long, pinnae almost opposite and slightly ascending, basal pair reduced and more widely spaced; *largest pinnae* to 20 cm

long, narrowly deltoid; *pinnules* all broadly adnate to pinna-rachis and connected to each other by a narrow wing; lowest pair of pinnules almost free, basiscopic one to 4.5 × 1.4 cm, acroscopic to 3.5 × 1.2 cm, lobed ⅔ towards costa; next pair of pinnules *c.* 4 and 2.5 cm long, less deeply lobed, rest of pinna evenly narrowed to apex, middle pinnules (or segments) 7—8 mm wide; veins pinnate in lobes of pinnules; lower surface of pinna-rachis hairy near apex only; costae of pinnules sparsely hairy; hairs present on or near edges of lamina. *Sori* medial on the veins, ± round; sporangia copiously setose (hairs as long as body of sporangium); spores pale yellowish, surface with a slightly raised reticulum of small meshes with broad walls between them.

Distribution: only known from the type and one other collection from NE. New Guinea (*Clemens* 6917, Morobe Dist., Sambanga, BM).

This species is very near *P. henriquesii* in form of frond, but differs in its hairiness (the rhizome of *P. henriquesii* is unknown). It is also near *P. subaurita*, differing in the pinnae much less oblique, in shorter basal basiscopic pinnules (or pinna-segments), much less hairy surfaces, and in copiously setose sporangia. The first fertile frond on the cultivated plant of *P. cyclocarpa* had largest pinnae only 9 cm long, basal basiscopic segments 2 cm long. Cytology: 2n = 124 (tetraploid).

6. Pseudophegopteris subaurita (Tagawa) Ching, Acta Phytotax. Sinica 8 (1963) 315. — *Dryopteris subaurita* Tagawa, Acta Phytotax. Geobot. 1 (1932) 157. — *Thelypteris subaurita* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 267; K. Iwats., Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 138. — *Phegopteris subaurita* Tagawa, Acta Phytotax. Geobot. 7 (1938) 73. — Type: *H. Ito*, Pai-wan-sya, Taiwan (Tokyo, not seen).

Caudex erect or suberect, stipes tufted; scales thin, light brown, narrow, hairy. *Stipe* 15—30 cm long, dark purplish-red, glossy, scaly near base, hairy throughout in the groove, sparsely on back; main rachis dark purplish, sparsely hairy beneath. *Lamina* to 100 cm long (Iwatsuki); pinnae opposite, 3 lowest pairs gradually reduced and more widely spaced, lowest less than half length of longest; *largest pinnae* to 15 cm or more long, at about 60° to rachis, acuminate, pinnatifid almost to costa, basal pair of segments almost free (broadly adnate), deeply lobed and narrowed to acute tip, basal basiscopic segment conspicuously longer than next, middle segments to 15 × 5 mm, crenate, with broadly pointed or rounded apex; *veins* paucipinnate in lobes of pinna-segments, veinlets simple; *lower surface* of pinna-rachis, costules, and veins copiously hairy, hairs spreading, *c.* ½ mm long; sparse erect hairs on lower surface between veins. *Sori* medial on veinlets, ± round; sporangia on specimens at Kew (including *Iwatsuki 4782*) rarely setiferous; spores thin-walled, raised reticulum not clearly seen.

Distribution: Taiwan and Ryukyu Islands.

Iwatsuki (l.c. 1965) states that the sporangia are setiferous, but, as above noted, they are rarely so in specimens I have seen. *Kanehira & Sasaki 21667*, Mt Arisan, Taiwan, named *Thelypteris hirtirachis* by Ching in 1931, has elongate basal pinna-segments as in *P. subaurita* but a thicker rachis than *Iwatsuki 4782*, only one pair of basal reduced pinnae, and sporangia copiously setose. It is much smaller than the other specimens labelled *T. hirtirachis* by Ching, and I do not think it should be referred to that species.

7. Pseudophegopteris kinabaluensis Holttum, *sp. nov.*

Rhizoma ignotum. *Stipes* ad 150 cm vel ultra longus, in sicco pallide brunneus, verrucis conspersis parvis squamulas angustas 5 mm longas ferentibus praeditus; rhachis primaria leviter rubro-suffusa, subtus more stipitis parce squamulosa, supra breve hirsuta. *Lamina* probabiliter ad 150 cm longa; pinnae infimae non reductae; *pinnae maximae* 40 cm vel

ultra longae; pinnulae pleraeque non oppositae, leviter obliquae, eae pinnarum infimarum 2.5—3 cm inter se remotae, lamina pinnularum omnium saltem leviter acroscopice rhachi adnata, pinnulae infimae quam adjacentes non longiores, pinnulae omnes basiscopicae quam acroscopicae majores; rhaches pinnarum supra prominentes et dense hirsutae, utroque latere alatae, laminis pinnularum basi cum alis rhacheos conjunctis; rhaches pinnarum subtus tenuiter hirsutae, squamulis brunneis conspersis praeditae; *pinnulae maximae* c. 10 × 3 cm, acuminatae, profunde lobatae (basin versus fere ad costam), lobo infimo basiscopico quam acroscopico longiore; costulae loborum 6 mm inter se distantes; lobi maximi acuti, ceteri apice rotundati, omnes ± incisi (usque dimidium costulam versus); *venae* loborum majorum paucipinnatae, loborum minorum furcatae; *costae* pinnularum costulaeque loborum subtus pilis longiusculis tenuibus patentibus copiosis atque squamulis minimis conspersis (cellulis uniseriatis septis brunneis separatis constructis) vestitae; costae pinnularum costulaeque loborum supra pilis crassioribus antrorsis vestitae. *Sori* fere orbiculati; sporangia non setifera; sporae reticulo leviter elevato maculis magnis constituto ornatae.

Typus: *H. P. Fuchs 21475*, Mt Kinabalu, Goking's Valley, 2700 m, on wet inundated ground along the river in damp shady moss-forest in the narrow valley (KSEPL, Rijswijk, Netherlands; Dupl. K, L). Also *Fuchs 21484*, same locality at 2800 m.

This species is near *P. yunkweiensis*, but the latter has acroscopic pinnules (except basal ones) about equal in length to basiscopic, pinnule-lobes crenate, and a different pubescence.

8. Pseudophegopteris yunkweiensis (Ching) Ching, Acta Phytotax. Sinica 8 (1963) 315. — *Thelypteris yunkweiensis* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 274. — *Phegopteris yunkweiensis* Tagawa, Acta Phytotax. Geobot. 7 (1938) 76. — Lectotype: *Pételot 3642*, Chapa, Tonkin, 1500 m (US, dupl. BM).

Rhizome unknown. *Stipe* 40 cm long (Ching), castaneous, glossy; rachis dark red, glabrescent on lower surface, 6 mm diameter. *Lamina* ovate, basal pinnae longest (Ching), pinnae subopposite, slightly oblique; *pinna* of lectotype 45 cm long, lower 3—4 pairs of acroscopic pinnules distinctly reduced, basal basiscopic pinnules not conspicuously elongate; pinnules *c.* 20 pairs, alternate, to *c.* 3 cm apart, all slightly adnate to rachis, the narrow wing connecting them only evident in distal half of pinna; pinna-rachis red as rachis, glabrescent beneath, copiously short-hairy on upper surface; *largest pinnule* 12 cm long, 2.4 cm wide, acuminate, adnate to pinna-rachis only about 2 mm each side of attachment of costa, widening a little above the subtruncate base, lobed to *c.* 1 mm from costa, costules of lobes *c.* 5 mm apart, lobes with crenate margins, blunt-pointed, often of irregular length; *veins* forked (simple in smaller lobes), the branches ending in hydathodes on upper surface well short of the margin; lower surface of costae bearing sparse slender hairs, and a few on costules; upper surface of costae only copiously hairy. *Sori* medial, almost circular, on acroscopic branch of a vein or sometimes on both branches; no indusia; sporangia lacking setae; spores pale with a slightly raised network of very large meshes.

Distribution: Yunnan, Tonkin.

Ching appears to cite two specimens as type; I have selected from these the specimen from Tonkin in the U.S. National Herbarium, from which the above description is mainly prepared. Ching wrongly states that the pinnules are only 1.4 cm wide. I agree that the other two specimens cited by Ching belong also to this species. They are: *Hancock 212*, Mengtze, Yunnan; *Cavalerie 4036*, Ku-y-tien, Yunnan-sen District, both at Kew. Hancock's specimen represents the upper part of a frond, with pinnae to 27 × 11 cm,

pinnules to 5.7 × 1.3 cm, all pinnules broadly adnate and lobed to 2½ mm from costa, their veins all simple. The Cavalerie specimen consists of part of the main rachis bearing a pair of pinnae 30 × 13 cm, pinnules to 7 × 1.7 cm, also below these pinnae the cut-off bases of a lower pair of about the same size (judged by thickness of rachis). At the British Museum is also a second Pételot specimen from Tonkin (no. 4128) bearing three pairs of pinnae, the basal ones 35 cm long. It is not clear to me whether Ching ever saw a complete frond; I have not, and therefore feel somewhat uncertain about the statement that the basal pinnae are the largest.

