CHING, Sunyatsenia 5 (1940) 237–240, *excl. Hypodematium* KUNZE & *Parapolystichum* CHING; Acta Phytotax. Sinica 8 (1963) 289–335, *excl. Hypodematium* KUNZE; HOLTTUM, J. Linn. Soc. Bot. 53 (1947) 130; Blumea 19 (1971) 17–52; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 30 (1929) 21–51; 31 (1964) 1–40, (1965) 125–197; PICHI SERMOLLI, Webbia 24 (1970) 709 (first Latin description). — **Fig. 1–20.**

Caudex erect, short-creeping or long-creeping, rarely scandent; vascular structure in all cases a radially symmetrical dictyostele; scales usually thin, not peltate, in almost all cases bearing both marginal and superficial unicellular hairs which are either acicular or glandular. *Vascular strands* at base of stipe 2, linear in section (rarely with an additional pair of small ones), uniting upwards to a U-shape; a linear aerophore with stomata continuous along each side of stipe and rachis. *Fronds* usually pinnate with crenate or lobed pinnae, in a few cases simple or bipinnate, never with basiscopically enlarged basal pinnae; apical lamina usually triangular and lobed, grading into upper pinnae, in some cases pinna-like; lower pinnae in many cases gradually much reduced or with abrupt transition to a series of small rudiments; a small *aerophore*, sometimes swollen or elongate, present at the base of each pinna; a translucent membrane present in the base of each sinus between adjacent pinna-lobes; *venation* in each pinna consisting of a costa bearing costules, each costule bearing pinnately-arranged veins in a pinna-lobe; veins free in deeply lobed pinnae, or basal veins in adjacent lobes anastomosing to form an excurrent vein, which may be joined by other veins, terminating at the base of a sinus-membrane, successive veins passing to the sides of the sinus-membrane where this is elongate. *Indument*: scales always present at base of stipe, gradually smaller upwards, minute (often consisting of a single row of cells) on the distal parts of fronds, often nearly all caducous; adaxial surface of rachis and costae always bearing antrorsely curved acicular unicellular hairs, in a few cases also septate acicular hairs; abaxial surface of rachis and costae usually bearing a different indument consisting of more slender unicellular acicular and/or glandular hairs or sessile glands of various forms (forked hairs in *Ampelopteris* only); surface of lamina between veins either quite glabrous or more often with a distinctive complement of hairs and glands different adaxially and abaxially. *Sori* borne on abaxial surface of veins, orbicular or sometimes elongate, indusiate or not; indusia reniform, glabrous or bearing hairs and/or glands, in some cases very small, athyrioid in some species of *Coryphopteris*; *sporangia* sometimes bearing glands or short acicular hairs (setae) near annulus, often with a hair of distinctive form on the sporangium-stalk; *spores* in almost all cases monolete, with perispore of varied form, in *Trigonospora* trilete. *Gametophyte* in all cases symmetrical-cordate, with unicellular chlorophyllous hairs on all parts, these hairs with ± swollen rounded tips which become wax-encrusted; in most cases, usually as a late development, unicellular acicular hairs, comparable with those on the sporophyte, may occur; other types of hair may be distinctive of some genera.

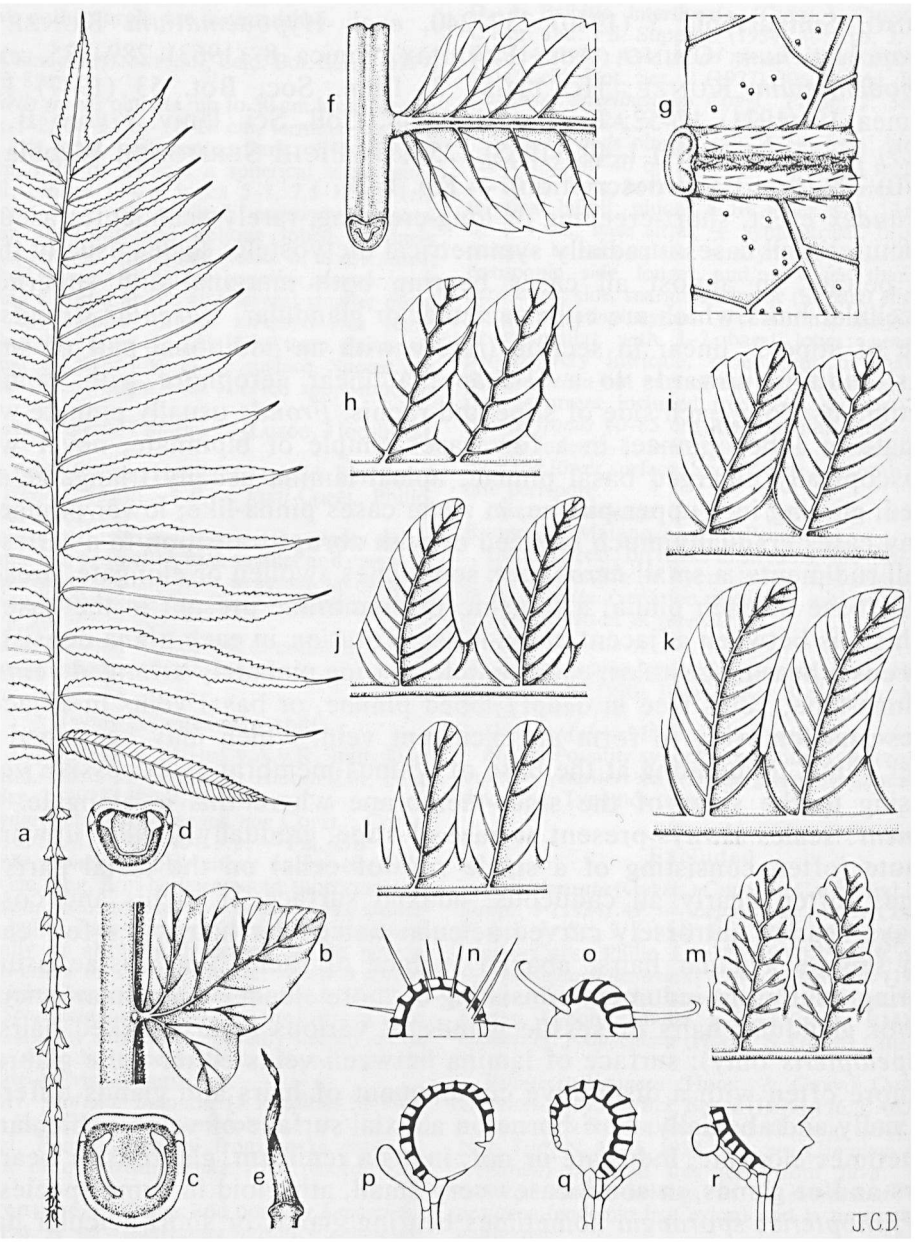

Fig. 1. *Sphaerostephanos penniger* (HOOK.) HOLTTUM. *a.* Whole frond, ×¼; *b.* a reduced pinna showing linear and round aerophores, ×2; *c.* CS base of stipe, ×3; *d.* CS rachis, ×3; *e.* scale, ×6; *f.* rachis and base of pinna, upper surface, ×1½; *g.* part of pinna, upper surface, showing unicellular hairs and glands, ×12. — Venation patterns in relation to sinus-membrane: *h. Sphaerostephanos penniger* (HOOK.) HOLTTUM, ×2; *i. Christella arida* (D. DON) HOLTTUM, ×6: *j. Plesioneuron fulgens* (BRAUSE) HOLTTUM, ×3; *k. Mesophlebion crassifolium* (BL.) HOLTTUM, ×4; *l. Coryphopteris viscosa* (BAK.) HOLTTUM, ×4; *m. Metathelypteris dayi* (BEDD.) HOLTTUM, ×3. — Sporangia, ×33: *n. Pronephrium repandum* (FÉE) HOLTTUM; *o. P. rubicundum* (v.A.v.R.) HOLTTUM; *p. Christella dentata* (FORSSK.) BROWNSEY & JERMY; *q Sphaerostephanos heterocarpus* (BL.) HOLTTUM; *r. Cyclosorus interruptus* (WILLD.) H. ITO.

Distribution. Throughout the tropics, especially in wetter areas; species few in temperate regions (5 in Europe), almost 1000 in all. The majority are terrestrial ferns of forest, but a few (especially in *Christella* and *Macrothelypteris*) occur in open places only, and a few (*Cyclosorus*, *Thelypteris*) in open swamps; some are adapted to grow on rocks by streams; very few are scandent; a few are casually epiphytic.

Fossils. Fossil ferns with veins anastomosing as in this family have been found in Lower Tertiary strata in both Europe and America, but in the absence of information concerning scales, hairs, glands and spores the affinity of such fossils to any existing groups cannot be definitely assessed; the oldest fossil which probably belongs to this family is *Aspidistes thomasii* HARRIS (Yorkshire Jurassic Flora 1, 1951, 181) which has bipinnate or tripinnate fronds with free veins, abundant superficial glands much as in *Coryphopteris* and trilete spores resembling those of *Trigonospora*.

Vegetative morphology. A combination of two characters is distinctive of the family: the arrangement of vascular strands in the stipe (Fig. 1c–d) and the presence of unicellular acicular hairs on the adaxial surface of rachis and costae (Fig. 1g). The only other fern with this combination is *Hypodematium*, which differs greatly in frond-form and in scales. Also distinctive of *Thelypteridaceae* is the frond-form of most species: simply pinnate fronds with most pinnae almost equal in length, each pinna symmetrical on either side of the costa with veins symmetrically arranged in the pinna-lobes. The venation in its relation to sinus-membranes is also unique among ferns.

Distinctions between species are provided by details of venation and of the distribution of hairs and glands (more rarely of scales) on the two surfaces, the abaxial surface in general providing the greater diversity. Maximum size of fronds is also distinctive in many cases, but often plants may be fertile at an immature size.

Dimorphism. In some species sterile fronds have much larger (both longer and broader) pinnae than fertile ones, and in such species transitional forms may occur. In other species there is some irregular dimorphism. In general, sterile fronds often have longer hairs than fertile ones on the lower surface, sometimes much longer ones.

In general the number of veins anastomosing is dependent on the depth of lobing of pinnae, but this situation is complicated by the relative length of the sinus-membrane (Fig. 1h–m). Where the membrane is very short and pinnae shallowly lobed, anastomosing veins from adjacent costules form a zig-zag excurrent vein and only one vein may end in contact with the membrane, but if the membrane is long (forming a prominent fold on the lower surface) only one pair of veins may be united, successive ones passing to the sides of the membrane as if to the edge of a pinna-lobe. These details need to be carefully observed. In rare cases a long membrane may be present with no veins actually united. In other cases (especially on *Pneumatopteris*) a vein passing to the side of a membrane may be continued to join with the vein next above it, thus forming a continuous vein on one side of the membrane and sometimes extending into the pinna-lobe. CHING and IWATSUKI both state that a character of *Abacopteris* FÉE (*Pronephrium* of the present work) is the absence of a sinus-membrane, but such a condition is not invariable even in pinnae which have almost entire margins.

The species with bipinnate fronds have all, or most, of the pinnules adnate to a pinna-rachis (Fig. 2h); this is a contrast to *Cyathea*, with which genus *Thelypteridaceae* have some features in common, and I suggest that it is a secondary development (see below on relationships with other groups). These bipinnate species (in *Macrothelypteris* and *Pseudophegopteris*) also have veins terminating within the margin (Fig. 1m) and adaxial surface of rachises and costae not grooved, both conditions shared by *Metathelypteris* and *Phegopteris*; in all other genera costae are grooved (Fig. 1f–g) and all free veins terminate at the margin.

In some species of several genera the aerophores at pinna-bases are swollen or elongate. CHRISTENSEN united several such tropical American species in a subgenus *Glaphyropteris*, and some species of Asia were also so placed by ITO in Nakai & Honda, Nov. Fl. Japonica, part 4 (1939), but CHING (1963) recognized that the species so named by ITO were neither closely related to each other nor to the American species of CHRISTENSEN.

In most species (apart from *Pronephrium*) the apical lamina of a frond is narrowly to

broadly triangular and ± deeply lobed, with a gradual transition at its base to the upper pinnae. The distal part of such an apical lamina has veins arranged in its lobes as in the lobes of a pinna, but near the base there is a transition from lobes to pinnae, with a transition also in venation. This transition in venation (especially when the terminal lamina is long and narrow) sometimes results in a condition comparable to that of normal pinnae or pinnules of *Pleocnemia* (a genus allied to *Tectaria*). In a few cases this peculiar transitional type of venation also occurs above the base of the apical lamina, and such a case was made the basis of a genus *Haplodictyum* by PRESL; some later authors, including CHING, thought that this venation indicated a real relationship of *Haplodictyum* to *Tectaria*, but certainly the former is a true thelypteroid fern. A fossil from America has also been reported with venation of *Haplodictyum* type (*Goniopteris claiborniana* BERRY, Bull. Torr. Bot. Club 44, 1917, 331, t.22).

Much-reduced pinnae at the base of a frond, usually with an abrupt transition to normal pinnae, occur in the large genera *Sphaerostephanos* (Fig. 1a–b) and *Pneumatopteris*; such a condition is rare in American *Thelypteridaceae*, though in *Amauropelta* lower pinnae are in most cases gradually much reduced. In young living fronds such reduced pinnae are seen to have more or less swollen white aerophores at their bases; in some cases the aerophore is larger than the lamina of the reduced pinna. The number, shape, and spacing of reduced pinnae provide useful distinguishing characters, but unfortunately some dried specimens do not show them fully and in other cases the frond-base is quite lacking. Where very young fronds are covered with mucilage the aerophores are sufficiently elongate for their tips to be free from the mucilage. Swollen aerophores (rarely much elongate) occur also in some genera where basal pinnae are not reduced.

Sori, sporangia and spores. The position of sori on veins is characteristic in each species; in *Chingia* sori are always near costules but within most genera there is much variation. More or less elongate sori occur in several genera, especially in *Stegnogramma* (all species) and *Sphaerostephanos*, but within the latter genus the species with elongate sori do not form a natural group. In some species where indusia are normally very small they are sometimes quite lacking, but in general size and indument of indusia are characteristic. In *Coryphopteris* distal sori sometimes have athyrioid indusia, basal ones rarely.

The form of sporangia and the presence of glands or hairs on them are always important diagnostically (Fig. 1n–r) but these characters are often unrecorded in original descriptions, even of recent publication. I have tried to obtain exact information from type specimens. In *Christella*, *Coryphopteris* and *Metathelypteris* there are neither glands nor hairs near the annulus (but see note under *Christella subpubescens*). Hooked hairs occur on sporangia in *Pronephrium sect. Grypothrix* (Fig. 1o) and in *Cyclogramma*. The sporangia of *Coryphopteris* are almost sessile but in most other members of the family they have slender stalks on some of which are hairs; the nature of these hairs is also distinctive (Fig. 1p–r) but I have not been able to report it for all species.

Spores of all species are covered with a perispore which may have many different external forms (see C. C. WOOD, J. Linn. Soc. Bot. 67, Suppl. I, 1973, 191–202, pl. 1–4); this has only been well observed since the introduction of the scanning electron microscope. The inner structure of spore-walls can only be seen by sectioning and has still been little investigated. LUGARDON has made sections of a representative set of spores; a report on this work will be published separately. It gives some support to the present arrangement but leaves many questions unanswered.

Gametophyte. Apart from the development in some species of acicular hairs, the general characters of gametophytes do not distinguish this family from others; the glandular hairs universally present occur also in other families. Reports have been published by L. R. ATKINSON on species of various genera in the Old World, summarizing also those of earlier authors (Phytomorphology 25, 1975, 38–54) and on *Chingia* (Fern Gaz. 11, 1975, 87–93). Gametophytes of *Mesophlebion crassifolium* have distinctive branched hairs and also spherical red glands resembling those on the stalks of sporangia of sporophytes. Gametophytes of *Chingia sakayensis* have distinctive multicellular hairs. Gametophytes of other genera show differences in the colour of glandular hairs or other less easily specified

characters. Gametophyte characters support the separation of the genera *Plesioneuron* and *Mesophlebion* which I formerly united (HOLTTUM 1971), but in general do not offer much important evidence as to the separation of, or inter-relations between, genera, partly because few species in most genera (as here recognized) have been examined.

Cytology. The first reliable reports on chromosomes were by I. MANTON in her book of 1950. Subsequently many reports have been published, as summarized by LÖVE, LÖVE and PICHI SERMOLLI in their Cytotaxonomical Atlas of the Pteridophyta (1977). Haploid numbers range from 27 to 36; several species are tetraploid and of some both diploid and tetraploid forms have been reported, in the wide-ranging species *Macrothelypteris torresiana* tetraploid and hexaploid. Only a small proportion of species have so far been examined, so that generalizations cannot usefully be made. In all recorded cases species belonging to one genus, as here recognized, have the same chromosome number except that both $n = 35$ and $n = 36$ occur in the genus *Pseudocyclosorus* in India (there is only one Malesian species). Hybridization experiments have only been reported by MANTON and her co-workers in the genus *Christella q.v.* for details.

Taxonomy. The distinguishing characters of this family were not recognized until CHRISTENSEN's study of tropical American species in 1913 (see below); in the 19th century there was much confusion in the use of generic names which were based mainly on soral characters.

LINNAEUS placed the species known to him in *Polypodium* or *Acrostichum*; he did not use characters of indusia in distinguishing genera. The name *Thelypteris* was published by SCHMIDEL in 1763; it has been conserved against *Thelypteris* ADANSON (= *Pteris*) which may have been published earlier in the same year. In 1791 SCHREBER proposed the name *Meniscium* for a species from tropical America having elongate exindusiate sori resembling those of the Malesian species here named *Pronephrium triphyllum*, which was transferred to *Meniscium* by SWARTZ in 1801; other authors followed this assignment but CHRISTENSEN stated his belief that the Malesian and American species in question are not closely related; see further discussion under *Pronephrium*.

In 1800 ROTH published the name *Polystichum* for ferns with either peltate or reniform indusia; these included some *Thelypteridaceae* in addition to *Polystichum aculeatum* (generic type) and species of *Dryopteris* and *Gymnocarpium*. GAUDICHAUD later included some tropical *Thelypteridaceae* in *Polystichum*.

In 1801 SWARTZ published *Aspidium*, with almost the same diagnosis as *Polystichum* ROTH, and included in it, besides *Thelypteridaceae* of several genera here recognized, species now placed in *Tectaria*, *Oleandra*, *Nephrolepis*, *Didymochlaena*, *Polystichum*, *Dryopteris*, *Cystopteris* and *Athyrium*. Also in 1801 CAVANILLES published the name *Tectaria* with a single species (now recognized as type of a non-Thelypteroid genus) but he later included in it a mixture similar to that in *Aspidium* SW. In 1803 MICHAUX published *Nephrodium*, which also included species of many genera now regarded as distinct; see below for confused later usage of this name.

In 1824 BORY published the name *Lastrea* for "la plus grande partie des Polypodes à feuilles bipinnatifides ou bipinnées", citing a few species only; he did not refer to *Aspidium* or *Nephrodium*, though the species he cited could have been placed in either. In 1833 LINK published *Cyclosorus* for the single species which he named *C. gongylodes*; this had previously been included in *Aspidium*, *Nephrodium* and *Polystichum*. BLUME in 1828 included all indusiate *Thelypteridaceae* in *Aspidium*, exindusiate ones in *Meniscium*, *Gymnogramme* and *Polypodium*; he established *Stegnogramma* for a species with elongate exindusiate sori and anastomosing veins.

SCHOTT's 'Genera Filicum', published in 1834, contained twenty beautifully engraved plates showing details of as many genera; these included a plate illustrating *Nephrodium* which showed for the first time with great exactness the unicellular acicular hairs characteristic of all *Thelypteridaceae* (also capitate hairs) and other details now considered significant; he also mentioned the vascular strands in the stipe. His description of the genus and list of species shows that he restricted it to thelypteroid ferns having anastomosing veins and round indusiate sori, none of which were in the original list published by MICHAUX (to

which he did not refer). SCHOTT also recognized *Thelypteris* SCHMIDEL as an allied genus with free veins.

In 1836 appeared PRESL's 'Tentamen Pteridographiae', containing a completely new system of fern genera. He adopted SCHOTT's definition of *Nephrodium* and included most free-veined thelypteroids in *Lastrea*. But in *Lastrea* he also placed species of *Dryopteris*, *Ctenitis* and several other genera now recognized. He retained exindusiate free-veined *Thelypteridaceae* in *Polypodium sect. Phegopteris* (with much admixture of non-thelypteroids), those with anastomosing veins of the *Nephrodium* pattern in *Goniopteris* and those with elongate sori in *Grammitis*. In 'Epimeliae Botanicae' (1851) PRESL proposed the new genera *Haplodictyum*, *Physematium*, *Proferea* and *Pronephrium* for thelypteroid ferns from the Philippines and Java.

W. J. HOOKER devoted the last twenty years of his life to producing 'Species Filicum' (five volumes, 1844–1864). He united all indusiate *Thelypteridaceae* in *Nephrodium*, and with them *Dryopteris*, *Ctenitis* and *Pleocnemia*; he followed PRESL in placing exindusiate species in *Polypodium*, but those with elongate sori in *Gymnogramme* and *Grammitis*.

Simultaneously with HOOKER's work, A. L. A. FÉE produced his 'Genera Filicum' (1852), in which his arrangement is more elaborate. He placed the majority of *Thelypteridaceae* in *Polypodiaceae*, tribe *Aspidieae*. Free-veined indusiate species, mixed with others now allocated to *Dryopteris* and *Ctenitis*, are placed in *Aspidium*; species with anastomosing veins and indusiate sori in *Nephrodium*, *Haplodictyum* and *Abacopteris*; species with round exindusiate sori in tribe *Polypodieae*, genera *Phegopteris* and *Goniopteris*; species with elongate sori in tribe *Meniscieae* and tribe *Leptogrammeae* (with admixture of species now referred to very different groups).

G. METTENIUS, in his 'Fil. Hort. Bot. Lipsiensis' (1856) included both indusiate and exindusiate thelypteroids with free or anastomosing veins in his "tribe" *Aspidiaceae*, separating all exindusiate species as *Phegopteris*, the rest in *Aspidium*. In his monograph of *Phegopteris* and *Aspidium* (1858) he had many non-thelypteroid species in both genera; but in his descriptions he noted characters of hairs, glands and scales with much more care than any previous author except SCHOTT.

JOHN SMITH, who observed more than 1000 species of ferns as cultivated plants, published another classification in 'Historia Filicum' (1875) and in a long introduction commented on previous schemes. He placed almost all thelypteroids in his tribe *Phegopteridiae*, separating indusiate and exindusiate species (the former as *Lastrea* and *Nephrodium*) in much the same way as METTENIUS, but noting that indusia are sometimes very small or fugacious so that separating on this character was often doubtful. Among free-veined ferns named *Lastrea* he had representatives of other genera (as now recognized) but he subdivided *Lastrea* to show some of these differences, as METTENIUS had not done.

R. H. BEDDOME, studying ferns in the field in southern India from 1856 to 1882, used HOOKER'S classification but recognized some of its unsatisfactory features. In his Handbook (1883) and its Supplement (1892) he included also species of the Malay Peninsula, and owing to a lack of critical study of Malesian ferns he sometimes misidentified Indian species with those of Java.

Field work on ferns in Java was undertaken by M. RACIBORSKI in 1897–1898, and the results were published in 'Flore de Buitenzorg, I, Pteridophytes' (1898). This includes much previously unrecorded ecological observation. RACIBORSKI placed free-veined *Thelypteridaceae* in *Aspidium* (with species of *Dryopteris* and *Ctenitis*) and those with anastomosing veins in *Nephrodium*.

H. CHRIST in 1897 attempted a new survey of all ferns ('Die Farnkräuter der Erde'). He followed METTENIUS in placing almost all thelypteroid ferns in *Aspidium* and *Phegopteris*. Subsequently he adopted CHRISTENSEN's concept of *Dryopteris* (see below) and in 1907 his survey of *Dryopteris* in the Philippines was published; his work on the present family was uncritical.

L. DIELS compiled a summary of *Polypodiaceae* for Engler & Prantl's 'Natürlichen Pflanzenfamilien' (I, Abt. 4, 1899). He included all thelypteroid ferns in his tribe *Aspidieae*, almost all of them in *Nephrodium*, uniting indusiate and exindusiate species in one genus for

the first time. He made an elaborate subdivision of *Nephrodium*, with free or anastomosing veins as a main distinction (vascular anatomy, scales, hairs and glands had no part in his system) and did not clearly separate thelypteroid ferns from the rest.

CARL CHRISTENSEN based his 'Index Filicum' (1905) mainly on DIELS but (following OTTO KUNTZE) he adopted the older name *Dryopteris* ADANSON (1763) in place of *Nephrodium*; under it he had the mixture as before. VAN ALDERWERELT VAN ROSENBURGH made a compilation of all recorded taxonomic information on Malesian ferns, with new descriptive data for many species, adopting CHRISTENSEN's scheme (except that he reverted to *Phegopteris* for exindusiate thelypteroids); this was published at Bogor in 1908. In subsequent years he published new descriptions of many species, his later observations being more detailed and critical, but in many cases he misapplied older names. C. A. BACKER & O. POSTHUMUS, in 'Varenflora voor Java' (1939) also adopted CHRISTENSEN's comprehensive *Dryopteris*, without attempting to separate thelypteroid species. Their work includes much new field observation but their citation of synonymy was often uncritical.

Having completed his Index, CHRISTENSEN realized that there was much mixture of unrelated species in his *Dryopteris* and he proceeded to make a detailed study of tropical American species. In the course of this work he distinguished thelypteroid ferns from the rest for the first time (Monograph of the genus *Dryopteris*, Dansk Selsk. Skr. VII, 10, 1913, 55–282; VIII, 6, 1920, 1–132), but he retained all in *Dryopteris*, placing the thelypteroids in subgenera, because he had not studied the Old World species and could not foresee how to fit them into his scheme. In subsequent years CHRISTENSEN made many studies of ferns of the Old World, adding to his knowledge, and in 1929–1932 R. C. CHING worked with him, specializing on the ferns of China and India. CHING wrote an important series of papers in the decade 1930–1940, including monographic treatment of *Thelypteridaceae* in mainland Asia, in the genera *Thelypteris*, *Cyclosorus*, *Abacopteris* and *Leptogramma*. In 1940 he recognized for the first time a family *Thelypteridaceae*. I accepted CHING's scheme, with reservations, in my book 'Ferns of Malaya' (1955).

COPELAND's work on Philippine ferns began in 1904, soon became extended to cover those of neighbouring regions, and culminated in his 'Genera Filicum' (1947) and 'Fern Flora of the Philippines' (1960). In the main, he accepted CHING's genera, but substituted *Lastrea* for *Thelypteris* which he regarded as illegitimate; he did not recognize a family *Thelypteridaceae*, and separated *Thelypteris* from *Cyclosorus* solely on the character of free or anastomosing venation; he regarded *Lastrea* as closely related to *Athyrium*.

In 1963 CHING elaborated his scheme of classification of *Thelypteridaceae* in mainland Asia, recognizing some new genera. K. IWATSUKI made a detailed study of morphology in the family, mainly in Japan and China, and published a new taxonomic survey in 1964–1965, recognizing the three genera *Stegnogramma*, *Thelypteris* (with many subdivisions) and *Meniscium*.

I began a study of all Old World species of the family in 1967, examining the types of almost all species and the complete collections in several major herbaria. I discovered that Malesian species are far more varied than those of mainland Asia, and I thus had a wider field of study than CHING and IWATSUKI. I devised a new scheme of genera which was published in 1971, and subsequently monographs of all Old World species of the major genera except *Sphaerostephanos* which is almost entirely Malesian and is here treated fully for the first time.

My first conclusion (at which I had already hinted in my book of 1955 on the ferns of Malaya) was that a division between *Thelypteris* and *Cyclosorus* based on free or united veins was not a natural one. I also concluded that the nature and distribution of glands and hairs provided important evidence which had never been well recorded. In such a perspective *Thelypteris* and *Cyclosorus*, restricted to their type species and near allies, are small and distinctive groups not closely allied to most of the species associated with them by previous authors. There thus appeared to be two alternatives: to include all species of the family in one genus *Thelypteris*, or to recognize a number of separate genera. I chose the latter because there is such a great diversity in Malesia that within a single genus, to be intelligible,

one would always have to specify a subgeneric or sectional name when citing a species; a specific name alone would not give sufficient information.