9. Pseudophegopteris aubertii (Desv.) Holttum, *comb. nov.* — *Polypodium aubertii* Desv., Mém. Soc. Linn. Paris 6 (1827) 243. — *Macrothelypteris aubertii* Pichi Sermolli, Webbia 23 (1968) 177, f. 2. — Type: 'Insula Mascareigne' (P).

Phegopteris helliana Fée, Gen. Fil. (1852) 247. — Type: *de Hell*, Bourbon (P?, not seen).

(?) *Phegopteris montbrissoniana* Fée, Gen. Fil. (1852) 247. — Type: *de Montbrison*, Bourbon (P?, not seen).

Polypodium sharpeanum Bak., Journ. Bot. 18 (1880) 369. — *Dryopteris sharpeana* C. Chr., Ind. Fil. (1905) 292; Dansk Bot. Ark. 7 (1932) 47, by error as syn. of *D. setigera* (Bl.) O.Ktze. — Type: *Langley Kitching*, Madagascar (K).

Caudex and stipe not known; *main rachis* stramineous or ± flushed with red. *Pinnae* to at least 40 × 15 cm; pinna-rachis beneath with spreading pale hairs; basal pinnules smaller than middle ones; largest *pinnules* 8 × 2.5 cm, acuminate, lamina at base slightly adnate on acroscopic side (on basiscopic side also of distal pinnules), lobed almost to costa, segments slightly oblique, to 4 mm wide, lobed up to half way to costule; veins mostly forked; costae and costules beneath bearing spreading pale hairs. *Sori* 1 or 2 to a lobe of each pinnule-segment, round; sporangia not setose; spores (of type of *P. sharpeanum*) with slightly raised reticulum of large meshes.

Distribution: Réunion, Madagascar.

I am indebted to Prof. Pichi Sermolli for identifying the specimens at Kew named *P. helliana* Fée with the type of Desvaux's species which he has seen at Paris. Madame Tardieu-Blot kindly searched for the type of *P. helliana* at Paris but did not find it, but from Fée's description I can hardly doubt its identity.

Christensen thought *Polypodium sharpeanum* Bak. not different from *Macrothelypteris setigera* (Bl.) Ching, a species of Malesia which at that time he did not distinguish from *M. torresiana* (Gaud.) Ching. The latter species does occur in Madagascar, and is at once distinguished by its long multicellular hairs and by the presence of indusia; also by its spores.

Unlike most species of *Pseudophegopteris*, the present species rarely has reduced scales on its lower surfaces, but they may occasionally be found.

10. Pseudophegopteris procera (Mann) Holttum, *comb. nov.* — *Polypodium procerum* Brack. in Wilkes, U.S. Expl. Exp. 16 (1854) 14, pl. 3, *non* Willd. 1810. — *Phegopteris procera* Mann, Proc. Am. Acad. Arts Sci. 7 (1867) 218. — *Phegopteris keraudreniana* (Gaud.) Mann var. *procera* Hillebr., Fl. Haw. Isl. (1888) 562, also var. *tripinnata* Hillebr. — *Dryopteris rubiformis* Robinson, Bull. Torr. Bot. Cl. 39 (1912) 596 (superfluous new name for *P. procerum* Brack. *non* Willd.). — *Toppingia procera* (Mann) Deg., Deg. & A. R. Smith in Deg. & Deg. Fl. Hawaii (1968) Fam. 17b. — Type: *Brackenridge*, Sandwich Isl (US, dupl. K).

Differs from *P. keraudreniana* (no. 11, q.v.) as follows: basal pinnules smaller than next; pinnules commonly 15 cm or more long, not adnate to pinna-rachis, bearing deeply

lobed tertiary leaflets up to 2½ cm long which are broadly adnate to axis of pinnule and mostly connected by a narrow wing; tertiary leaflets usually with a blunt tip, rarely acute (var. *tripinnata* Hillebr.).

Distribution: Hawaii.

11. Pseudophegopteris keraudreniana (Gaud.) Holttum, *comb. nov.* — *Polypodium keraudrenianum* Gaud. in Freyc., Voy. Bot. (1827) 362, t. 7; Hook., Spec. Fil. 4 (1862) 268; Hook. & Bak., Syn. Fil. (1867) 313 excl. loc. Java. — *Phegopteris keraudreniana* Mann, Proc. Amer. Acad. Arts Sci. 7 (1867) 218; Hillebr., Fl. Haw. Isl. (1888) 561, excl. var. *procera* & var. *tripinnata*. — *Toppingia keraudreniana* (Gaud.) Deg., Deg. & A. R. Smith in Deg. & Deg. Fl. Hawaii (1968) Fam. 17 b. — Type: *Gaudichaud*, Sandwich Isl., Jan. 1823 (P; fragment at K).

Rhizome long-creeping, to at least 2 cm diameter (Hillebrand). *Stipe* (Hillebrand) 1—2 m long, stramineous, glossy, persistently scaly near base, scales elsewhere early caducous, residual ones very small (reduced to short hairs), sometimes present also on smaller axes of frond. *Lamina* to 2—3 m or more long, growing at the tip for a long period; lowest pinnae shorter than next; rachises stramineous or ± flushed with red, glossy, short-hairy on upper surface; *pinnae* opposite, to 60 cm or more long, basal pinnules very close to main rachis, basal basiscopic ones sometimes longer than next but longest pinnules at ± ⅓ from base of pinna; *pinnules* 4—7 cm long, to 1.5 cm wide (rarely to 15 × 3 cm), adnate to pinna-rachis (distal ones connected by a narrow wing), lobed ½—⅔ towards costa, apex blunt to acute, lobes entire or slightly sinuous, rounded; *veins* pinnate in pinnule-lobes, veinlets forked; *costae* of pinnules and veins bearing spreading hairs on lower surface; shorter antrorse hairs on upper surface of costae. *Sori* subterminal on the veins, almost round; sporangia usually bearing slender hairs; mature spores not seen.

Distribution: Hawaii.

The distinctions between this and *P. procera*, as stated in the present paper, are tentative, based on several specimens at Kew, and need checking by field study. Kew specimens do not show any clear correlation between red colour on rachis and shape of pinnules, as suggested by Robinson (see *P. procera*). Specimens from Java placed here by Baker in Herb. Kew. are *P. palustris* (Bl.) Ching.

12. Pseudophegopteris rectangularis (Zoll.) Holttum, *comb. nov.* — *Polypodium rectangulare* Zoll., Syst. Verz. (1854) 37, 48. — Type: *Zollinger* 1802, 'in arenosis ad flum. Tjiapoes', Java (G, dupl. L).

Polypodium distans Don var. *minor* Clarke, Trans. Linn. Soc. II Bot. 1 (1880) 545 t. 79, f. 1. — Type: *Clarke*, Sikkim (K).

Dryopteris moussetii Rosenst., Fedde Rep. 8 (1910) 278. — *Phegopteris moussetii* v. A. v. R., Handb. Suppl. (1917) 306. — Type: *Mousset s.n.* 1909, Tengger Mts, Java (S-PA ?, not seen).

Phegopteris oppositipinna v. A. v. R., Bull. Jard. Bot. Btzg II, 16 (1914) 24; Handb. Suppl. (1917) 307. — *Dryopteris oppositipinna* C. Chr., Ind. Fil. Suppl. II (1915) 16. — *Thelypteris oppositipinna* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 268; Holttum, Rev. Fl. Malaya 2 (1954) 239, fig. 137. — *Pseudophegopteris oppositipinna* Ching, Acta Phytotax. Sinica 8 (1963) 315. — Type: *Matthew s.n.*, G. Singgalan, Sumatra (BO, dupl. K).

Caudex short, erect or suberect, stipes tufted; *stipe* to 25 cm long, slender, glossy, dark purplish, bearing scattered short spreading hairs throughout and narrow scales near base. *Lamina* to *c.* 30 × 12 cm, narrowed to both ends, several pairs of lower pinnae gradually

reduced and more widely spaced; free pinnae only a few pairs, rest with base of lamina ± broadly adnate to rachis, upper ones gradually merging into the deeply lobed acuminate frond-apex; *largest pinnae* to 6 × 1.5 cm, narrowed evenly from base to acuminate apex, lobed up to ¾ to the costa at base, less deeply distally and in smaller pinnae, lobes slightly oblique, entire, rounded; veins in basal pinna-lobes 5 or more pairs, simple (sometimes forked in lowest pinnae which, though short, may have much-widened bases); rachis, costae, and costules beneath bearing slender spreading hairs *c.* ½ mm long; a few slender erect hairs and also short capitate hairs on lower surface between veins. *Sori* ± round, subterminal on veins; sporangia usually with slender hairs; spores pale, thin-walled, with slight indication of raised surface reticulum with small round meshes.