In the New World are some other distinctive groups, one of which (*Amauropelta*) extends across Africa to the Mascarene Islands (Holttum, J. S. Afr. Bot. 40, 1974, 130), doubtfully to Ceylon and not to Malesia. The New World genus *Meniscium* is mentioned under the genus *Pronephrium* in the present work. The species of islands in the Pacific Ocean eastwards from New Guinea (about 100) are almost all common to Malesia or related to Malesian species (Allertonia 1, pt 3, 1977).

The result of this long history of confusion is that all names published in the 19th century have been transferred, by one author or another, to *Aspidium*, *Nephrodium* and *Dryopteris*, in some cases also to *Goniopteris*, *Lastrea*, *Meniscium* or *Phegopteris*; and in the 20th century most names have been transferred to *Thelypteris* or *Cyclosorus* or both. In view of the preference by some people for a comprehensive genus *Thelypteris*, I have cited names in that genus if such have been published, and I have tried to avoid the use of new specific epithets where such would have to be changed on transfer to *Thelypteris*.

Few species were originally described in terms which distinguish them clearly from others, with the result that names were often mis-used or new ones needlessly created. Few collectors understood how to distinguish between species of this family and the need for careful preservation of the base of a frond; much herbarium material is therefore in some measure unsatisfactory and new collections by specialists are still needed. Too many species (my own included) are based on a single collection which may not adequately show possible variation; but in many other cases repeated collections show a degree of uniformity which confirms their status. It cannot be doubted that the number of species in Malesia is very large, and that probably more remain to be discovered.

Relationship to other groups. In Journ. Linn. Soc. Bot. 53 (1947) 130–133 I commented on resemblances between *Thelypteridaceae* and *Cyathea*, and listed them more fully in Blumea 19 (1971) 18–19: shape of fronds; shape of leaflets; abundant hairs on adaxial surfaces of rachis quite distinct in nature from scales; arrangement of aerating tissue with a separate small area at the base of each pinna (this area sometimes swollen both in *Cyathea* and in *Thelypteridaceae*); relationship of sori to veins. As *Cyathea* has invariably deeply lobed leaflets and free veins, there is not scope for development of a sinus-membrane, but there is a rudiment of it, especially in *Cyathea subg. Sphaeropteris sect. Schizocaena* of my arrangement in Flora Malesiana. *Cyathea* has a base chromosome number 69, about double that of members of *Thelypteridaceae*; *Cyathea* has also a much more complex vascular system. In some species of *Cyathea* the lower pinnae are gradually reduced, in others there is a long stipe and the lowest pinnae are not much reduced; in *Thelypteridaceae* also both these conditions occur.

Most species of *Cyathea* have amply bipinnate fronds, but young plants of all of them have simply pinnate fronds. I suggest that the evolution of *Thelypteridaceae* began by the persistence of the simply pinnate form in an adult condition (neoteny). I further suggest that those extant *Thelypteridaceae* which have bipinnate fronds are a secondary development from simply pinnate ancestors. Their pinnules are always adnate to the pinna-rachis in a way not found in *Cyathea*.

Cyathea fronds have free veins, and it is likely that this was a character also of early *Thelypteridaceae*. But it is probable that the distinctive pattern of anastomosis of veins, with its precise relationship to sinus-membranes (a pattern found in no other ferns) originated early. In some of the genera here recognized it seems probable that the species with free veins are not primitive in their own genera; for example, in *Sphaerostephanos* (the largest genus in Malesia) the great majority of species have anastomosing veins, the few species which have free veins not forming a closely allied group nor limited to one area. The same is true in *Pneumatopteris* and *Christella*. But there are other genera which perhaps evolved directly from free-veined ancestors (*e.g. Coryphopteris* and *Trigonospora*).

There is another group of terrestrial ferns which agree with *Thelypteridaceae* in having abundant distinctive hairs, not homologous with scales, on the adaxial surface of frond-axes, namely *Ctenitis*, *Tectaria* and allied genera. The latter differ from *Thelypteridaceae* in

vascular anatomy of stipes, shape of fronds (pinnae often asymmetric at their bases, basal pinnae enlarged basiscopically), have a different kind of anastomosis of veins, lack sinus-membranes, and the hairs on the adaxial surface of frond-axes are always multicellular with short cells, not acicular in form. I see no close alliance between *Thelypteridaceae* and other groups, but point out the similarity of sori to those of *Tectaria, Dryopteris* and other genera, which seems to me to imply a common ancestry from ancient tree-ferns (see Journ. Linn. Soc. Bot. 67, Suppl., 1973, 5).

In his recent scheme of classification of ferns (Webbia 31, 1977, 313–512), PICHI SERMOLLI places *Thelypteridaceae* in *Aspidiales*, an Order which he regards as related more nearly to *Dennstaedtiales* than to *Dicksoniales*. Within *Aspidiales* he regards *Thelypteridaceae* as nearest to *Aspleniaceae*, but in my view these two families have little in common except the chromosome number 36 in a majority of species and should not be placed in the same Order. PICHI SERMOLLI regards a creeping rhizome as probably primitive in *Thelypteridaceae* (p. 441) and (ignoring the genus *Trigonospora*) states that difference in spores is an argument against a relationship to *Cyathea* (p. 437); he does not mention the various similarities to *Cyathea* indicated above. After reading his statement, I cannot agree with his arrangement, either in reference to *Thelypteridaceae* as a whole or as to the interrelations of genera within it. As regards the latter, he offers no justification for the subdivision proposed on pp. 440–445; for example, he places *Thelypteris* and *Cyclosorus* wide apart, without explanation, whereas they seem to me to be rather nearly related.

I assume an erect caudex to be primitive in *Thelypteridaceae* partly because I regard a common origin with *Cyathea* as probable, and partly because the caudex in all species has the radial structure characteristic of an erect habit; in none of the species with a creeping rhizome has a dorsiventral structure (of the kind occurring in *Dennstaedtia*) developed. All species of *Thelypteridaceae* which have long creeping rhizomes appear to me to be more specialized than those with an erect caudex; nearly all of the former are plants of open places, whereas the great majority of members of the family are adapted to a forest habitat. *Cyclosorus* and *Thelypteris* (in the strict sense here adopted) are ferns of freshwater swamps in sunny places. *Sphaerostephanos unitus* and *S. invisus* also grow in the open, usually in less wet places, and are among the very few species in that large and varied genus which have a long-creeping rhizome.

I agree that, in evolution, the megaphyll of ferns may have been derived from a branch-system arising from a creeping rhizome, but if so that stage occurred very early, before any groups now known originated. In 1949 the idea was in my mind that living *Gleicheniaceae*, with their long-creeping rhizomes, might preserve an original plant-form, and that, as suggested by BOWER, *Cyathea* might have originated from a *Gleichenia*-like ancestor (Biol. Reviews 24: 268). But after making a survey of the tree-ferns in the present Series (vol. 1, part 2) I concluded that the erect habit was probably primitive for *Cyathea*, and that the plant-form (though not the form of sporangia) of modern *Gleicheniaceae* is probably derivative and not primitive (there is no evidence of its existence before the Cretaceous); I have discussed this theme in Phytomorphology 14 (1965) 477–480.

CONSPECTUS OF MALESIAN GENERA

1. Upper surface of costae not grooved; veins not reaching margin (except distal ones in *Phegopteris*) Group of PHEGOPTERIS
2. Fronds bipinnate; n = 31.
3. Scales thin; perispore forming a reticulum of few meshes separated by low broad ridges **1. Pseudophegopteris**
3. Scales thickened at base; perispore minutely complex . . . . . **2. Macrothelypteris**
2. Fronds simply pinnate; n = 30 or 35.
4. Basal scales with short superficial setae; pinnae free; n = 35 . . . . . **3. Metathelypteris**
4. Basal scales flat with marginal hairs; pinnae with semicircular rachis-wings between them; n = 30 **4. Phegopteris**

1. Upper surface of costae grooved; veins all reaching margin.
5. n = 33 or less; sporangia sessile, lacking glands or hairs . . . . . Group of CORYPHOPTERIS

6. Caudex erect; spores with thin translucent wing; plants of mountain ridges in Malesia **5. Coryphopteris**
6. Caudex slender, creeping; spores various; a mixture still unresolved . . . . **6. Parathelypteris**

5. n = 36 or 35; sporangia stalked, in many cases bearing glands or setae.
7. No reduced pinnae at base of frond; subentire pinnae with goniopteroid or meniscioid venation rarely present.
8. No glands or hairs on body of sporangia except in *Thelypteris*.
9. Caudex short, erect; spores trilete with discontinuous perispore forming minute papillae; no scales on costae . . . . . Group of TRIGONOSPORA
10. On rocks by streams, S.E. Asia and W. Malesia . . . . . **7. Trigonospora**
10. (Related genus in Africa: *Menisorus*)
9. Caudex creeping; spores monolete with ample perispore; scales present on lower surface of costae . . . . . Group of THELYPTERIS
11. No large red glands on hairs on sporangium-stalks nor on lower surface of costae **8. Thelypteris**
11. Large red glands on hairs of sporangium-stalks, sometimes on lower surface of pinnae also.
12. Veins free; forest plants of Malesia . . . . . **9. Mesophlebion**
12. Veins anastomosing; plants of wet ground in the open.
13. Fronds not proliferous; no forked hairs present . . . . . **10. Cyclosorus**
13. Fronds proliferous; forked hairs present . . . . . **11. Ampelopteris**
8. Glands or setae usually present on body of sporangia . . . . . Group of CHINGIA
14. Veins anastomosing, with long sinus-membrane . . . . . **12. Chingia**
14. Veins free; sinus-membrane short; decurrent obliquely towards costa . . **13. Plesioneuron**
7. Reduced pinnae usually present at base of frond; species without such pinnae mostly having broad subentire normal pinnae.
15. Hooked hairs on frond; veins free . . . . . **14.** Isolated genus **Cyclogramma**
15. Hooked hairs present only in *Pronephrium sect. Grypothrix* which has much anastomosis of veins.
16. Spores with many small wings or a ± continuous translucent wing with cross-wings; aerophores ± swollen . . . . . Group of SPHAEROSTEPHANOS
17. Broad thin scales, lacking superficial hairs, on base of stipe; capitate hairs, rarely setae, or neither, on sporangia.
18. Veins free; lamina between them not pustular when dry . . . . . **15. Pseudocyclosorus**
18. Veins in most species anastomosing; lamina between them pustular when dry **16. Pneumatopteris**
17. Scales on base of stipe narrow, hairy on surface; spherical glands on setae usually present on sporangia.
19. Reduced pinnae normally present . . . . . **17. Sphaerostephanos**
19. Reduced pinnae lacking.
20. Sori in most species round or nearly so; pinnae mostly free.
21. Pinnae rarely to 20 pairs; veins anastomosing . . . . . **18. Pronephrium**
21. Pinnae to 30 pairs, not over 2.5 cm long . . . . . **19. Nannothelypteris**
20. Sori always elongate along veins; pinnae mostly adnate; sporangia always setiferous **20. Stegnogramma**
16. Spores coarsely tuberculate or ridged; aerophores not or rarely swollen; elongate glands often present . . . . . Group of CHRISTELLA
22. Basal large pinnae much narrowed at base; 1–2 pairs of reduced basal pinnae inconstantly present; venation in several species inconstant . . . . . **21. Amphineuron**
22. Basal pinnae not much narrowed at base, usually auricled; a few pairs of lower pinnae gradually reduced, lowest not very small . . . . . **22. Christella**

The above conspectus does not attempt to state all characters of the various divisions, but is an attempt to show inter-relations as I see them at present.

Pseudophegopteris and *Macrothelypteris* have bipinnate fronds approaching those of *Cyathea* in size but differ in their mainly adnate pinnules; as above noted, I doubt whether they are to be regarded as primitive in the family. Other genera have more definitely primitive characters, *e.g.* the miniature arborescent habit of *Coryphopteris*, the trilete spores of *Trigonospora*, but the latter has 36 chromosomes and may be related to *Pseudocyclosorus*. *Coryphopteris* plants are confined to acid peaty soil on mountain ridges, where they grow with *Plagiogyria* which is certainly a primitive relic. In the New World (and to a small

extent in Africa) *Amauropelta*, in habit mainly similar to *Coryphopteris*, is a comparable genus (of 200 species) but differs in having lower pinnae almost always gradually reduced whereas that condition is rare in *Coryphopteris*.

The genera *Thelypteris*, *Mesophlebion*, *Cyclosorus* and *Ampelopteris* seem to be a natural group with peculiar glands, scaly costae, creeping rhizome and unreduced basal pinnae. *Mesophlebion* looks like the primitive element, adapted to a forest habitat; the other genera have become adapted to open swampy ground and, like many other swamp-plants, are widely distributed (it should be noted that *Mesophlebion chlamydophorum* grows in swamp-forest). In my judgement, most species which have been included in *Cyclosorus* are not at all nearly related to this group of genera. *Ampelopteris* is peculiar in having forked hairs on the rachis similar to those of the American genus *Goniopteris* (in the strict sense of CHRISTENSEN's monograph) but is not otherwise much like *Goniopteris*; if they have a common ancestor it must be rather far back.

Cyclogramma is a peculiarly isolated genus of a few species in mainland Asia (one of them reaching northern Luzon). I doubt whether its hooked hairs indicate a relationship to *Pronephrium sect. Grypothrix*; it should be noted that slender hooked hairs occur also in some species of *Amauropelta* which is not nearly related to either *Cyclogramma* or *Pronephrium*.

The series of genera from *Pseudocyclosorus* to *Stegnogramma* comprise the great majority of Malesian species of the family, and I judge that this is a natural group; the genera within it are not easy to characterize clearly, though typical species in each are distinct enough. Most species of the group have anastomosing veins, but in most genera there are some species with free veins, which again indicates the unnatural state of COPELAND's distinction between *Lastrea* and *Cyclosorus* by the character of free or anastomosing veins. Most of these ferns have reduced basal pinnae, but there is much variation, and I can find no sharp division between *Pronephrium* and *Sphaerostephanos*; I maintain these two genera partly for convenience and partly because many members of *Pronephrium* do form a group distinct from typical *Sphaerostephanos*. The whole question needs much further study; it will not be solved by examining a few species.

The final group of two genera, *Christella* and *Amphineuron* is perhaps also related to the *Sphaerostephanos* group, but appears to be distinct in its spores and glands.

Unicellular glands of one sort or another are characteristic of most genera. In many cases these glands are distinctive when seen at a magnification of not less than ×25, but they are in some measure modified in the process of preparing specimens for the herbarium, and their differences are not easy to describe. They need a microchemical study.

The great range of variation in detail within almost all genera appears to me to indicate that the family is still in an active state of evolution. I cannot agree with LÖVE, LÖVE and PICHI SERMOLLI that "most of the recognized species of pteridophytes are evidently old and well-established taxa" (p. xiv) nor that "the species of ferns are usually clearly distinct and established through their substantial age" (p. xi), having an existence of "millions of generations" (p. xiii). It seems to me evident that genera and species in *Thelypteridaceae* are in most cases not older than those in many families of Angiosperms.

Citation of literature and synonyms. An attempt has been made to include all binomials based on Malesian species, with citation of types, all of which have been examined except where otherwise indicated. Binomials based on extra-Malesian species which are regarded as synonyms are in most cases cited, or reference is made to their treatment in other recent literature. Descriptions published in works on Malesian ferns are in all cases cited, though some of them are of doubtful value. BEDDOME's work is also cited, as he included information on ferns of Malaya, and information about the occurrence of Malesian species in India; similarly the Flore Générale de l'Indochine is often also cited. Some of this information occurs also in my precursory papers, but in some of these the information is incomplete, and in all cases the work has been revised for the present Flora.

Descriptive details. So far as possible, these are arranged in the same sequence for all species. The *distance between costules* is measured along the costa from which they arise; this can be more exactly stated than the width of pinna-lobes. The nature and distribution of

glands and hairs is separately indicated for the lower (abaxial) and upper (adaxial) surfaces; those on the lower surface are usually more distinctive, but often both need to be observed to provide clear distinctions between allied species. Failure to observe differences in these characters has caused much confusion among earlier authors, and more information still remains to be recorded. Spores have only been approximately described. I hope that a separate publication on spores in the family may later be possible.

The key to genera which follows is artificial (the numbers of the genera are those of the Conspectus) and is designed to lead as simply as possible to the right genus for any species in Malesia. It will not serve a similar purpose for all species in the Old World. I have compiled taxonomic studies of all species in Africa and adjacent islands (J. S. Afr. Bot. 40, 1974, 123–168) and in Australasia and the Pacific (Allertonia 1, part 3, 1977). Most Indian species are covered in my precursory papers in Blumea or elsewhere, as cited under the genera.

KEY TO THE GENERA IN MALESIA

1. Costae not grooved on upper surface; veins not reaching margin.
 2. Fronds bipinnate.
  3. Scales on lower surface of frond, if present, consisting of a row of cells with red cross-walls acicular hairs all unicellular . . . . . **1. Pseudophegopteris**
  3. Scales on axes of frond thickened at base, or replaced by long slender septate acicular hairs **2. Macrothelypteris**
 2. Fronds simply pinnate.
  4. Stipe-scales bearing superficial hairs; rachis-wing, if present, narrow and of even width.
   5. Sori indusiate . . . . . **3. Metathelypteris**
   5. Sori exindusiate . . . . . **1. Pseudophegopteris**
  4. Stipe-scales with marginal hairs only; pinnae connected by wings along the rachis forming semicircular lobes between pinnae . . . . . **4. Phegopteris**
1. Costae grooved on upper surface; free veins all reaching margin.
 6. Fronds simple, or pinnate with lower pinnae not decrescent (small basal pinnae inconstantly present in *Amphineuron*).
  7. Spores trilete; caudex short, erect; on rocks by streams . . . . . **7. Trigonospora**
  7. Spores normally monolete; caudex and habitat various.
   8. Rhizome long-creeping in wet ground; broad flat scales present on lower surface of costae.
    9. Veins free . . . . . **8. Thelypteris**
    9. Veins anastomosing.
     10. Fronds not proliferous; sori indusiate . . . . . **10. Cyclosorus**
     10. Fronds proliferous; sori exindusiate . . . . . **11. Ampelopteris**
   8. Not this combination of characters.
    11. Caudex erect; sporangia unstalked, lacking hairs and glands; some sessile resinous glands on lower surface in most species; plants of mountain ridges . . . . . **5. Coryphopteris**
    11. Not this combination of characters.
     12. Caudex massive, erect; scales narrow, rigid, brittle; sori close to costules, exindusiate or with very small indusia . . . . . **12. Chingia**
     12. Not this combination of characters.
      13. Sori elongate along veins, exindusiate; sporangia bearing slender straight setae **20. Stegnogramma**
      13. Sori round, or if elongate and exindusiate the sporangia bearing hooked hairs or none.
       14. Veins free.
        15. Basal basiscopic vein of each group arising from costa below the attachment of its costule; a red gland at the end of hairs on stalks of sporangia . . . . . **9. Mesophlebion**
        15. Basal basiscopic vein of each group not always thus arising; hairs on sporangium-stalk otherwise.
         16. Rhizome long-creeping; no glands nor hairs on sporangia.
          17. Rhizome slender; pinnae rarely over 6 cm long . . . . . **6. Parathelypteris**
          17. Rhizome 5–7 mm diameter; pinnae 10 cm or more long . . . . . **22. Christella**
         16. Rhizome not long-creeping; sporangia in some cases with glands or hairs.
          18. Bases of lower pinnae not greatly narrowed.
           19. Pinnae rigid, commonly at least 10 × 1 cm . . . . . **13. Plesioneuron**
           19. Pinnae thin, to 3 cm long, rarely 1 cm wide.

20. Sporangia bearing glands.
21. Pinnae 20–30 pairs, no glands on their lower surface . . . . **19. Nannothelypteris**
21. Pinnae c. 7 pairs; glands present . . . . . **18. Pronephrium**
20. Sporangia lacking glands . . . . . **22. Christella**
18. Bases of lower pinnae much narrowed . . . . . **21. Amphineuron**
14. Veins anastomosing.
22. Spores coarsely tuberculate or ridged; sporangia lacking glands.
23. Basal pinnae much narrowed at their bases . . . . . **21. Amphineuron**
23. Basal pinnae not much narrowed at their bases which are in most cases auricled on acroscopic side . . . . . **22. Christella**
22. Spores with a thin wing and cross-wings or many small thin wings.
24. Pinnae 20 pairs or more, 2–3 cm long . . . . . **19. Nannothelypteris**
24. Pinnae much longer, or fewer.
25. Pinnae or simple fronds subentire; lower surface between veins often pustular **18. Pronephrium**
25. Pinnae deeply lobed; surface between veins not pustular . . **17. Sphaerostephanos**
6. Lower pinnae gradually reduced, or an abrupt change to small pinnae at base of frond.
26. Hooked hairs present on lower surface of frond . . . . . **14. Cyclogramma**
26. Hooked hairs lacking.
27. Rhizome slender, long-creeping; many lower pinnae gradually reduced; some septate acicular hairs on lower surface . . . . . **6. Parathelypteris**
27. Not this combination of characters.
28. Caudex erect; pinnae to c. 5 cm long, lower ones gradually reduced; sporangia sessile, lacking glands or hairs; plants of high mountain ridges . . . . . **5. Coryphopteris**
28. Not this combination of characters.
29. Basal scales on stipe in almost all cases broad and thin; lamina between veins on upper surface almost always smooth and glabrous, lower surface of costae never densely hairy; glandular hairs on lower surface, if present, minute and colourless.
30. Veins free; reduced basal pinnae consisting of an aerophore with a minute lamina; pinnae not pustular between veins on lower surface when dried . . . . . **15. Pseudocyclosorus**
30. Veins anastomosing, or if free the reduced basal pinnae with a distinct green lamina; lower surface of pinnae between veins ± pustular when dried . . . . . **16. Pneumatopteris**
29. Basal scales narrow; upper surface between veins often bearing hairs and/or glands, lower surface of costae usually with copious hairs; sessile spherical or elongate glands often present.
31. Body of sporangium lacking hairs or glands; an elongate unicellular glandular hair on sporangium-stalk, similar hairs sometimes also on lower surface of veins; spores coarsely tuberculate or ridged . . . . . **22. Christella**
31. Body of sporangium usually with sessile spherical glands or setae; hairs on sporangium-stalk consisting of several cells; spores with many small thin wings or a continuous wing with cross-wings; sessile spherical glands present on lower surface in many species **17. Sphaerostephanos**

1. PSEUDOPHEGOPTERIS

CHING, Acta Phytotax. Sinica 8 (1963) 313; HOLTTUM, Blumea 17 (1969) 12. — *Thelypteris* group 4 CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 246. — *Phegopteris sensu* TAGAWA, Acta Phytotax. Geobot. 7 (1938) 73, p.p. — *Phegopteris sect. Lastrella* H. ITO in Nakai & Honda, Nov. Fl. Jap. n. 4 (1939) 152, *excl. P. decursive-pinnata.* — *Thelypteris subg. Phegopteris sect. Lastrella* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 25, (1965) 137, *excl. T. decursive-pinnata.* — *Toppingia* DEG., DEG. & A. R. ... in Deg. & Deg. Fl. Hawaii (1968) fam. 17b. — *Macrothelypteris sensu* PICHI SERMOLLI, Webbia 24 (1970) 715, *p.p.* — **Fig. 2a–g.**

Caudex erect or prostrate, in *P. aurita* long-creeping; scales thin with short hairs on surface; stipe and rachis glossy, in most cases castaneous. *Lamina* in most species bipinnate with pinnules adnate to pinna-rachis,

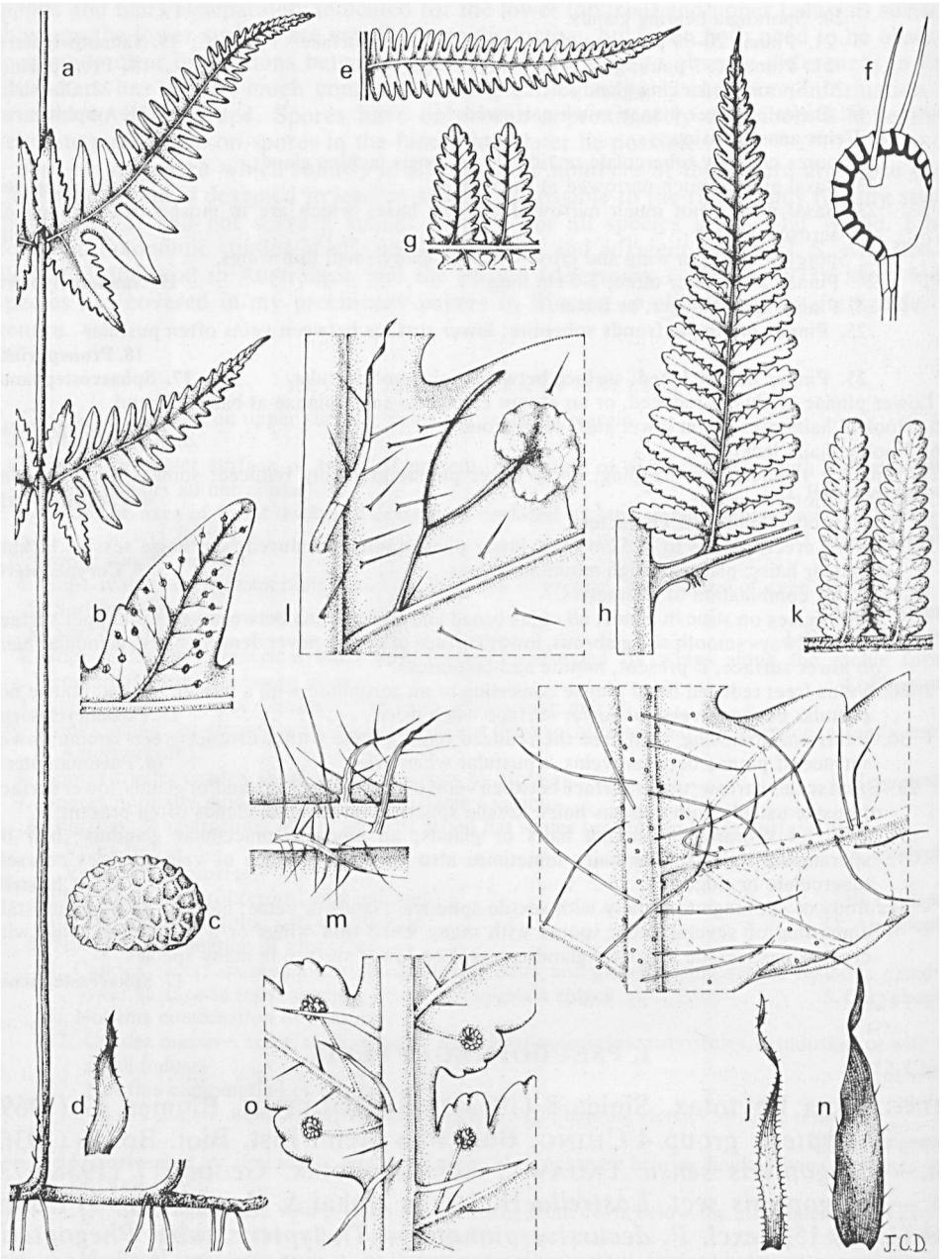

Fig. 2. *Pseudophegopteris aurita* (HOOK.) CHING. *a.* Rhizome and base of frond, ×6; *b.* lobe of a pinna, ×3; *c.* spore, ×333; *d.* scale from stipe, ×6. — *P. rectangularis* (ZOLL.) HOLTTUM. *e.* One pinna, ×2/3; *f.* sporangium, ×33. — *P. paludosa* (BL.) CHING. *g.* Two pinna-lobes, ×2/3. — *Macrothelypteris torresiana* (GAUD.) CHING. *h.* One pinnule, ×2; *i.* base of pinna-lobe (sori outlined), ×24; *j.* scale from stipe, ×4. — *M. polypodioides* (HOOK.) HOLTTUM. *k.* Pinnule-lobes, ×2; *l.* base of pinnule-lobe, ×32; *m.* scales on pinna-rachis, ×2; *n.* scale from stipe, ×4. — *M. setigera* (BL.) CHING. *o.* Part of pinnule, showing hairs and scales, ×12 (*a–d* NAKAIKE 401, *e–g* MATTHEW *s.n.*, *h–n* cult. Kew, ex MOUSSET 718).

often connected by a narrow wing, in two species simply pinnate with lobed pinnae; pinnae opposite or nearly so, lower ones usually somewhat reduced and more widely spaced; tips of veins thickened, not running to margin; scales on lower surface of rachis and pinna-rachis few at maturity of frond, those on distal axes reduced to a single row of short cells with reddish cross-walls; hairs on lower surfaces unicellular, acicular or capitate or both. *Sori* always exindusiate, globose or ± elliptic, in a few cases elongate along veins; sporangia bearing acicular hairs or not; spores usually pale, with a slightly-raised reticulum forming broad meshes on the surface.