Distribution: NE. India, W. Malesia (Sumatra, Malaya, Borneo, Java, on mountains at 1000—1500 m).

I found this species in dry sandy ground in the bed of small streams, both in Malaya and Sumatra; Zollinger reports a similar habitat. It is sometimes difficult to be sure of the distinction between young plants of *P. pyrrhorhachis* or *P. paludosa* and mature plants of the present species, but I believe it to be distinct. As regards synonymy, I feel sure of including *Dryopteris moussetii* here, as Rosenstock wrote that name on a specimen of the type collection of *P. rectangulare* in the Rijksherbarium, Leiden.

13. Pseudophegopteris persimilis (Baker) Holttum, *comb. nov.* — *Polypodium persimile* Baker, J. Bot. 14 (1876) 344. — *Dryopteris persimilis* C. Chr., Ind. Fil. (1905) 284; Bishop Mus. Bull. no. 177 (1943) 84. — Type: *Whitmee 204*, Samoa (K).

Caudex erect, bearing a tuft of stipes. *Stipe* 90 cm long, rather pale when dry except near base, ± persistently scaly throughout, warty where scales have fallen; scales attached by a crescent-shaped base, dull, dark and flaccid when dry, 5—7 mm long, 1 mm wide at base, bearing slender acicular hairs on surface near base; *rachis* pale, smooth and glabrescent beneath, densely hairy in groove of upper surface. *Lamina c.* 90 cm long, bipinnate and deeply tripinnatifid; lowest pinnae little shorter than next; *largest pinnae* 36 × 16 cm, basal pinnules usually little shorter than sub-basal ones (in a few cases the basal basiscopic pinnule is longest); pinna-rachis pale and sparsely hairy on lower surface; *pinnules* to 10 × 2.5 cm, sessile, acuminate, lobed to less than 1 mm from costa, basal lobes sometimes longest; costules 4½—5 mm apart; segments almost at right angles to costa, thin, the largest lobed ½ way to costule, apices rounded, veins paucipinnate in the larger lobes; lower surfaces of costae and costules bearing spreading, slender, acicular hairs to ½ mm long, with some hairs also on edge of lamina; on costules also scattered hairs (reduced scales) of 2 or 3 cells, terminal cell swollen, orange; on veins and on surface between veins scattered short capitate hairs. *Sori* round, one to each lobe of a lamina-segment (sometimes 2 on basal acroscopic lobe), on basal acroscopic veinlet, not terminal, exindusiate; no hairs seen on sporangia; spores pale golden yellow, with a very slightly raised reticulum of rather large meshes.

Distribution: Samoa; known only from type collection and *Sledge 1785*, Savaii, forest above Aopo, 4000 ft (K).

Baker compared the original specimen to *Lunathyrium boryanum* (Willd.) H. Ohba (*Dryoathyrium* Ching), but Christensen in 1943 noted the close resemblance to *Dryopteris uliginosa* (*Macrothelypteris torresiana* of present paper) and was not sure of a distinction. Dr Sledge's excellent new specimen shows the distinction in hairs and scales from *Macrothelypteris*; the above description is prepared from it.

14. Pseudophegopteris cruciata (Willd.) Holttum, *comb. nov.* — *Aspidium cruciatum* Willd., Spec. Pl. 5 (1810) 278. — *Dryopteris cruciata* C. Chr., Ind. Fil. (1905) 259. — *Thelypteris cruciata* Tard., Notul. Syst. 15 (1955) 91; Alston, Ferns W. Trop. Afr. (1959) 61; Tard. in Humbert, Fl. Madag. 5e Fam. 1 (1958) 285, f. xl, 7—9. — *Macrothelypteris cruciata* Pichi Sermolli, Webbia 23 (1968) 179, f. 3. — Type: *Bory*, Mauritius (B, phot. seen).

Phegopteris straminea Fée, Gen. Fil. (1852) 246. — Type: *de Montbrisson*, Bourbon (not seen).

Polypodium sessilifolium Hook., Spec. Fil. 4 (1862) 251, *nom. illeg.*, *non* Hook. l.c. 168, *nec* Liebm. — *P. bojeri* Hook., Spec. Fil. 4 (1862) 290. — Type: *Bojer s.n.*, Mauritius (K).

Nephrodium subglandulosum Bak., Syn. Fil. (1867) 285. — *Dryopteris subglandulosa* O. Ktze, Rev. Gen. Pl. 2 (1891) 813. — Type: *Vieillard & Deplanche s.n.*, Bourbon (K).

Thelypteris glabrata var. *hirsuta* Tard., Notul. Syst. 14 (1952) 344; Mém. Inst. Franç. Afr. Noire no. 28 (1953) 120, fig. 12, 13 (not *Aspidium glabratum* Mett. *ex* Kuhn).

Caudex not seen; *stipe* to 30 cm or more long, rough and scaly near base, rest glossy, stramineous or ± rufous. *Lamina* to 100 cm or more long; lowest 2—3 pairs of pinnae reduced; longest *pinnae* to 25 cm long, basal basiscopic pinnules not much longer than next; *pinnules* to 5 × 1.5 cm, distinctly narrowed at base but always adnate to pinna-rachis, larger ones deeply lobed, lobes slightly oblique, edges crenate, tip rounded; veins forked or simple; lower surface of pinna-rachis, costae, and costules bearing spreading slender hairs. *Sori* on acroscopic vein-branches, not or little elongate; sporangia lacking setae.

Distribution: Mascarene Islands; Tanzania (*E. M. Bruce 56*, BM); West Tropical Africa (?).

Specimens from Ghana and the Cameroons at Kew, named *T. cruciata* by Alston, differ from Mascarene specimens by being smaller and having most pinnules broadly adnate (a Ghana specimen, examined cytologically, showed n = 62; see Alston 1959, p. 80). One from Congo (*Callens 2181*) has very widely spaced comparatively broad pinnae (25 × 10 cm) and very deeply lobed pinnules which are only slightly adnate. It seems to me probable that these West African specimens represent two species distinct from *P. cruciata*; more complete material is needed, from fully mature plants.

This species and *P. aubertii* (no. 9) are certainly closely allied, but I believe they are distinct. The distinctions of size of pinnae, and of reduction of pinnules at bases of the larger pinnae, can only be seen by comparisons of complete fronds of fully mature plants. A Seychelles specimen is in Herb. BM. Also in Herb. BM are specimens from Mauritius which are ± intermediate between this species and *P. aubertii*, with pinnae to 30 cm long, pinnules to 6.5 × 2.0 cm, but with the lowest acroscopic pinnule reduced; I think they should be referred to *P. aubertii*.

15. Pseudophegopteris pallida Ching, Acta Phytotax. Sinica 8 (1963) 315. — *Thelypteris brunnea* var. *pallida* Ching, Bull. Fan Men. Inst. Biol. Bot. 11 (1941) 59. — Type: *Fang 8748*, Yunnan (not seen); also cited *Ching 22719*, Yunnan (not seen).

Stipe and rachis pale stramineous; lamina thin, drying green; lower surfaces hairy or glabrous.

16. Pseudophegopteris dianae (Hook.) Holttum, *comb. nov.* — *Polypodium dianae* Hook., Spec. Fil. 4 (1862) 234; J. C. Mellis, St Helena (1875) 355, pl. 55. — *Dryopteris dianae* C. Chr., Ind. Fil. (1905) 262. — Type: *Cuming* 423, St. Helena (K).

Polypodium molle Roxb. in Beatson, St Helena (1816) 318, *nom. illeg.*, *non* Jacq.; Hook. & Bak., Syn. Fil. (1867) 308. — *Phegopteris mollis* Kuhn, Fil. Afr. (1868) 123. — Type: *Roxburgh*, 1813—1814, St. Helena (not seen).

Caudex erect; *stipe* 15—35 cm long, reddish, densely and persistently scaly throughout (also lower surface of rachis); scales thin, light brown, to 6 × 2½ mm, bearing a few hairs; slender hairs also among the scales, especially in the adaxial groove. *Lamina* to 50 cm or more long and 30 cm wide; pinnae numerous, opposite or nearly so, contiguous or overlapping, spreading with distal part upcurved, lowest pair slightly reduced and deflexed with narrowed bases; *longest pinna* commonly 16 × 3½ cm, exceptionally to 22 × 7 cm, lobed to within 1—3 mm from costa, distal half rather evenly attenuate to apex, base not dilated but basiscopic segments longest (except in basal pinnae); largest pinna-segments crenate (exceptionally lobed ¼ to costule), usually with rounded apices but on one very large frond acute; lower surfaces of costae and costules densely covered with slender spreading hairs *c.* 1 mm long, similar hairs more sparse on veins, some erect slender hairs and short glandulair hairs on surface between veins; upper surface of costae shortly antrorse-hairy, of costules sparsely so; veins in larger segments pinnate with one or more sori on each group, not reaching the margin, their ends thickened. *Sori* round or slightly elliptic; sporangia usually with 1 or 2 setae; spores thin-walled, no distinct markings seen.