Type species: *Pseudophegopteris pyrrhorhachis* (KUNZE) CHING.

Distr. St Helena, S. Tomé & Fernando Poo; tropical Africa; Mascarene Islands; tropical and subtropical Mainland Asia; *Malesia*; Samoa, Hawaii; about 20 *spp.*

Ecol. In Malesia, only on mountains at 1200–2800 m, often near streams, in open places; most species appear to be local, and have been little collected.

Cytol. Base chromosome number 31; *P. pyrrhorhachis* diploid, tetraploid and hexaploid (India, Ceylon); *P. aurita* diploid (N. India), tetraploid (New Guinea); *P. cyclocarpa* tetraploid; *P. rectangularis* tetraploid (N. India).

This genus has been united by PICHI SERMOLLI with *Macrothelypteris*, but the two are very distinct in scales and spores. *Pseudophegopteris* differs also in its invariable mountain habitat; this is seen strikingly in the Pacific where *Macrothelypteris torresiana* and *M. polypodioides* are widely dispersed at low altitudes, *Pseudophegopteris* represented only by two isolated mountain species in Samoa and Hawaii.

KEY TO THE SPECIES

1. Rhizome slender, wide-creeping; some sori elongate . . . . . **1. P. aurita**
1. Rhizome erect, or if creeping thick with fronds near together; sori not elongate.
2. Pinnae to *c.* 6 cm long, nearly all adnate to rachis, lobed not more than ¾ to costa **2. P. rectangularis**
2. Pinnae much longer, mostly not adnate to rachis and with adnate pinnules.
3. Basal basiscopic pinnules conspicuously longer than next.
4. Copious short capitate hairs present on lower surface of pinna-rachis and costae of pinnules **3. P. tenggerensis**
4. All hairs on lower surfaces acicular . . . . . **4. P. cyclocarpa**
3. Basal basiscopic pinnules not conspicuously longer than next.
5. Pinnules on largest pinnae almost free, lobed almost to costa.
6. Lower surface of costae hairy; lobes of largest pinnules lobed almost to costule **5. P. kinabaluensis**
6. Lower surface of costae glabrous; lobes of largest pinnules almost entire . **6. P. sumatrana**
5. Pinnules on largest pinnae all broadly adnate to pinna-rachis, lobed not more than half-way to costa . . . . . **7. P. paludosa**

1. Pseudophegopteris aurita (HOOK.) CHING, Acta Phytotax. Sinica 8 (1963) 314; HOLTTUM & ROY, Blumea 13 (1965) 131; HOLTTUM, Blumea 17 (1969) 13. — *Gymnogramme aurita* HOOK. Ic. Pl. 10 (1854) t. 974, 989; Spec. Fil. 5 (1864) 141; BEDD. Ferns Brit. Ind. Suppl. (1876) 24. — *Phegopteris aurita* (HOOK.) J. SM. Cat. Cult. Ferns (1857) 17; Hist. Fil. (1875) 234; METT. Farngatt. IV (1858) 15. — *Polypodium auritum* (HOOK.) LOWE, Ferns Brit. & Exot. 2 (1858) t. 51. — *Leptogramma aurita* (HOOK.) BEDD. Handb. (1883) 377, f. 216. — *Dryopteris aurita* (HOOK.) C. CHR. Ind. Fil. (1905) 253. — *Thelypteris aurita* (HOOK.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 266. — Type: GRIFFITH, Khasya Hills (K). — **Fig. 2a–d.**

Rhizome 2–3 mm diam. (dry), scales near apex 3–4 mm long. *Stipe* dark purplish, glossy, to 60 cm long. *Lamina* 30–70 cm long; pinnae well-spaced, commonly to 15 cm long, upper ones adnate to rachis merging with broadly deltoid apical lamina, lowest 1–2 pairs reduced; pinnae of largest fronds lobed almost to costa, lobes rounded to acute, basal lobes conspicuously longer than next, basal basiscopic lobes of largest pinnae 3–5 cm long, lobed up to half-way to costule; veins pinnate in the pinna-lobes, simple or forked; rachis short-hairy on upper surface, glabrous beneath; costae densely short-hairy on both surfaces, rest glabrous. *Sori* elongate to globose along middle to distal part of veins; sporangia setose.

Distr. N. E. India to S. W. China, Tonkin; in *Malesia*: Sabah (Mt Kinabalu, CLEMENS 40306, MOLESWORTH ALLEN 3234), Philippines (Luzon,

PRICE 836, Mt San Cristobal), Papua New Guinea (several coll.).

Ecol. In Malesia at 1400–2200 m, in open places.

2. Pseudophegopteris rectangularis (ZOLL.) HOLTTUM, Blumea 17 (1969) 19. — *Polypodium rectangulare* ZOLL. Syst. Verz. (1854) 37, 48. — *Thelypteris rectangularis* (ZOLL.) NAYAR & KAUR, Comp. to Bedd. (1974) 72. — Type: ZOLLINGER 1802, Tjiapoes, Java (G; L, LE, P).

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

Dryopteris moussetii ROSENST. Fedde Repert. 8 (1910) 278. — *Phegopteris moussetii* (ROSENST.) v.A.v.R. Handb. Suppl. (1917) 306. — Type: MOUSSET *s.n.* Tengger Mts, Java (isotype FI).

Phegopteris oppositipinna v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 24; Handb. Suppl. (1917) 307. — *Thelypteris oppositipinna* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 268; HOLTTUM, Rev. Fl. Malaya 2 (1955) 239, f. 137. — *Pseudophegopteris oppositipinna* (v.A.v.R.) CHING, Acta Phytotax. Sinica 8 (1963) 315. — Type: MATTHEW, G. Singgalan, Sumatra (BO; K). — **Fig. 2e–f.**

Caudex short, suberect. *Stipe* to 25 cm long, dark purplish, bearing short sparse spreading hairs, scaly near base. *Lamina* to 30 × 12 cm, narrowed to both ends, several pairs lower pinnae more widely spaced; free pinnae few, rest with base of lamina ± adnate to rachis; *largest pinnae* 6 × 1.5 cm, narrowed evenly from base to apex, lobed up to ¾ to costa at base, lobes entire, rounded; veins in basal pinna-lobes 5 or more pairs; rachis, costae and costules beneath with hairs 0.5 mm long, some capitate hairs between veins. *Sori* ± globose, subterminal on veins, sporangia with slender setae.

Distr. N. E. India, *W. Malesia*: Sumatra, Malaya, Borneo, Java.

Ecol. On mountains at 1000–1500 m, in open sandy places by streams.

3. Pseudophegopteris tenggerensis HOLTTUM, Reinwardtia 8 (1974) 500. — Type: BUYSMAN 40, Tengger Mts, Nongko, 1200 m, 1906 (U).

Caudex unknown. *Stipe* castaneous, glossy. *Largest pinnae* 33 cm long, subpinnate; pinnules lobed, all broadly adnate and connected by a narrow wing on pinna-rachis, basal basiscopic pinnule 7 × 1.6 cm, conspicuously longer than next; lower surface of pinna-rachis and of costae of pinnae bearing copious short capitate hairs and a few acicular hairs, upper surface bearing spreading brown acicular hairs only. *Sori* almost globose, those on lower veins ellipsoid; sporangia lacking setae.

Distr. *Malesia*: East Java. Known only from type and two other specimens at Utrecht, possibly all from same source.

4. Pseudophegopteris cyclocarpa HOLTTUM, Blumea 13 (1965) 131; Blumea 17 (1969) 15. — Type: cult. Hort. Bot. Kew. 578/63 *n.* 57, origin near Mt Hagen, Western Highlands, Papua New Guinea, 2000 m, leg. HOLTTUM (K).

Caudex branching; branches short, suberect. *Stipe* to 60 cm long, dark purplish brown, scaly and hairy near base, scales 6 × 1 mm. *Lamina* to 80 cm or more long, basal pinnae reduced; *largest pinnae* to 20 cm long, narrowly deltoid; pinnules all broadly adnate to pinna-rachis, lowest pair 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, rest of pinna evenly narrowed towards apex, middle pinnules 7–8 mm wide; veins pinnate in lobes of pinnules; acicular hairs present on lower surface of pinna-rachis at least near its apex, also on costae of pinnules and near margin. *Sori* medial on veins, globose or nearly so; sporangia copiously setose.

Distr. *Malesia*: Papua New Guinea. Known from type and two other collections from Western Highlands at 2000–2800 m, also one from Morobe District at 2000 m.

5. Pseudophegopteris kinabaluensis HOLTTUM, Blumea 17 (1969) 16. — Type: H. P. FUCHS 21475, Mt Kinabalu, 2700 m (SRR; K, L).

Caudex not seen. *Stipe* to 150 cm long, pale brownish, with rachis bearing scattered narrow scales on lower surface. *Lamina c.* 150 cm long, lowest pinnae not or little reduced; *largest pinnae* 40 cm long, lower pinnules 2.5–3 cm apart, adnate slightly to rachis on acroscopic side; largest pinnules 10 × 3 cm, at base lobed almost to costa; costules to 6 mm apart, lobes incised up to halfway to costule; lower surface of costae of pinnules bearing slender spreading hairs and small uniseriate scales, hairs on upper surface more abundant and thicker. *Sori* almost globose; sporangia not setiferous.

Distr. *Malesia*: Sabah (Mt Kinabalu). Only known from type and one other collection, from wet inundated ground in narrow Goking's valley at 2700–2800 m.

6. Pseudophegopteris sumatrana HOLTTUM, Blumea 17 (1969) 22. — Type: HOLTTUM 26211, Kerinci Peak, 2000 m, Sumatra (K; BO, SING).

Caudex of type not recorded; of New Guinea specimens erect. *Stipe* 100 cm long, reddish. *Lamina* 150 cm long; lower pinnae distinctly reduced, largest *c.* 30 cm long; pinnules on basiscopic side longer than on acroscopic; *largest pinnules* 7.5 × 1.7 cm, acuminate, partly adnate at base to pinna-rachis, lobed ¾ towards costae, lobes subentire with rounded apices, costules 3–6 mm apart, veins mostly forked; lower surface of rachis, costae and costules glabrous. *Sori* above the fork on a vein, sometimes on both branches, almost globose; sporangia not setiferous.

Distr. *Malesia*: Central West Sumatra (Mt Kerinci). In addition to the type, several collections from Papua New Guinea at 1700–2300 m appear to be referable to this species.

Ecol. Open place by small stream.

Note. *P. sumatrana* is related to *P. kinabaluensis* but smaller, and glabrous on lower surface. New Guinea specimens resemble the Sumatran type, not the plants from Kinabalu, but it is possible that the two should be united.

7. **Pseudophegopteris paludosa** (BL.) CHING, Acta Phytotax. Sinica 8 (1963) 315; HOLTTUM & ROY, Blumea 13 (1965) 131; HOLTTUM, Blumea 17 (1969) 23. — *Aspidium paludosum* BL. Enum. Pl. Jav. (1828) 168, *non* RADDI 1825. — *Polypodium paludosum* BL. Fl. Jav. Fil. (1851) 192, t. 90; HOOK. Spec. Fil. 4 (1862) 214. — *Macrothelypteris paludosa* (BL.) LÖVE & LÖVE, Taxon 26 (1977) 325. — Type: BLUME, Java (L, *n.* 908,335-309).

Polypodium distans sensu RACIB. Fl. Buitenz. 1 (1898) 96. — *Dryopteris distans sensu* v.A.v.R. Handb. (1908) 496, *p.p.* — *Dryopteris brunnea* (WALL.) C. CHR. Ind. Fil. (1905) 255, *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. Malaya 2 (1955) 240 *p.p.* — *Lastrea pyrrhorhachis sensu* COPEL. Fern Fl. Philip. (1960) 330 *p.p.* — **Fig. 2g.**

Caudex massive, erect; stipe and rachis dark reddish. *Frond* with stipe to more than 200 cm long; 2–4 pairs lower pinnae gradually reduced; largest pinnae 20–35 cm long, bearing broadly adnate segments or pinnules 2.5–4 cm long which are contiguous except in largest pinnae; costules 10–12(–15) mm apart; basal basiscopic pinnules largest but not much longer than next; lower surface of pinna-rachis, costae, costules and veins bearing slender acicular hairs almost 1 mm long. *Sori* globose or nearly so; sporangia usually not setose.

Distr. Apparently throughout *Malesia*, to Eastern New Guinea, on mountains at 1200–2500 m, but specimens are few.

Ecol. BLUME's type was from an open swamp. The first collection from Malaya was in a small forest clearing at Cameron Highlands; now where much of the forest is cleared plants are abundant along streams at 1500 m. At Fraser's Hill quite small plants, on drier ground, have fertile fronds.

Notes. The specific epithet *brunnea*, taken up by CHRISTENSEN in Index Filicum and subsequently used by several authors, was never validated. This Malesian species differs from the Indian *P. pyrrhorhachis* (KUNZE) CHING in its massive erect caudex and larger size. I cannot decide, from herbarium specimens, how many species of this alliance occur in India; there, as in Malesia, more field work is needed.

2. MACROTHELYPTERIS

(H. ITO) CHING, Acta Phytotax. Sinica 8 (1963) 308; HOLTTUM, Blumea 17 (1969) 25; Allertonia 1 (1977) 177. — *Thelypteris* group 10 CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 248. — *Thelypteris sect. Macrothelypteris* H. ITO in Nakai & Honda, Nov. Fl. Jap. *n.* 4 (1939) 141; K. IWATS. Acta Phytotax. Geobot. 18 (1960) 155. — *Thelypteris subg. Thelypteris sect. Metathelypteris* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 145, *p.p.* — **Fig. 2h–o.**

Caudex short, creeping or suberect; scales (also on base of stipe) narrow, ± thickened at least near base, with marginal and superficial acicular and/or capitate hairs. *Lamina* bipinnate-tripinnatifid with ± adnate pinnules; lowest pinnae little reduced; scales on rachis and pinna-rachis narrow, pallid, thickened at base and sometimes wholly terete, with or without marginal hairs; hairs on surface of frond slender and acicular or short and capitate, some long multicellular hairs always present. *Sori* always small, usually with a small but persistent indusium often hidden by mature sporangia; sporangia bearing capitate hairs; spores with a very fine surface reticulum not resolvable by light microscope, and slight wings.

Type species: *Macrothelypteris oligophlebia* (BAK.) CHING.

Distr. Mascarene Islands; warmer parts of mainland Asia; *Malesia*; Queensland; islands of the Pacific (including Hawaii) south to Kermadec Island; 10 species.

As pointed out by CHING, the type selected by ITO is a little-known species from central China. In 1969 I placed it as a variety of *M. torresiana*, but I am now doubtful about this, and have not seen enough material to make a good judgement. In 1965 IWATSUKI included this genus in *Thelypteris subg. Thelypteris sect. Metathelypteris* but the scales of the latter (here ranked as a genus) are different, also the chromosome number.

Cytol. Base chromosome number 31; *M. ornata* diploid (N. India); *M. torresiana* tetraploid (India, Ceylon, Singapore) and hexaploid (Ceylon); *M. viridifrons* tetraploid (Japan).

KEY TO THE SPECIES

1. Rachises and lower surface of axes of frond lacking scales . . . . . **1. M. torresiana**
1. Rachis, pinna-rachises and axes of pinnules scaly on lower surface.
2. Scales on main rachis sparse; scales on pinna-rachis copiously ciliate . . . **2. M. polypodioides**
2. Scales on main rachis abundant, with strongly thickened bases; scales on pinna-rachis not or little ciliate.
3. Basal scales thin; scales on rest of stipe and rachis flat above the terete base . . **3. M. setigera**
3. Basal scales rigid with inflexed edges; scales on rest of stipe and rachis almost wholly terete **4. M. multiseta**

1. Macrothelypteris torresiana (GAUD.) CHING, Acta Phytotax. Sinica 8 (1963) 310; HOLTTUM, Blumea 17 (1969) 27, *excl. syn. Polypodium fragile* BAK. — *Polystichum torresianum* GAUD. in Freyc. Voy. Uran. Physic. Bot. (1828) 333. — *Thelypteris torresiana* (GAUD.) ALSTON, Lilloa 30 (1960) 111; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 151, 153. — Type: GAUDICHAUD, Mariana Is. (P; G).

Aspidium uliginosum KUNZE, Linnaea 20 (1847) 6. — *Dryopteris uliginosa* (KUNZE) C. CHR. Ind. Fil. Suppl. III (1934) 100; BACKER & POSTH. Varenfl. Java (1939) 42, *p.p.* — *Thelypteris uliginosa* (KUNZE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 342; HOLTTUM, Rev. Fl. Malaya 2 (1955) 241; BROWNLIE in Aubrév. Fl. Nouv. Caléd. 3 (1969) 209; MORTON, Contr. U.S. Nat. Herb. 38 (1973) 219. — Type: cult. Hort. Bot. Leipzig, origin Java (BR).

Polypodium trichodes HOULST. & MOORE, Gard. Mag. Bot. 3 (1851) 18; MORTON, Contr. U.S. Nat. Herb. 38 (1973) 264. — Type: cult., origin "East Indies" (BM).

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

Dryopteris setigera var. pallida v.A.v.R. Handb. (1908) 203; Suppl. (1917) 169. — Type: origin not specified (BO).

Dryopteris trichodes ROSENST. Meded. Rijksherb. Leiden 31 (1917) 6, *p.p.*; MORTON, Contr. U.S. Nat. Herb. 38 (1973) 265. — Lectotype (MORTON): ZOLLINGER 354, Java (L).

Nephrodium setigerum sensu HOOK. & BAK. Syn. Fil. (1867) 284, *p.p.* — *Aspidium setigerum sensu* RACIB. Fl. Buitenz. 1 (1898) 178, *p.p.?* — *Dryopteris setigera sensu* C. CHR., Ind. Fil. (1905) 292, *p.p.*; v.A.v.R. Handb. (1908) 202, *p.p.*; C. CHR. Gard. Bull. Str. Settl. 7 (1934) 243. — **Fig. 2h–j.**

Caudex short-creeping. *Stipe* to 50 cm long, glaucous when young, persistent base swollen and fleshy covered with many narrow dark brown scales bearing both acicular and capitate hairs, rest of stipe and rachis smooth. *Lamina* to 70 × 50 cm, deeply tripinnatifid, pinnae 12–15 pairs, sub-basal ones longest; *largest pinnae* 20 × 9 cm, deltoid, pinnate with all pinnules but lowest adnate to a narrowly green-winged pinna-rachis; pinnules oblique to pinna-rachis, largest 5–8 × 1.5–2.5 cm, acuminate, cut almost to costa into oblique dentate to deeply lobed segments 2.5 – 4 mm wide, largest to 12 mm long; costae and costules bearing scattered pale slender hairs on lower surface, some of them multicellular and over 1 mm long; whole lower surface of lamina bearing short capitate hairs. *Sori* globose; indusia very small bearing a few capitate hairs; sporangia bearing 2–3 short capitate hairs.

Distr. Mascarene Islands; warmer parts of mainland Asia and Japan; *Malesia*; Queensland, Polynesia, Hawaii; adventive at various places in the New World from Florida southwards.

Ecol. In Malesia in open or lightly shaded places in low country, especially in areas with a dry season.

Note. GAUDICHAUD described this species very carefully, but his description was overlooked, and there is much confusion in the literature between this species, *M. setigera* and *M. polypodioides*. The first author to distinguish it clearly was CHING, under the name *Thelypteris uliginosa* (1936) but BACKER & POSTHUMUS (1939) ignored the distinction between *T. uliginosa* and *T. setigera*. See also note under *M. polypodioides*.

2. Macrothelypteris polypodioides (HOOK.) HOLTTUM, Blumea 17 (1969) 29; Allertonia 1 (1977) 179. — *Alsophila polypodioides* HOOK. in Nightingale, Oceanic Sketches (1835) 131. —

Type: NIGHTINGALE, "South Sea Islands" (K).

Lastrea leucolepis PRESL, Epim. Bot. (1851) 39; COPEL. Fern Fl. Philip. (1960) 332. — *Dryopteris leucolepis* (PRESL) MAXON, Proc. Biol. Soc. Wash. 36 (1923) 172. — *Thelypteris leucolepis* (PRESL) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 345. — *Macrothelypteris leucolepis* (PRESL) CHING, Acta Phytotax. Sinica 8 (1963) 309. — Type: CUMING 114, Luzon (PRC; BM, K).

Cheilanthes gigantea CESATI, Rendic. Ac. Sci. Nap. 16 (1877) 25, 29. — *Polypodium cheilanthoides* BAK. in Beccari, Malesia 3 (1866) 45, *nom. nov.* (not *P. gigantea* DESV.). — *Dryopteris brunneo-villosa* C. CHR. Ind. Fil. (1905) 255, *nom. nov.* — *Phegopteris cheilanthoides* (BAK.) v.A.v.R. Handb. (1908) 494. — Type: BECCARI, Mt Arfak, W. New Guinea (FI; K). — **Fig. 2k–n.**

Caudex short, prostrate; *stipe* to 80 cm long, pale, basal half at least bearing copious acicular and capitate hairs and scales; *scales* thin, pale, to 20 mm long, hardly 1 mm wide at thickened base, bearing acicular hairs on surface near base, distally on edges, old stipe covered with wart-like bases of fallen scales. *Lamina* to 80 cm long; lower pinnae to 35 × 15 cm, rest gradually smaller; lower surface of rachis (sparsely) and pinna-rachis (copiously) bearing narrow pale scales to 3 mm long, 0.3 mm wide with thickened bases and slender patent marginal hairs; *largest pinnules* 10 × 1.5 cm, almost at right angles to pinna-rachis, with tertiary leaflets connected by a very narrow wing on costa; upper surface of costa densely hairy, of costules sparsely, very narrow hair-pointed and ciliate scales on lower surface of costa grading distally to slender septate hairs; tertiary leaflets at right angles to costa, larger ones deeply lobed, capitate hairs on lower surface. *Sori* small, on acroscopic branch of a vein; indusia small, with capitate hairs; sporangia with capitate hairs.

Distr. S.E. Asia (Thailand, Taiwan), through *Malesia* (Philippines, New Guinea) to N.E. Australia (Queensland) and the Pacific (Cook Is., Fiji, Samoa, Tahiti, Rapa, Austral Is.).

Ecol. At low altitudes, to 700 m, on edge of forest.

Note. When writing *Species Filicum*, HOOKER suppressed his earlier name *Alsophila polypodioides* (although citing the specimen) and this was not listed by CHRISTENSEN in *Index Filicum*. This species has been much confused with the preceding and with *M. setigera*. In 1923 MAXON pointed out the distinctions between *M. polypodioides* (which he named *Dryopteris leucolepis*) and *M. torresiana* (which he named *D. setigera*).

3. **Macrothelypteris setigera** (BL.) CHING, Acta Phytotax. Sinica 8 (1963) 309; HOLTTUM, Blumea 17 (1969) 31. — *Cheilanthes setigera* BL. Enum. Pl. Jav. (1828) 138. — *Dryopteris setigera* (BL.) 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* CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 345. — Type: BLUME, Java (L, *n.* 908,337–1168).

Cheilanthes stenophylla KUNZE, Bot. Zeit. 6 (1848) 212. — Type: ZOLLINGER 2675, Java (L).

Dryopteris backeri v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 18 (1908) 8; *ibid.* 21 (1908) 3; Handb. (1908) 817; Suppl. (1917) 169, 171. — Type: BACKER, Krakatau (BO, not seen).

Aspidium vile (*non* KUNZE) RACIB. Fl. Buitenz. 1 (1898) 173. — *Dryopteris uliginosa sensu* BACKER & POSTH. Varenfl. Java (1939) 42, *p.p.* — **Fig. 2o.**

Similar to *M. polypodioides* in size and in divisions of lamina, differing in abundant scales with thickened terete bases and entire (rarely ciliate) margins on rachis and pinna-rachis. A comparison of living plants from Java and the Philippines needs to be made.

Distr. *Malesia*: Sumatra, Java, Lombok, Flores, Timor, S.W. Celebes, Ternate.

Ecol. In open places at medium altitudes; reported by RACIBORSKI to form extensive thickets with *Gleichenia hispida* on G. Guntur in Java. Small plants may be fertile; one such was type of *Cheilanthes stenophylla* KUNZE.

4. **Macrothelypteris multiseta** (BAK.) CHING, Acta Phytotax. Sinica 8 (1963) 309; HOLTTUM, Blumea 17 (1969) 31. — *Nephrodium multisetum* BAK. J. Linn. Soc. Bot. 22 (1886) 226. — *Dryopteris multiseta* (BAK.) 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* (BAK.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 347. — Type: G. F. HOSE, G. Matang, Sarawak, 610 m (K).

Stipe at least 70 cm long, reddish when old; basal scales rigid, 10 × 1 mm, base thickened and edges inrolled; scales above base copious, persistent, dark, hair-pointed, entire, 5–7 mm long, hardly 0.5 mm wide, basal part terete; main rachis similarly and persistently scaly. *Pinnae* commonly 35 cm long, maximum 50 cm; pinna-rachis pale with darker spreading rigid entire scales which are almost wholly terete; pinnules commonly 8 × 1.8 cm, bearing tertiary leaflets connected by a narrow wing, axis of pinnule scaly as pinna-rachis but scales smaller, hair-pointed; tertiary leaflets lobed half-way to costule; lower surface of lamina bearing short capitate hairs. *Sori* one to each lobe of a tertiary leaflet; indusium small, with capitate hairs; sporangia with similar hairs.

Distr. *Malesia*: Borneo (North Borneo, Sarawak), Sumatra.

Ecol. In rather open places at 500–1250 m, sometimes abundant, but very local; only found at one place on Mt Kinabalu.

3. METATHELYPTERIS

(H. ITO) CHING, Acta Phytotax. Sinica 8 (1963) 304; HOLTTUM, Blumea 19 (1971) 26; J.S. Afr. Bot. 40 (1974) 127; Kalikasan 5 (1976) 115. — *Thelypteris sect. Metathelypteris* H. ITO in Nakai & Honda, Nov. Fl. Jap. *n.* 4 (1939) 137; K. IWATS. Acta Phytotax. Geobot. 18 (1960) 147; Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 145, *p.p.* — **Fig. 1m, 3.**

Caudex short, erect or decumbent with tufted fronds; *stipes* green when living, scaly at base only, scales less than 10 mm long, narrow with a few short acicular hairs; *lamina* simply pinnate (in *M. flaccida* almost bipinnate) with deeply lobed pinnae, basal pinnae not or little reduced; veins free, often forked, with thickened ends not reaching margin; upper surface of costae prominent, not grooved; acicular and/or capitate hairs, not spherical glands, present on lower surfaces; scales on lower surface of costae, if present, uniseriate, about as in *Pseudophegopteris*; *sori* indusiate, indusia thin; sporangia sometimes with a hair of several cells on the stalk, no hairs nor glands on body; spores with irregular ridges variously united.

Type species: *Metathelypteris gracilescens* (BL.) CHING.