Distribution: St Helena; reported by Mellis in 1862 as 'a very common roadside fern along Sandy Bay ridge'; found also in 1956 (*N. R. Kerr*, K). J. D. Hooker reported plants as 3 to 5 feet high.

17. Pseudophegopteris sumatrana Holttum, *sp. nov.*

Caudex ignotus; *stipes* 100 cm longus; rhachis primaria leviter rubro-suffusa, supra hirsuta; *lamina* c. 150 cm longa; *pinnae* suboppositae, leviter obliquae, inferiores ± reductae, rhachibus supra dense hirsutis, subtus glabris; *pinnulae* infimae non auctae, basiscopicae quam acroscopicae longiores; pinnulae maximae 7.5 × 1.7 cm, acuminatae, basi partim rhachidi adnatae, ¾ vel ultra costam versus lobatae, costulis 3—6 mm inter se distantibus; lobi pinnularum apice rotundati, margine leviter sinuati, textura tenues; venae pleraeque furcatae; costae costulaeque subtus glabrae; *sori* supra bifurcationem venulae siti, interdum ramos ambo occupantes, ± rotundati; sporangia non setifera; sporae reticulo leviter elevato maculis mediocris ± rotundatis constituto ornatae.

Typus: *Holttum 26211*, Korinchi Peak, Sumatra, 2000 m (K; dupl. SING, BO). Found growing by a stream in an open place; no other known collection.

18. Pseudophegopteris hirtirachis (C. Chr.) Holttum, *comb. nov.* — *Dryopteris hirtirachis* C. Chr. in Léveillé, Cat. Pl. Yunnan (1916) 104. — *Thelypteris brunnea* var. *hirtirachis* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1916) 271. — Type: *Cavalerie* 1910, Pin-fa. Kouy-Tcheou (P?, not seen).

Caudex erect in Indian specimens, not known in type; *stipe* to 55 cm long, near base covered with brown scales, rest smooth, glabrescent, reddish to dark purplish. *Lamina* to *c.* 80 cm long; pinnae many, lowest 1—2 pairs reduced, lowest 10 cm long; main rachis dark purplish with short, stiff, spreading hairs on lower surface and thicker antrorse hairs on upper; *largest pinna* 20 cm long; pinna-rachis ± suffused throughout with red, usually paler than main rachis, similarly hairy; *pinnules* on basiscopic side longer than on acroscopic, basal pinnules usually not conspicuously longer than next; pinnules to 3½ cm long, lobed half-way to costule, shortly blunt-pointed, dilated at base and joined to a narrow wing along pinna-rachis, bases *c.* 8 mm wide; veins pinnate in the larger lobes; short, slender, spreading hairs on costules and veins beneath and on surfaces between veins. *Sori* almost round; sporangia usually with 2 or more setae.

Distribution: West China, NE. India.

At Kew are *Cavalerie 7193, 7212, 7704, 1851*, all from near the type locality and named by Ching. At BM is *Ching 5895*, Kwangsi ('tufted fern').

Indian specimens: *Gamble 8339*, Darjeeling, 6000 ft, and *8171*, 5000 ft. These differ from Chinese specimens in being larger, with pinnae to 30 cm long and main rachis hardly hairy on lower surface (pinna-rachis hairy as in Chinese specimens); *8171* is reported as having tufted stipes.

Ching cites also *Kanehira & Sasaki 21607*, Taiwan, but this has elongate basal basiscopic pinnules as in *P. subaurita* (no. 6) and I have so named it.

19. Pseudophegopteris paludosa (Bl.) Ching, Acta Phytotax. Sinica 8 (1963) 315; Holttum & Roy, Blumea 13 (1965) 131. — *Aspidium paludosum* Bl., Enum. Pl. Jav. (1828) 168, *nom. illeg., non* Raddi 1825. — *Polypodium paludosum* Bl., Fl. Jav. Fil. (March 1851) 192, t. 90; Hook., Spec. Fil. 4 (1862) 244. — Type: *Blume*, Java (L, no.908, 335—309).

Polypodium distans (*non* Don) Racib., Fl. Buitenz. 1 (1898) 96. — *Dryopteris distans* v. A. v. R., Handb. (1908) 496, *p. p.* — *Dryopteris brunnea* (Wall.) C. Chr., *nom. nud.*; Backer & Posth., Varenfl. Java (1939) 46, *p. p.* — *Thelypteris brunnea sensu* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 74, *p. p.*; Holttum, Rev. Fl. Mal. 2 (1954) 240, *p. p.* — *Lastrea pyrrhorhachis* (Kze) Copel., Gen. Fil. (1947) 139, *p. p.*; Fern Fl. Philip. (1960) 330, *p. p.*

Caudex apparently erect, bearing tufted stipes which are ± reddish. *Frond*, including stipe, to more than 200 cm long; 2—4 pairs of lower pinnae gradually reduced; *largest pinnae* commonly more than 20 cm long (to at least 35 cm), bearing broadly adnate segments or pinnules 2.5—4 cm long which are usually contiguous (if spaced, connected by a narrow wing along pinna-rachis), costules 10—12(—15) mm apart; basal pinna-segments or pinnules largest, but basal basiscopic ones not greatly longer than next; lower surface of pinna-rachis, costae, costules, and veins bearing slender, spreading, unicellular hairs almost 1 mm long. *Sori* round or slightly elongate, sporangia usually not setose (none are setose on Blume's type specimen, though he records setae present). *Small plants*, with largest pinnae 8.5 × 2.5 cm, may be fertile.

Distribution: apparently throughout Malesia, including Philippines and New Guinea, on mountains at about 1200—2500 m; but good specimens are few, and field observations are needed to decide whether the small fertile plants are young stages or belong to a distinct species.

The Malesian plants here assigned are very similar to Indian ones separated as *P. pyrrhorhachis* (no. 20) but certainly attain a larger size than any I have seen from India. For a note on the epithet *brunnea*, see *P. pyrrhorhachis*.

In most cases where a habitat is recorded, it is by streams. I first found the species in Malaya by a stream in a forest clearing (made a few years previously) at 5000 ft. Mrs Molesworth Allen records it as occurring in grassy places in full sun, and also as common by streamsides in shade (Gard. Bull. Singap. 17: 260. 1959). Blume's original locality appears to have been an open swamp, but Backer & Posthumus give the habitat in terms much as Mrs Allen. In New Guinea I found a plant at 7000 ft on the edge of forest, by a logging trail. In Malaya the species is spreading at hill stations where forest is cleared.

MALAYA. *Molesworth-Allen 2259*, Fraser's Hill (sterile), *2511* (fertile).

JAVA. *Zollinger 1579*; *de Vriese 550*; *Surbeck 1190*, Siboeatan-suid, 1650 m; *Elbert 116*, Res. Madioen, 2300—2600 m; *Raciborski s.n.*, Kandang Badak; *Matthew s.n.*, Kandang Badak, 2600 m, open space in forest; *Mousset 84*, Kletak 1500 m (small, sterile); *Mousset in Rosenst. Fil. Jav. Exsic. 132* (larger, sterile); *Matthew*, 17 Dec. 1912, Gedeh, 1400 m (small, fertile).

PHILIPPINES. *Loher 860*, N. Luzon, Mt Tonglon (small, fertile).
NEW GUINEA. *Brass 22889*, Papua, Mt Dayman 2230—2250 m; *Millar & Holttum NGF 18608*, NE. New Guinea, Western Highlands, 2300 m.

20. Pseudophegopteris pyrrhorhachis (Kze) Ching, Acta Phytotax. Sinica 8 (1963) 315. — *Polypodium pyrrhorhachis* Kze, Linnaea 24 (1851) 257. — *Lastrea pyrrhorhachis* Copel., Gen. Fil. (1947) 139. — Type: *Weigle-Schaeffer 6*, Nilgiris (not seen).

Polypodium distans Don, Prodr. Fl. Nepal (1825) 2, *nom. illeg.*, *non* Kaulf. 1824; Baker, Syn. Fil. (1867) 308, *p. p.*; Clarke, Trans. Linn. Soc. II Bot. 1 (1880) 544, *p. p.* — *Phegopteris distans* (Don) Mett., Farngatt. IV (1858) 16; Bedd., Handb. (1883) 292. — Type: *Wallich s.n.*, Nepal (not found in BM).