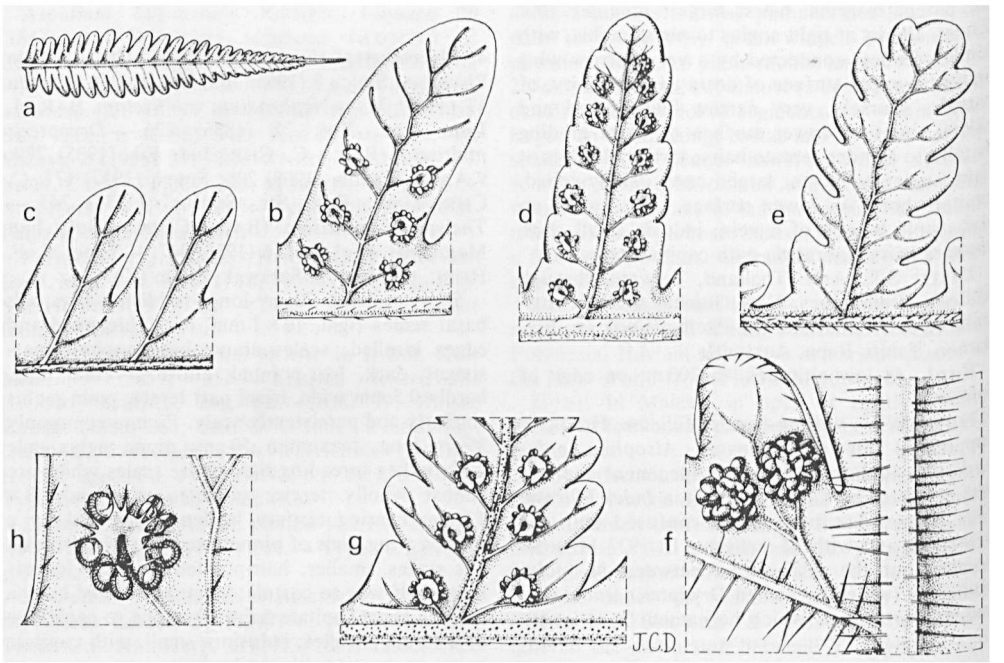

Fig. 3. *Metathelypteris gracilescens* (BL.) CHING. *a.* One pinna, ×⅔; *b.* pinna-lobes, lower surface, ×6; *c.* pinna-lobes, upper surface, ×6. — *M. dayi* (BEDD.) HOLTTUM. *d.* Pinna-lobe, ×4. — *M. flaccida* (BL.) CHING. *e.* Pinna-lobe, upper surface, ×4; *f.* lower surface, ×12. — *M. singalanensis* (BAK.) CHING. *g.* Base of a pinna-lobe, ×6. — *M. uraiensis* (ROSENST.) CHING. *h.* Sorus, ×16 (*a–c* HOLTTUM 53; *d* DAY *s.n.*; *e–f* MATTHEW *s.n.*; *h* M. G. PRICE 3368).

Distr. Fernando Poo & S. Tomé; Nigeria (an undescribed species); Madagascar, Ceylon & India, S. China to Japan; *Malesia*; about 12 species.

Ecol. In Malesia all species occur on mountains at 1000–2000 m, usually on steep earth slopes or rocks. The only species which are both widely distributed and locally common are the tetraploid *M. dayi* and the (probably tetraploid) form of *M. flaccida* which has long hairs on the lower surface; these occur in somewhat open places, especially where paths have been made in the forest. Of the rest, *M. singalanensis* is a forest fern of restricted distribution in Sumatra, *M. gracilescens* is widely distributed but rarely abundant.

Cytol. Chromosome number 35 (*M. dayi* tetraploid; *M. flaccida* diploid and tetraploid in Ceylon).

KEY TO THE SPECIES

1. Veins always simple except sometimes in basal acroscopic lobes of pinnae . . **1. M. gracilescens**
1. Veins normally forked except distal ones.
2. Pinnae with some hairs on lower surface between veins; lobes of larger pinnae lobed more than half way to costule . . . . . **2. M. flaccida**
2. Pinnae not hairy between veins on lower surface; pinna-lobes entire to crenate, shallowly lobed only on largest fronds.
3. Pinnae rarely over 6 cm long; indusia bearing acicular hairs . . . . . **3. M. uraiensis**
3. Pinnae of well-grown plants 12 cm or more long; indusia bearing capitate hairs.
4. Lower surface of costae and costules bearing copious capitate hairs.
5. Texture thin, drying dark green; veins conspicuously branched . . . . **4. M. singalanensis**
5. Texture firm, drying yellow-green; veins forked near tips, branches little diverging **4b. M. singalanensis var. surbeckii**
4. Lower surfaces of costae and costules bearing sparse acicular hairs . . . . . **5. M. dayi**

1. Metathelypteris gracilescens (BL.) CHING, Acta Phytotax. Sinica 8 (1963) 305; HOLTTUM, Kalikasan 5 (1976) 116. — *Aspidium gracilescens* BL. Enum. Pl. Jav. (1828) 155; RACIB. Fl. Buitenz. 1 (1898) 170. — *Lastrea gracilescens* (BL.) MOORE, Ind. Fil. (1858) 93; BEDD. Handb. (1883) 234, *p.p.*; Suppl. (1892) 51, *p.p.*; COPEL. Fern Fl. Philip. (1960) 322; TAGAWA, Col. Illus. Jap. Pterid. (1962) f. 240. — *Nephrodium gracilescens* (BL.) HOOK. Spec. Fil. 4 (1862) 93, *p.p.* — *Dryopteris gracilescens* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 186 *excl. syn. Aspidium glanduligerum*; BACKER & POSTH. Varenfl. Java (1939) 38. — *Thelypteris gracilescens* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 327; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 147. — Type: BLUME, Java (L).

Nephrodium vulcanicum BAK. Ann. Bot. 5 (1891) 127. — *Thelypteris vulcanica* (BAK.) REED, Phytologia 17 (1968) 324. — Type: HANCOCK, G. Pangerango, Java (K).

Athyrium benguetense CHRIST, Philip. J. Sci. 2 (1907) Bot. 161; COPEL. Philip. J. Sci. 3 (1908) Bot. 300. — Type: LOHER, Mt Data, Luzon, Feb. 1894 (not found at P).

Dryopteris calva COPEL. in Elmer Leafl. Philip. Bot. 3 (1910) 805. — *Dryopteris gracilescens var. calva* (COPEL.) C. CHR. Ind. Fil. Suppl. III (1934) 82. — *Lastrea calva* (COPEL.) COPEL. Gen. Fil. (1947) 138, Fern Fl. Philip. (1960) 323. — Type: ELMER 11485, Mt Apo, Mindanao (MICH; BM, E, K).

Dryopteris sublaxa HAYATA, Icon. Pl. Formos. 4 (1914) 183, f. 122. — Type: HAYATA, Mt Arisan, Taiwan, Jan. 1912 (TI, seen by IWATSUKI).

Dryopteris arisanensis ROSENST. Hedwigia 56 (1915) 340. — Type: FAURIE 389, Mt Arisan, Taiwan (isotype KY seen by IWATSUKI). — **Fig. 3a–c.**

Caudex short-creeping; *stipe* 18–25 cm long, pale, scales 2 mm long. *Lamina* 25–30 cm long; pinnae 15–18 pairs, rather close; basal pinnae narrowed at basiscopic base. *Largest pinnae* of type 7.5 × 1.4 cm, of type of *Nephrodium vulcanicum* 9 × 2.0 cm, short-acuminate, lobed to 1 mm from costa or more deeply, lobes entire, separated by narrow sinuses, basal acroscopic lobe of middle pinnae somewhat elongate; costules commonly 3 mm apart; veins 6–7 pairs, simple or rarely forked in basal acroscopic pinna-lobes; lower surface of rachis and costae with varied complement of short acicular and capitate hairs, sometimes almost glabrous. *Sori* medial or a little supramedial, near tips of veins; indusia small, thin, glabrous.

Distr. S. Japan, Taiwan; Darjeeling; in *Malesia*: Malaya, Sumatra, W. Java, N. Borneo, Luzon, Mindoro, Mindanao, New Guinea.

Ecol. In Malesia at 1500–2200 m, in forest, in two cases on rocks near waterfall; only one collection from Malaya, from 1800 m at Cameron Highlands.

Note. *M. decipiens* (CLARKE) CHING, described from Darjeeling, differs in having shorter fronds with basal pinnae largest, veins mostly forked, at least in the crenate lobes of basal pinnae.

2. Metathelypteris flaccida (BL.) CHING, Acta Phytotax. Sinica 8 (1963) 306. — *Aspidium flaccidum* BL. Enum. Pl. Jav. (1828) 161; RACIB. Fl.

Buitenz. 1 (1898) 176. — *Lastrea flaccida* (BL.) MOORE, Ind. Fil. (1858) 92; BEDD. Ferns S. India (1864) t. 250; Handb. (1883) 244. — *Nephrodium flaccidum* (BL.) HOOK. Spec. Fil. 4 (1862) 133, t. 263. — *Dryopteris flaccida* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 195; BACKER & POSTH. Varenfl. Java (1939) 41. — *Thelypteris flaccida* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 336. — Type: BLUME, Boerangrang, Java (L, *n.* 908,332–1093). — **Fig. 3e–f.**

Caudex short, erect. Stipe 25–45 cm long, pale, hairy in groove only. *Lamina* 25–45 cm long; pinnae to 15 pairs, well-spaced; lowest pinnae narrowed a little on basiscopic side. *Largest pinnae* 8.5–12 × 1.8–3.5 cm, acuminate, lobed to a narrow wing on costa; lobes of largest pinnae lobed more than half way to costule, their tips blunt-pointed; costules 4–6 mm apart; veins pinnate in larger lobules of pinna-lobes, forked in smaller ones; lower surface bearing slender erect acicular hairs throughout, those on costae and costules 1 mm long in typical form (some plants in Ceylon and Malaya have hairs less than 0.5 mm). *Sori* 1–2 in each lobule of a pinna-lobe; indusia thin, pale, bearing short acicular hairs.

Distr. Ceylon & S. India, N.E. India to Yunnan, Thailand; in *Malesia*: Java, Sumatra (?), Malaya, Borneo.

Ecol. In W. Java abundant at 1500 m. In Malaya not found until in recent years plants have appeared on earth banks beside roads where forest has been cleared at Cameron Highlands and on Taiping Hills; these plants have short hairs on the lower surface of costae as in some plants found by MANTON in Ceylon.

3. Metathelypteris uraiensis (ROSENST.) CHING, Acta Phytotax. Sinica 8 (1963) 306; C. M. KUO, Fl. Taiwan 1 (1975) 419; HOLTTUM, Kalikasan 5 (1976) 117. — *Dryopteris uraiensis* ROSENST. Hedwigia 56 (July 1915) 341. — *Thelypteris uraiensis* (ROSENST.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 336; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 148, 152. — *Lastrea uraiensis* (ROSENST.) TAGAWA, Col. Ill. Jap. Pterid. (1962) 223. — *Macrothelypteris uraiensis* (ROSENST.) LÖVE & LÖVE, Taxon 26 (1977) 325. — Type: FAURIE 22, Urai, Taiwan (isotypes G, P).

Dryopteris hirtisquamata HAYATA, Icon. Pl. Formos. 5 (Nov. 1915) 277. — Type: T. ITO & FUJII, Taiwan (TI, seen by IWATSUKI). — **Fig. 3h.**

Caudex short-creeping; *stipe c.* 20 cm long, pale. *Lamina c.* 18 × 12 cm; pinnae to 18 pairs; lowest pinnae short-stalked and narrowed at base. *Largest pinnae* 4.5–6.0 cm long, 1.4–1.8 cm wide, lobed to 1 mm from costa; costules 3–4 mm apart; veins to 6 pairs, mostly forked; lower surface of costae, costules and veins bearing acicular hairs, hairs between veins sparse. *Sori* medial to supramedial, near tips of veins; indusia thin with short acicular hairs on edge.

Distr. S. Japan, Ryukyu Islands, Taiwan, Kwangtung, Yunnan; in *Malesia*: Philippines (N. Luzon: M. G. PRICE 2915, Solsona; 3368, Mt Data, Ilocos Norte Prov.).

Note. This species is very near *M. gracilescens* but appears to be distinct in the characters mentioned in the key.

4. Metathelypteris singalanensis (BAK.) CHING, Acta Phytotax. Sinica 8 (1963) 306. — *Nephrodium singalanense* BAK. J. Bot. 18 (1880) 212. — *Lastrea singalanensis* (BAK.) BEDD. Handb. Suppl. (1892) 54. — *Dryopteris singalanensis* (BAK.) C. CHR. Ind. Fil. (1905) 293; v.A.v.R. Handb. (1908) 194. — *Thelypteris singalanensis* (BAK.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 334. — Type: BECCARI 471, G. Singgalang 1700 m, Sumatra (K; FI *n.* 12963 in Herb. Becc.).

Dryopteris media v.A.v.R. Bull. Jard. Bot. Btzg II, 11 (1913) 9; Handb. Suppl. (1917) 162. — Type: MATTHEW 514, G. Singgalang, Sumatra (BO; K). — **Fig. 3g.**

a. ***var.*** **singalanensis**

Caudex short, erect; stipe 30–50 cm long, pale; scales *c.* 7 mm long, narrow above widened base which is fully 1 mm wide. *Lamina* 50–70 cm long; pinnae to 25 pairs, often almost opposite, drying dark green, thin; basal pinnae not reduced. *Largest pinnae* of type 9.3 × 2.3 cm, of other specimens to 12 × 3.0 cm (fertile), 14 × 4 cm (sterile), lobed almost to costa; lobes of almost all pinnae crenate, of largest ones distinctly lobed; veins 10–12 pairs, nearly all forked, in largest lobes twice forked; lower surface of rachis, costae, costules and veins bearing copious very short capitate hairs and sometimes a few acicular hairs, some capitate hairs also on surface between veins; upper surface of rachis and costae bearing copious acicular hairs 0.2 mm long, hairs on costules minute. *Sori* on acroscopic branches of veins; indusia bearing many short capitate hairs.

Distr. *Malesia*: Central W. Sumatra (G. Singgalang).