Polypodium griffithii Hook., Spec. Fil. 4 (1862) 236. Lectotype: *Griffith*, Mishmee (K).

Nephrodium microstegium Hook., Spec. Fil. 4 (1862) 119, t. 250. — *Lastrea microstegia* Bedd., Ferns Brit. India (1865) t. 39. — Type: *Hk. fil. & Thomson*, Khasya (K).

Polypodium paludosum (*non* Bl.) Bedd., Ferns S. India (1863) t. 168. — *Polypodium distans* var. *adnatum* Clarke, Trans. Linn. Soc. II Bot. 1 (1880) 544. — Type: *Wallich* 328 (K).

Polypodium late-repens Trotter & Hope, J. Bombay Nat. Hist. Soc. 12 (1899) 628, t. 14. — *Dryopteris late-repens* C. Chr., Ind. Fil. (1905) 274. — Lectotype: *Trotter 523*, Punjab, Hazara Dist., Thandiana (K).

Polypodium brunneum Wall. Cat. no. 333 (*nom. nud.*). — *Dryopteris brunnea* C. Chr., Ind. Fil. (1905) 255 (*nom. nud.*). — *Thelypteris brunnea* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 269 (*nom. nud.*), including var. *glabrata* (not *P. distans* var. *glabratum* Clarke).

Rhizome suberect, or short-creeping, 5—7 mm diam. when dried, with stipe-bases 1—3 cm apart; *stipe* 20—60 cm long, stramineous or slightly flushed with red in distal part; *lamina* 50—75 cm long, 20—30 cm wide at widest part, 2—4 pairs of lower pinnae gradually reduced (degree of reduction very varied, lowest pinnae sometimes 4 cm or less long, sometimes over 10 cm); *pinnae* 20—30 pairs, ± oblique, longest 15—20 cm long, 2—4 cm wide, pinnatifid almost to costa; costules 5—7 mm apart; segments with broad bases which are contiguous or almost so, commonly 1.5—2.0(—2.5) cm long, crenately lobed or pinnatifid half-way to costule, veins in lobes forked or paucipinnate; lower surface of pinna-rachis and costules bearing spreading hairs often much less than 1 mm long, with shorter hairs on veins and some slender erect hairs on surfaces between veins. *Sori* on acroscopic branch of a forked vein, near its apex, round or running a little along the vein; sporangia not setose; spores with a slight superficial reticulum (*Stewart 21174*, Mussourie).

Distribution: India & Ceylon, W. China, Tonkin. Several specimens were collected in wet ground near streams, as noted by Hope, l.c.

Var. **glabrata** (Clarke) Holttum, *stat. nov.* — *Polypodium distans* var. *glabratum* Clarke, Trans. Linn. Soc. II Bot. 1 (1880) 544. — Type: *Clarke 9824*, Yaklu, Sikkim, 10,000 ft (K). (Not *Thelypteris brunnea* var. *glabrata sensu* Ching l.c. *supra*).

Pinna-rachis and costae of pinnules beneath bearing very short capitate hairs, not acicular hairs.

I have reduced *Polypodium late-repens* (described from N. India) to Kunze's species (described from S. India) as, like Ching (1936) I can see no distinction between specimens lacking rhizomes; and those with rhizomes are few. I am inclined to think that young plants (which may be fertile from an early stage) usually have a short rhizome, and such have been more usually collected. The rhizome on specimens at Kew labelled *P. late-repens* by Hope is up to 10 cm long, with stipe-bases quite close together; a similar though

shorter piece of rhizome is attached to a Ceylon specimen. It seems possible that the extent of creeping and spacing of fronds may be due to conditions of soil or of light (presence of other vegetation).

I have not seen the type of *P. distans* Don, a later homonym, but Baker's use of the name is clear from specimens at Kew. *N. microstegium* Hook. was based on a young frond which certainly lacks indusia, although Hooker stated that very small ones were present (the artist showed exindusiate sori on the plate). The specific epithet *brunnea*, taken up by Christensen in *Index Filicum* and subsequently used by Ching, Backer and Posthumus, and Holttum, was never validly published; even Ching in 1936 published no description with it.

DOUBTFUL SPECIES

Polypodium riedleana Gaud. in Freyc., Voy. Bot. (1827) 327. — *Dryopteris riedleana* v. A. v. R., Handb. (1908) 230. — Type: *Gaudichaud*, Timor.

This is described as having lower pinnae gradually reduced, stipe and rachis dark red, glossy though pubescent, basal lobes of each pinna larger than next, indusia 'presque diaphanes, tres-peu visibles, velues'. No dimensions are given, and the venation is not described.

It seems possible that this is a species of *Pseudophegopteris* with strongly setose sporangia.

MACROTHELYPTERIS

(H. Ito) Ching, Acta Phytotax. Sinica 8 (1963) 308. — *Thelypteris group* 10 Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 248. — *Thelypteris* sect. *Macrothelypteris* H. Ito in Nakai & Honda, Nov. Fl. Jap. no. 4 (1939) 141; Iwatsuki, Acta Phytotax. Geobot. 18 (1960) 155. — *Thelypteris* subg. *Thelypteris* sect. *Metathelypteris* Iwatsuki, Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 145, *p. p.*

Caudex short, creeping or suberect. *Fronds* bipinnate-tripinnatifid with ± adnate pinnules; lowest pinnae little smaller than next; *scales* at base of stipe narrow, ± thickened at least near base, with some marginal hairs and also superficial hairs which are acicular or capitate; scales on rachis often with thickened base, sometimes with marginal hairs, always with an acicular hair-tip; *hairs* on surfaces of frond slender, acicular, or short and capitate, or both, some long, slender, multicellular hairs always present; *veins* in lobes of pinnae pinnate, veinlets usually forked, not reaching margin. *Sori* always small, mostly with a small but persistent indusium often hidden by the mature sporangia (indusium lacking in *M. ornata*), not terminal on the veins; sporangia usually bearing short capitate hairs near annulus; spores with a ± winged perispore, lacking a raised reticulum of the kind characteristic of *Pseudophegopteris*.

Type species: *Polystichum torresianum* Gaud.

Distribution: Mascarene Islands; warmer parts of mainland Asia, Malesia, NE. Australia, islands of the Pacific (including Hawaii); *M. torresiana* is adventive in tropical and subtropical America.

Ito specified *Nephrodium oligophlebium* Baker as type of his section *Macrothelypteris*, and Ching cited the same species when raising the section to generic rank; but Ching wrote 'this is certainly a bad choice', and stated that *torresiana* would be a much better type. Subsequently Iwatsuki reduced *oligophlebia* to varietal status (as var. *calvata*) under *torresiana*, and that status is here accepted, pending further study of *oligophlebia* in China.

Macrothelypteris shares with *Pseudophegopteris* the character of amply branched fronds having adnate ultimate leaflets, and also a base chromosome number 31 (observed only

in *M. torresiana*). *Thelypteris beddomei* also has the number 31, and slender septate hairs on lower surfaces of its small axes; but it appears to be related to *T. glanduligera* (Kze) Ching, of China and Japan, type of Ching's genus *Parathelypteris*. Thus there appear to be at least three groups of species having a base number 31; and certainly there are more than three having the number 36.

Thelypteris hattorii (H. Ito) Tagawa approaches *M. torresiana* in its bipinnate fronds with pinnules adnate to pinna-rachis. But I think it is related to *T. flaccida* (Bl.) Ching, a species placed by Ching in his genus *Metathelypteris*. *T. hattorii* and *T. flaccida* have a similar distribution of pubescence; they agree also (with other species placed in *Metathelypteris*) in having very small residual scales on the frond-axes and in lacking multiseptate hairs. The chromosome number of *T. flaccida* is 35; also that of the related Malesian species *T. singalanensis* (Bak.) Ching. Examination of the cytology of *T. hattorii* would be a further test of its relationship.

KEY TO THE SPECIES

1. Rachises and lower surface of axes of pinnules lacking scales.
   2. Lowest pinnae *c.* 7 × 2.5 cm . . . . . **1. M. changshaensis**
   2. Lowest pinnae much longer.
      3. Pinnules at right angles to pinna-rachis; pinnule-lobes at right angles to costa.
         4. Pinnules contiguous. Yunnan . . . . . **2. M. contingens**
         4. Pinnules widely spaced. Japan . . . . . **3. M. viridifrons**
      3. Pinnules distinctly oblique to pinna-rachis; pinnule-lobes oblique.
         5. Many slender septate hairs on lower surfaces of frond.
            6. Lowest pinnae largest; stipe castaneous . . . . . **4. M. ogasawarensis**
            6. Lowest pinnae somewhat reduced; stipes glaucous . . . . . **5. M. torresiana**
         5. Few slender hairs, mostly unicellular, on lower surfaces . . **M. torresiana** var. **calvata**
1. Rachis, pinna-rachis, and axes of pinnules scaly on lower surface.
   7. Scales on main rachis sparse (rachis almost smooth); scales on pinna-rachis copiously ciliate. **6. M. polypodioides**
   7. Scales on main rachis abundant, with conspicuously thickened bases; scales on pinna-rachis not or little ciliate.
      8. Basal scales thin (crumpled when dried); scales on rest of stipe and rachises flat above the terete base.
         9. Exindusiate; fronds to 4½ m or more long . . . . . **7. M. ornata**
         9. Indusiate; fronds smaller . . . . . **8. M. setigera**
      8. Basal scales rigid with inflexed edges; scales on rest of stipe and on rachises almost entirely terete. **9. M. multiseta**

1. Macrothelypteris changshaensis Ching, Acta Phytotax. Sinica 8 (1963) 311. — Type: *C. K. Chang 51*, near Changsha, Hunan (PE, not seen).

Ching's description is very brief: fronds broadly lanceolate, with lowest pinnae only 7 × 2.5 cm. I wonder whether this could be related to *Thelypteris flaccida* (Bl.) Ching (*Metathelypteris* Ching, 1963) rather than to the other species here included in *Macrothelypteris*.

2. Macrothelypteris contingens Ching, Acta Phytotax. Sinica 8 (1963) 310. — Type: *Yunnan Complex Exped. 7303* (PE, not seen).

This is described as like *M. torresiana* but smaller, thinner, and more finely divided, with pinnae, pinnules, and pinnule-segments at right angles to the larger axes bearing them.

3. Macrothelypteris viridifrons (Tagawa) Ching, Acta Phytotax. Sinica 8 (1963) 310. — *Dryopteris elegans* var. *subtripinnata* Tagawa, Acta Phytotax. Geobot. 2 (1933) 193. — *Thelypteris viridifrons* Tagawa, J. Jap. Bot. 12 (1936) 747; K. Iwats., Mem. Coll.

Sci. Univ. Kyoto B, 31 (1965) 155. — *Thelypteris oligophlebia* var. *subtripinnata* H. Ito in Nakai & Honda, Nov. Fl. Jap. pt 4 (1939) 144. — *Lastrea viridifrons* Tagawa, Acta Phytotax. Geobot. 15 (1953) 14; Col. Ill. Jap. Pterid. (1962) fig. 244. — *Lastrea oligophlebia* var. *subtripinnata* Ohwi, Fl. Jap. Pterid. (1957) 100. — Type: *Tagawa 531*, Honshu, near Uzi, Prov. Yamasiro (KYO, not seen).

Differs from *M. torresiana* as follows: fronds obligately dying in winter season; stipes green (not glaucous), basal scales few; lowest primary pinnae long-stalked; pinnules more widely spaced, their segments well separated and almost at right angles to costa; sporangia lacking hairs.

Distribution: Japan.

I have seen living plants in cultivation at Kew, raised from spores received from Japan.

4. Macrothelypteris ogasawarensis (Nakai) Holttum, *comb. nov.* — *Dryopteris ogasawarensis* Nakai, Bot. Mag. Tokyo 43 (1929) 2; H. Ito, Bot. Mag. Tokyo 49 (1935) 433, 436, fig. 8. — *Thelypteris ogasawarensis* H. Ito in Nakai & Honda, Nov. Fl. Jap. pt 4 (1939) 144; K. Iwats., Acta Phytotax. Geobot. 18 (1960) 159; Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 154. — Type: *Nakai*, Kita Iwo Isl. (TI, not seen).

Differs from *M. torresiana* as follows: fronds, large, quadripinnate, triangular in outline with lowest pinnae longest; stipe faintly castaneous, glossy, not glaucous.

Distribution: Bonin Islands.

I am indebted to Dr Iwatsuki for the above information about this species, of which I have seen no specimens.

5. Macrothelypteris torresiana (Gaud.) Ching, Acta Phytotax. Sinica 8 (1963) 310. — *Polystichum torresianum* Gaud. in Freyc., Voy Bot. (1824) 333. — *Thelypteris torresiana* Alston, Lilloa 30 (1960) 111; K. Iwats., Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 151, 153. — Type: *Gaudichaud*, Mariana Isl. (P).

Aspidium uliginosum Kunze, Linnaea 20 (1847) 6. — *Dryopteris uliginosa* C. Chr., Ind. Fil. Suppl. III (1934) 100; Backer & Posth., Varenfl. Java (1939) 42, *p. p.* — *Thelypteris uliginosa* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 342; Holttum, Rev. Fl. Malaya 2 (1954) 241. — Type: cult. Hort. Bot. Leipzig, origin Java (not seen).

Polypodium nemorale Brack. in Wilkes, U.S. Expl. Exped. 16 (1854) 16, *nom. illeg.*, *non* Salisb. — Type: *Brackenridge*, Samoa (US, dupl. K).

Polypodium tenericaule Hook. in J. Bot. Kew Misc. 9 (1857) 353. — *Lastrea tenericaulis* Moore, Ind. Fil. (1858) 99; Bedd., Handb. (1883) 266; Tagawa, Index Pterid. Jap. (1959) 223. — *Nephrodium tenericaule* Hook., Spec. Fil. 4 (1862) 142, *p. p.*, excl. t. 269. — Type: *Alexander*, China (K).

Nephrodium setigerum (Bl.) Hook. & Bak., Syn. Fil. (1867) 284, *p. p.* — *Aspidium setigerum* (*non* Bl.) Racib., Fl. Buitenz. 1 (1898) 176. — *Dryopteris setigera* (Bl.) C. Chr., Ind. Fil. (1905) 292, *p. p.*; v. A. v. R., Handb. (1908) 202, *p. p.*; C. Chr., Gard. Bull. S. S. 7 (1934) 243.

Polypodium fragile Bak., J. Linn. Soc. Bot. 16 (1877) 203' — *Nephrodium fragile* Bak., Ann. Bot. 5 (1891) 322. — *Dryopteris fragilis* C. Chr., Ind. Fil. (1905) 266; Dansk. Bot. Ark. 7 (1932) 47, pl. 10, fig. 4—7. — Type: *H. Gilpin*, Madagascar (K).

Dryopteris lasiocarpa Hayata, J. Coll. Sci. Univ. Tokyo 30 (1911) 417. — *Thelypteris oligophlebia* var. *lasiocarpa* H. Ito in Nakai & Honda, Nov. Fl. Jap. pt 4 (1939) 144. — Type: *Nakahara 994*, Formosa (TI, not seen).

Dryopteris setigera var. *pallida* v. A. v. R., Handb. (1908) 203; Bull. Jard. Bot. Btzg II, 11 (1913) 11; Handb. Suppl. (1917) 169. — Type: not specified (BO).

Dryopteris trichodes Rosenst., Meded. Rijksherb. Leiden 31 (1917) 6, *p. p.* — Type: see note below.

Caudex short-creeping; *stipes* to 50 cm long, glaucous when living, stramineous when dry (sometimes dark on old fronds), persistent base swollen and fleshy, covered with many narrow dark brown scales bearing many acicular and capitate hairs; rest of stipe and rachis smooth, glabrescent (finely hairy when young). *Lamina* to *c.* 70 × 50 cm, deeply tripinnatifid, with 12—15 pairs of free pinnae, sub-basal ones longest; *largest pinnae c.* 20 × 9 cm, deltoid, pinnate with all pinnules but the lowest ± adnate to a narrowly green-winged pinna-rachis; *pinnules* distinctly oblique to pinna-rachis, lowest ones of basal pinnae reduced but of upper pinnae not so, largest 5—8 × 1.5—2.5 cm, acuminate, cut almost to costa into oblique dentate to deeply lobed segments 2½—4 mm wide, basiscopic basal (largest) segment to 12 mm long; costae and costules beneath clothed with scattered, pale, stiff, slender hairs, some multicellular and over 1 mm long; whole lower surface of lamina bearing short, erect, unicellular, capitate hairs which are usually not conspicuously yellow; upper surface of pinna-rachis and costae raised, with copious antrorse hairs; *veins* in largest segments 7—12 pairs, forked or pinnate, distal part of each vein thickened. *Sori* round, indusia very small bearing a few capitate hairs; sporangia each with 2—3 short capitate hairs near annulus; spores pale, with irregular wings somewhat anastomosing, the wings apparently with reticulate thickening.

Distribution: Mascarene Islands; warmer parts of mainland Asia and Japan; Malesia; NE. Australia, Polynesia, Hawaii; adventive at various places in the New World from Florida southwards; in fairly open places, not in deep shade, tolerating a rather pronounced dry season but evergreen in Malaya.

This species differs from those following in the absence, on mature fronds such as are usually preserved in a herbarium, of detectable transitions between the brown scales of the stipe-base and the slender hyaline septate hairs on the lamina. But on young developing fronds one can find small scales which are brown distally with hyaline basal cells; these show the intermediate condition. They are closely matched by scales on fronds of *Phegopteris connectilis* in which the basal part is hyaline and the distal part brown; in *P. connectilis* every stage of transition from brown scales to completely hyaline ones and to hairs can be seen, but the intermediate stages in *M. torresiana* are very soon lost by the developing frond.

Polypodium fragile Bak. was described from a small specimen. I think it is only a stunted form of the present species (which is known from other, well-developed, specimens from the Mascarene Islands). It lacks septate hairs, but has indusia and spores as in *M. torresiana*.

Rosenstock's brief description under the name *Dryopteris trichodes* was the first associated with that specific epithet, which when used by several previous authors was always part of a *nomen nudum*. After the description Rosenstock cited *Cuming 1* (Philippines), most specimens of which are *M. polypodioides* (no. 6) though one at BM is *M. torresiana*, and *Zollinger 354* (Java) which is *M. torresiana*.

Cytology: *M. torresiana* (under the name *Thelypteris uliginosa*) has several times been reported as tetraploid, in India, Ceylon, and Singapore, and once as hexaploid in Ceylon.

Var. **calvata** (Bak.) Holttum, *stat. nov.* — *Nephrodium setigerum* var. *calvatum* Bak., Journ. Bot. 13 (1875) 201. — *Thelypteris uliginosa* var. *calvata* K. Iwats., Acta Phytotax. Geobot. 18 (1960) 158. — *T. torresiana* var. *calvata* K. Iwats., Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 154. — Type: *Shearer s. n.*, 1873, Kiukiang (K).

Nephrodium oligophlebium Bak., Journ. Bot. 13 (1875) 291. — *Aspidium oligophlebium*

Chr., Bull. Herb. Boiss. II, 4 (1904) 616. — *Dryopteris oligophlebia* C. Chr., Ind. Fil. (1905) 280. — *Thelypteris oligophlebia* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 339. — *Macrothelypteris oligophlebia* Ching, Acta Phytotax. Sinica 8 (1963) 309. — Type: *Quekett s.n.*, 1873—4, Kiangsi (K).

Hypolepis punctata var. *henryi* Chr., Mém. Soc. Bot. France 1, Mém. 1 (1905) 61. — Type: *Henry* 2154, Ichang (P, dupl. K).

Dryopteris elegans Koidz., Bot. Mag. Tokyo 38 (1924) 108. — *Thelypteris oligophlebia* var. *elegans* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 339. — *Lastrea oligophlebia* var. *elegans* Tagawa, Index Pterid. Jap. (1959) 222. — *Thelypteris uliginosa* var. *elegans* K. Iwats., Acta Phytotax. Geobot. 18 (1960) 158. — *Macrothelypteris oligophlebia* var. *elegans* Ching, Acta Phytotax. Sinica 8 (1963) 309. — Type: *Kimura*, Kiusiu (TI, not seen).

The types of *N. setigerum* var. *calvatum* Bak. and *Hypolepis punctata* var. *henryi* Chr. are well-developed fertile fronds, differing from typical *M. torresiana* in having comparatively few and shorter hairs on the lower surfaces, hairs of two cells being rare; the small indusia appear glabrous but some perhaps have a few capitate hairs. Specimens at Kew agreeing with these two types are: *C. S. Fan & Y. Y. Li 129*, Anhwei Prov.; *Henry 3061*, Nan-T'o; *Silvestri s.n.*, Sept. 1917, Hu-pé, Mt Triora; *Taquet s.n.*, Sept. 1908, Quelpaert Isl. Korea (*Rosenst. Fil. Kor. Exsic. 8*); *Steward 9797*, Honan Prov.; *Faber s.n.*, Aug. 1885, Ningpo Mts.

The type of *N. oligophlebium* Bak. is a small frond (pinnae to 13 cm long) with a few young sori having glabrous indusia; it has very few hairs on the lower surface. I am not sure whether it should be placed here. If it represents a distinct species, more and better specimens are needed to characterize the species clearly.

6. Macrothelypteris polypodioides (Hook.) Holttum, *comb. nov.* — *Alsophila polypodioides* Hook. in Nightingale, Oceanic Sketches (1835) 131. — Type: *Nightingale*, S. Sea Islands (K).

Lastrea leucolepis Presl, Epim. Bot. (1851) 39; Copel., Fern Fl. Philip. (1960) 332. — *Aspidium leucolepis* Fée, Gen. Fil. (1852) 292. — *Dryopteris leucolepis* Maxon, Proc. Biol. Soc. Wash. 36 (1923) 172; C. Chr., Ind. Fil. Suppl. III (1934) 255. — *Thelypteris leucolepis* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 345. — *Macrothelypteris leucolepis* Ching, Acta Phytotax. Sinica 8 (1963) 309. — Type: *Cuming 114*, Luzon (PR, dupl. K, BM).

Polypodium pallidum Brack. in Wilkes, U.S. Expl. Exp. 16 (1854) 18; Hook., Spec. Fil. 4 (1862) 266. — Type: *Brackenridge*, Tahiti (US, dupl. K).

Nephrodium tenericaule Hook., Spec. Fil. 4 (1862) 142, *p. p.*, excl. t. 269. — *Cheilanthes gigantea* Cesati, Rend. Ac. Sci. Nap. 16 (1877) 25, 29. — *Polypodium cheilanthoides* Bak. in Beccari, Malesia 3 (1886) 45 (new name for *C. gigantea* Cesati, not *P. giganteum* Desv.). — *Dryopteris brunneo-villosa* C. Chr., Ind. Fil. (1905) 255 [not *D. gigantea* (Mett.) C. Chr. *nec D. cheilanthoides* (Kze) C. Chr.]. — *Phegopteris cheilanthoides* v. A. v. R., Handb. (1908) 494. — Type: *Beccari*, Mt Arfak, New Guinea (FI, dupl. K).

Dryopteris trichodes Rosenst., Meded. Rijksherb. Leiden 31 (1917) 6, *p. p.*

Rhizome short, prostrate, with ascending apex; *stipe* to 80 cm long, pale, dull, basal half at least bearing copious slender hairs and scales; *scales* thin, pale, to 20 mm long, hardly 1 mm wide at base, bearing copious very slender unicellular hairs and sometimes a few of more than one cell, the hairs on surface of scale near its base, distally on edges, base of scales thick and dark, of larger ones flat, of smaller ones terete, leaving warts when scales fall; also on surface of stipe throughout many very short hairs with spherical, pale yellow, glossy tips; in groove some very slender multicellular hairs to 2 mm or more long. *Main rachis* pale, hairy as stipe, with many small warts on lower surface.

Lamina 80 cm long; basal 2—3 pairs of pinnae to 35 × 15 cm, upper ones gradually shorter; basal pinnules of lower pinnae somewhat reduced; pinna-rachis hairy above as main rachis, beneath with narrow pale scales to 3 mm long and ¼ mm wide bearing spreading slender marginal hairs, bases only of scales thickened and persisting as small warts; *largest pinnules* sessile, *c.* 10 × 2.5 cm, acuminate, almost at right angles to pinna-rachis, apparently pinnate but the leaflets (segments) all with broad bases connected by a very narrow wing along costa; upper surface of costae densely hairy, of costules sparsely; costa beneath bearing very narrow pale scales with long hair-tips, marginal hairs present on their wider basal part, these scales grading to slender multicellular hairs, short capitate hairs also present; *lamin i-segments* almost at right angles to costa, larger ones deeply lobed, veins forked or paucipinnate in the lobes, lamina beneath bearing capitate hairs. *Sori* small, on acroscopic branch of a vein; indusium small, persistent, bearing many short capitate hairs; sporangia bearing 2—3 similar capitate hairs near annulus; spores not winged, surface apparently minutely and irregularly granular.

Distribution: Thailand, Taiwan, Philippines, New Guinea, Queensland, Cook Isl, Fiji, Samoa, Tahiti, Rapa, Austral Isl; at low altitudes (to 700 m), on edges of forest.

Hooker (1862, p. 142) cited Nightingale's specimen under *Nephrodium tenericaule* but not the original name, which was thus overlooked by later authors. The only information on the sheet regarding locality of origin is 'South Sea Islands', but in 1862 Hooker stated Society Islands. A recent excellent collection is *Sledge 1717*, Samoa, Savaii, in scrub in crater of Mt Matavanu, 700 m.

7. Macrothelypteris ornata (Wall. *ex* Bedd.) Ching, Acta Phytotax. Sinica 8 (1963) 309. — *Polypodium ornatum* Wall. *ex* Bedd., Ferns Brit. India (1864) t. 171; Clarke, Trans. Linn. Soc. II Bot. 1 (1880) 545; Hope, J. Bombay Nat. Hist. Soc. 15 (1903) 81. — *Phegopteris ornata* J. Sm., Hist. Fil. (1875) 233; Bedd., Handb. Ferns Br. India (1883) 294. — *Dryopteris ornata* C. Chr., Ind. Fil. (1905) 281; Contr. U.S. Nat. Herb. 26 (1931) 276. — *Thelypteris ornata* Ching, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 276. — Type: *Beddome s.n.*, Wynad, Nilgiris, 3000 ft (K).

Nephrodium tenericaule Hook., Spec. Fil. 4 (1862) t. 269 (*excl. descr. et syn. plur.* p. 142).

Frond, including stipe, to 4½ m or more tall (Beddome). *Stipe* at first scaly throughout, densely so near base, later verrucose from thick persistent bases of scales suffused with dull red; *scales* thin, light brown, to 15 × 1 mm, copiously hairy on edges and on surfaces (at least near base); *rachis* more sparsely scaly, scales mostly persistent, much smaller than on stipe, glabrous with conspicuously thickened bases. *Largest pinnae* to *c.* 65 × 25 cm; pinna-rachis stramineous, bearing scattered glabrous, brown, flat scales 3 mm long with thickened bases; pinnules 2½—3 cm apart, to 15 × 3 cm, slightly oblique, acuminate; leaflets of 3rd order at right angles and well spaced along pinnules but adnate to a distinct green wing on pinnule-axis, deeply lobed, veins pinnate in the lobes; on lower surface of axes of pinnules a transition from very narrow scales with thick bases to multiseptate hairs, also slender unicellular hairs and short capitate hairs; on lower surface of costules of tertiary leaflets slender hairs, some of more than one cell; on raised upper surface of pinna-rachis and axes of pinnules copious antrorse hairs. *Sori* 1—3 to each segment of a tertiary leaflet, often filling its basal part, exindusiate; sporangia usually bearing short capitate hairs; spores narrowly winged, sometimes with irregular transverse wings.

Distribution: mountains of southern and NE. India and N. Burma.

Beddome gave the first description of this species, and described it from his own specimens, though using Wallich's name; I therefore regard Beddome's specimen as type, not Wallich's. Hooker confused several species under the name *Nephrodium*

tenericaule, but his tab. 269 was prepared from a specimen of *M. ornata* collected by J. D. Hooker in Sikkim; the specimen is exindusiate, and is so shown in the plate.

8. Macrothelypteris setigera (Bl.) Ching, Acta Phytotax. Sinica 8 (1963) 309. — *Cheilanthes setigera* Bl., Enum. Pl. Jav. (1828) 138. — *Hypolepis setigera* Hook., Spec. Fil. 2 (1852) 62. — *Nephrodium setigerum* Hook., Syn. Fil. (1867) 284. — *Aspidium setigerum* Kuhn, Verh. Zool. Bot. Ges. 19 (1869) 578. — *Dryopteris setigera* O. Ktze, Rev. Gen. Pl. 2 (1891) 813; v. A. v. R., Handb. (1908) 202, *p. p.*; Suppl. (1917) 169, excl. var. *pallida*; Backer & Posth., Varenfl. Java (1939) 337, *p. p.* — *Thelypteris setigera* (Bl.) Ching, Bull. Fan Mem. Inst. Biol. Bot 6 (1936) 345. — Type: *Blume*, Java (L no. 908 . 337—1168).

Cheilanthes stenophylla Kunze, Bot. Zeit. 6 (1848) 212. — Type: *Zollinger 2675*, Java (L).

Aspidium vile (*non* Kze) Racib., Fl. Buitenz. 1 (1898) 173. — *Dryopteris backeri* v. A. v. R., Bull. Dep. Agr. Ind. Neerl. 18 (1908) 8; Ibid. 21: 3; Handb. (1908) 817; Suppl. (1917) 169, 171. — Type: *Backer*, Krakatau (BO, not seen).

Dryopteris uliginosa sensu Backer & Posth., Varenfl. Java (1939) 42, *p. p.*

Caudex erect or suberect; *stipes* to at least 80 cm long, slightly reddish when dry, green when living, densely covered at base with thin light brown scales to 20 mm long, less than 1 mm wide, their edges and surfaces sparsely hairy, also with copious very slender pale hairs, rest of stipe more sparsely scaly and hairy, scales mostly under 10 mm long and ½ mm wide, thin, with sparse marginal hairs and thickened bases which form small warts of irregular shape when scales are shed; *main rachis* bearing many persistent, pale, entire, hair-pointed scales of which the lower part is terete (not flat), edges rarely with slender hairs. *Lowest pinnae* slightly reduced; *largest pinnae* to 30 × 12 cm; pinna-rachis pale, narrowly winged throughout, bearing on lower surface many very narrow, persistent, hair-pointed, pale scales 2—3(—5) mm long with prominent thickened bases, with or without a few marginal hairs; *pinnules* to 10 × 2.5 cm, lobed almost to costa, segments slightly oblique, lobed less than half-way to costule, veins forked in the lobes, costae beneath bearing very narrow, pale, hair-pointed scales as pinna-rachis and multiseptate hairs, costules bearing slender hairs, some of several cells, all surfaces beneath bearing short capitate hairs. *Sori* small, with small indusia bearing hairs; sporangia bearing capitate hairs near annulus; spores opaque, with a narrow wing, surface minutely granular or pitted.

Distribution: Sumatra, Java, Lombok, SW. Celebes, Flores, Timor, Ternate; in open places at medium altitudes. Raciborski reported this species as forming extensive thickets with *Gleichenia hispida* on G. Guntur, also on Krakatau Island. Isolated plants in exposed places may be small and also fertile; one such was the type of *Cheilanthes stenophylla* Kze.

M. setigera is intermediate between *M. polypodioides* and *M. multiseta*, both in morphology and distribution. A specimen of doubtful status, rather intermediate between *M. setigera* and *M. multiseta*, is *Zippelius 268*, W. Java, type of *Dryopteris backeri* var. *aspera* v. A. v. R. Handb. 818 (BO, L). Typical specimens are: JAVA. *Backer & Posthumus 564*, Djember, 600 m; *Schimper P251*, Kampong Tjibogen, W. Java, 250 m; *Posthumus 1343*, Bawean Isl., 200 m. SUMATRA. *Lörzing 5779*, Sibolangit, 400 m. CELEBES. *Bünnemeijer 10791*, SW. Celebes, 280 m. SUMBAWA. *Kostermans 18805*, 700 m. FLORES. *Jaag 1720*, 1000 m.

9. Macrothelypteris multiseta (Bak.) Ching, Acta Phytotax. Sinica 8 (1963) 309. — *Nephrodium multisetum* Bak., Journ. Linn. Soc. Bot. 22 (1886) 226. — *Dryopteris multiseta* C. Chr., Ind. Fil. (1905) 279; v. A. v. R., Handb. (1908) 203; Suppl. (1917) 171; C. Chr., Gard. Bull. Str. Settl. 7 (1934) 243. — *Thelypteris multiseta* Ching, Bull. Fan Mem.

Inst. Biol. Bot. 6 (1936) 347. — Type: *G. F. Hose s.n.*, Matang, Sarawak, 610 m (K).

Stipe to at least 70 cm long, reddish when old, near base bearing copious rigid light brown scales *c.* 10 × 1 mm, ± hairy, base thickened, edges inrolled; above base bearing very copious spreading, rigid, persistent, dark, hair-pointed, entire scales 5—7 mm long, hardly ½ mm wide, basal part ± terete, rest flat but more than one cell thick; main rachis similarly and persistently scaly. *Pinnae* commonly to 35 cm long, exceptionally to 50 cm; pinna-rachis pale with darker, spreading, rigid, entire scales which are almost terete throughout; pinnules commonly to 8 × 1.8 cm (to 10 × 2.4 cm), bearing tertiary leaflets connected by a narrow wing; costa beneath bearing terete, entire, rigid, hair-pointed scales as pinna-rachis but smaller; tertiary leaflets all attached by a broad base, commonly lobed half-way to costule,veins forked or paucipinnate in the lobes, costule bearing spreading septate hairs, lower surface of lamina with short capitate hairs. *Sori* one to each lobe of a tertiary leaflet; indusium small, with capitate hairs; sporangia also with similar hairs.

Distribution: North Borneo, Sarawak, Sumatra; in rather open places at 500—1250 m.

Additional specimens: BORNEO. *Holttum 25294*, Kinabalu, 1250 m. SUMATRA. *Matthew s.n.*, 8 Jan. 1914, G. Kerinchi, 920 m.