Ecol. "on bank by path in forest" (MATTHEW); two collections from 1500 and 2100 m.

b. ***var.*** **surbeckii** HOLTTUM, *var. nov.*

A typo speciei differt: pinnis in sicco brunneo-virentibus, firmioribus; venis saepe simplicibus, versus apicem tantum breviter furcatis; pagina inferiore inter venas pilis capitatis destituta. — Type: SURBECK 1193, Sibuatan-Zuid, Sumatra, 1700 m (L). Also ALSTON 14974, Sidikalang (BM).

Distr. *Malesia*: Central Sumatra, *c.* 350 km north of G. Singgalang.

5. Metathelypteris dayi (BEDD.) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 205; Kalikasan 5 (1976) 117. — *Aspidium dayi* BEDD. J.

Bot. 26 (1888) 4. — *Lastrea dayi* (BEDD.) BEDD. Handb. Suppl. (1892) 54. — *Dryopteris dayi* (BEDD.) C. CHR. Ind. Fil. (1905) 260; v.A.v.R. Handb. (1908) 188. — *Thelypteris dayi* (BEDD.) NAYAR & KAUR, Comp. to Bedd. (1974) 59. — Type: J. DAY, Perak, March 1887 (K).

Nephrodium creaghii BAK. Kew Bull. (1898) 230. — *Dryopteris creaghii* (BAK.) C. CHR. Ind. Fil. (1905) 258; v.A.v.R. Handb. (1908) 185; C. CHR. Gard. Bull. Str. Settl. 7 (1934) 240. — Type: CREAGH, N. Borneo (K).

Dryopteris flavo-virens ROSENST. Fed. Rep. 10 (1912) 334; v.A.v.R. Handb. Suppl. (1917) 165. — *Lastrea flavo-virens* (ROSENST.) COPEL. Gen. Fil. (1947) 138; Philip. J. Sci. 78 (1951) 423. — *Thelypteris flavo-virens* (ROSENST.) REED, Phytologia 17 (1968) 277. — Type: BAMLER W.11 *partim*, Wareo, 600 m, Papua New Guinea, 11 June 1909 (S-PA).

Dryopteris aureoviridis ROSENST. Fed. Rep. 13 (1914) 216; v.A.v.R. Handb. Suppl. (1917) 161. — *Thelypteris aureoviridis* (ROSENST.) REED, Phytologia 17 (1968) 262. — Type: J. WINKLER 179, *in terra Batacorum*, Sumatra, 1911 (not seen; Ros. Fil. Sumatr. exsicc. 141 from same locality at K, L).

Dryopteris diversivenosa v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 23. — *Thelypteris diversivenosa* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 251. — Type: BÜNNEMEIJER 1104, Tanang Taloe, 1000 m, Ophir Distr. Sumatra (BO).

Thelypteris singalanensis sensu HOLTTUM, Rev. Fl. Malaya 2 (1955) 243, *p.p.*, f. 138; M. G. PRICE, Brit. Fern Gaz. 10 (1973) 255. — **Fig. 1m, 3d.**

Caudex short, erect; plants fertile from a small size. *Stipe* 20–45 cm long, pale; basal scales very narrow, 5–7 mm long, not widened at base. *Lamina* to 50 cm long, firm, drying yellow-green; free pinnae *c.* 15 pairs, at least lower ones opposite; basal pinnae sometimes a little reduced, always ± narrowed at base. *Largest pinnae* to 16 × 3 cm, lobed to 1–2 mm from costa; lobes entire on small fronds, crenate to lobulate on larger ones; costules almost at right angles to costae, on larger pinnae 5–6 mm apart; veins to 10 pairs, almost all forked, basiscopic branch sometimes forked again; lower surface of rachis and base of costae glabrous, distally on costae and costules sparse acicular hairs 0.2 mm long, rarely a few short capitate hairs; hairs on upper surface of rachis 0.2 mm long, on costae 0.3 mm, on costules very short. *Sori* on acroscopic branches of veins; indusia thin with capitate hairs on edge.

Distr. Tonkin; Thailand; *Malesia*: Sumatra, Malaya, W. Java, Borneo, Luzon, Mindanao, New Guinea.

Ecol. In Malaya locally abundant at hill stations on earth banks beside paths in open or partially shaded places; in exposed places conspicuously yellow-green. One plant from Malaya cultivated at Kew was tetraploid.

Note. Another specimen labelled W. 11 by BAMLER (collected in 1914) was type of *Dryopteris distincta* COPEL.

4. PHEGOPTERIS

FÉE, Gen. Fil. (1852) 242 *emend.* CHING, Acta Phytotax. Sinica 8 (1963) 312; HOLTTUM, Blumea 17 (1969) 9. — *Polypodium* § *Phegopteris* PRESL, Tent. Pterid. (1836) 179, *p.p.* — *Thelypteris subg. Phegopteris sect. Phegopteris* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 25 and *sect. Lastrella p.p.*

Caudex wide-creeping or short and suberect; fronds pinnate with deeply lobed pinnae which are connected with each other by a wing along the rachis, the wing forming, between one pinna and the next, a ± semicircular lobe containing a branched vein arising directly from the rachis; frond-form either deltoid or (in sole Malesian species) lanceolate with lower pinnae gradually reduced; veins in pinna-lobes simple or branched, tips of distal ones only reaching margin; sori subterminal on veins or their branches, exindusiate or with a very small indusium; sporangia often bearing short acicular or capitate hairs; lower surface of rachis and costae of pinnae copiously scaly; scales pale, thin, narrow, with slender spreading marginal hairs and a hair-tip; larger, darker and often less hairy scales present at base of stipe; surfaces of frond bearing acicular and capitate hairs.

Type species: *Polypodium phegopteris* L. (*Phegopteris polypodioides* FÉE).

Distr. Three species, one widely distributed in north temperate regions and south to Himalayas, one in E. North America, one in S.E. Asia.

Cytol. Base chromosome number 30: *P. connectilis* triploid; *P. hexagonoptera* diploid; *P. decursive-pinnata* diploid and tetraploid.

Notes. FÉE and other authors of the 19th century included in this genus free-veined species resembling *Nephrodium* but lacking indusia; METTENIUS admitted also species with anastomosing veins. The result in either case was an unnatural mixture. CHING was the first author to restrict the genus in the sense here accepted. The species described below differs from the type in elongate fronds on a suberect caudex.

1. 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; HOLTTUM, Blumea 17 (1969) 11; C. M. KUO, Fl. Taiwan 1 (1975) 427, f. 148. — *Polypodium decursive-pinnatum* VAN HALL, Nieuwe Verh. Kon. Ned. Inst. Wet. 5 (1836) 204; HOOK. 2nd Cent. Ferns (1861) t. 49. — *Aspidium decursive-pinnatum* (VAN HALL) KUNZE, Bot. Zeit. 6 (1848) 555; METT. Fil. Hort. Lips. (1856) 89. — *Nephrodium decursive-pinnatum* (VAN HALL) HOOK. in Blakiston, Five Months on the Yangtse (1862) 365; DIELS in E. & P. Nat. Pfl. Fam. I, 4 (1899) 171. — *Leptogramma decursive-pinnata* (VAN HALL) J. SM. Hist. Fil. (1875) 232. — *Dryopteris decursive-pinnata* (VAN HALL) O. KTZE Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. Suppl. (1917) Corr. 48; Bull. Jard. Bot. Btzg II, 28 (1918) 23. — *Thelypteris decursive-pinnata* (VAN HALL) CHING, Bull. Fan Mem. Inst. Bot. 6 (1939) 275; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 137. — Type: South China *ex* Herb. VAN HALL (L).

Lastrea decurrens J. SM. in Curt. Bot. Mag. 72 (1846) Comp. 32. — Type: CAMERON, China (BM).

Caudex short, suberect; *stipes* tufted, 3–10 cm long, closely scaly and hairy throughout; scales at base firm, brown with copious stiff marginal hairs; *lamina* to 50 cm long, narrowed gradually to apex and base; lowest pinnae 10–15 mm long, middle pinnae 3.5–8 cm long, 6–10 mm wide, lobed $\frac{1}{2}$–$\frac{2}{3}$ towards costa; veins in lobes pinnate, veinlets simple; sori subterminal on veinlets, to 8 on larger lobes; indusium very small, bearing long stiff unicellular hairs; sporangia bearing either acicular or capitate hairs.

Distr. Central & S.E. China, Tonkin, Taiwan, Korea; in *Malesia* recorded from Celebes and East Java.

Ecol. In Taiwan, at low and median altitudes, usually on rocks (C. M. KUO).

Notes. At Paris is a specimen of ZOLLINGER 1442 named *Asplenium erectum* WILLD., *ex* Herb. DRAKE, from East Java, "ad pedem Mt Lamongan 1500', Jan. 1845". v.A.v.R. records a cultivated plant at Bogor originating from Celebes, collected there by KOORDERS. These are the only known records of the occurrence of the species in Malesia.

A small indusium was first described by J. SMITH in *Lastrea decurrens*. CHING and IWATSUKI have stated that the receptacle bears a tuft of hairs, not an indusium; but there is a distinct flat structure with hairs on its margin which I would not call part of the receptacle.

MITUI has recorded diploid and tetraploid conditions in the species, but no-one has distinguished the two forms from other characters, and I cannot see clear distinctions among herbarium specimens.

For some years a plant flourished in cultivation in the Botanic Garden at Penang but did not reproduce itself from spores. Plants grow well in the Temperate Fern-House at Kew.

5. CORYPHOPTERIS

HOLTTUM, Blumea 19 (1971) 33; Blumea 23 (1976) 18–47; Allertonia 1 (1977) 195. — *Parathelypteris sect. Melanostipes* CHING, Acta Phytotax. Sinica 8 (1963) 301, *p.p.* — **Fig. 11, 4.**

Caudex erect, to *c.* 30 cm tall except in *C. inopinata*; *stipes* dark throughout or paler distally, in a few cases bearing spreading septate hairs near base, always with rather broad scales which in most species lack acicular hairs. *Lamina* commonly 20–40 cm long, rarely to 80 cm, apex never pinna-like; lowest pinnae not or little reduced except in *C. fasciculata* and *C. squamipes*, narrowed towards their bases and often wider at their middle than other pinnae; basal acroscopic lobe often enlarged and dentate

with some forked veins; aerophores at bases of pinnae somewhat swollen; *pinnae* always deeply lobed, one or more basal lobes sometimes free; veins in lobes simple or rarely once forked, both basal veins to edge above base of sinus; lower surface of rachis, costae, costules and veins always bearing some reduced scales (smallest filiform); spreading acicular hairs usually present on lower surface of axes of frond (sometimes replaced by short capitate hairs), in some cases longer hairs which may be septate; sessile resinous glands (which may collapse on drying) present on lower surfaces of many species, in some also on upper surface; costa always grooved on upper surface; hairs on upper surface of rachis and costae always acicular, normally unicellular, in a few species septate. *Sori* usually with rather large indusia which may be glandular or hairy, distal sori (rarely all) sometimes asymmetric as in *Athyrium*; sporangia short-stalked, never with glands or hairs on body, sometimes with a sessile gland on the stalk; spores usually pale, translucent, with a ± continuous wing and a few cross-wings, in at least one species with many small wings.

Type species: *Coryphopteris viscosa* (BAKER) HOLTTUM.

Distr. N.E. India to S. China and Japan; *Malesia* (except Java and Lesser Sunda Islands), Solomon Islands, New Caledonia, Fiji, Samoa, Tahiti, Rapa, Marquesas; in all about 47 species.

Cytol. In HOLTTUM, Ferns of Malaya (1955) p. 624, MANTON recorded n = 32 for *Thelypteris pectiniformis* (fig. 8) and 2n = c. 70 for *T. viscosa*; the latter record was probably made from a plant of the species later named *Coryphopteris arthrotricha* HOLTTUM. In June 1980 J. W. GRIMES examined a plant of *C. arthrotricha*, from Cameron Highlands, Malaya, in cultivation at Kew, and found n = 66, indicating a tetraploid with base number 33. This number had not previously been recorded for any species in the family. There are no other records of observations on the chromosomes of this genus. It seems possible that the count of n = 32 for *C. pectiniformis* might have been an error for 33, as the photograph in fig. 8 shows some overlapping of chromosomes. Counts from other species are needed to confirm that n = 33 is characteristic of the genus.

Ecol. Plants of this genus occur only in ± mossy forest on mountain ridges where the soil is leached and often peaty; Mrs A. G. PIGGOTT reports a pH of 4.0 for soil on G. Ulu Kali in Malaya (Fern Gaz. 11, 1978, 428). In this habitat there are usually no other thelypteroid ferns.

Notes. The greatest number of species (20) occur in New Guinea, where there is the greatest and most varied development of suitable mountainous country.

Critical new field work is needed everywhere for a better understanding of this genus; more new species may remain to be discovered, and some here described need to be more clearly characterized. The presence and distribution of glands is always a significant character, as in other members of the family. The glands of *Coryphopteris* are resinous and sometimes collapse when dried by artificial heat or when treated with alcohol before drying; in the collapsed state they are often difficult to see.

Among species lacking glands, the only one widely distributed is *C. badia*. This appears to be peculiar in growing always in moss-cushions, sometimes on branches of trees. The bases of stipes are covered with slender hairs like those on roots and probably have the same function.

Species 1–3 have hairs of a different type at the bases of stipes; these are rigid and spreading, consisting of many cells. Habitat conditions for these species have not been well recorded. One of them is *C. unidentata* which has larger fronds than any other in the genus and is only known from three mountains in the north of Malaya. *C. arthrotricha*, the common species on the Main Range of Malaya, has septate hairs on the upper surface of costae, not at the base of stipes; *C. tahanensis*, only known from Gunung Tahan in Malaya, is intermediate between *C. multisora* of Borneo and *C. arthrotricha*.

The almost invariable miniature arborescent habit of well-grown plants of all species of this genus, and the fact that they are confined to ridge-tops where other thelypteroid ferns will not grow, suggests that *Coryphopteris* may be the relic of a primitive section of the family. The *Cyathea*-like septate hairs on upper surface of rachis and costae in *C. unidentata, C. hirsutipes, C. multisora, C. tahanensis* and *C. arthrotricha* may also be a relic of a primitive condition. The only species which show a partially bipinnate condition are *C. habbemensis* and *C. stereophylla*, both much smaller in stature than *C. unidentata*.

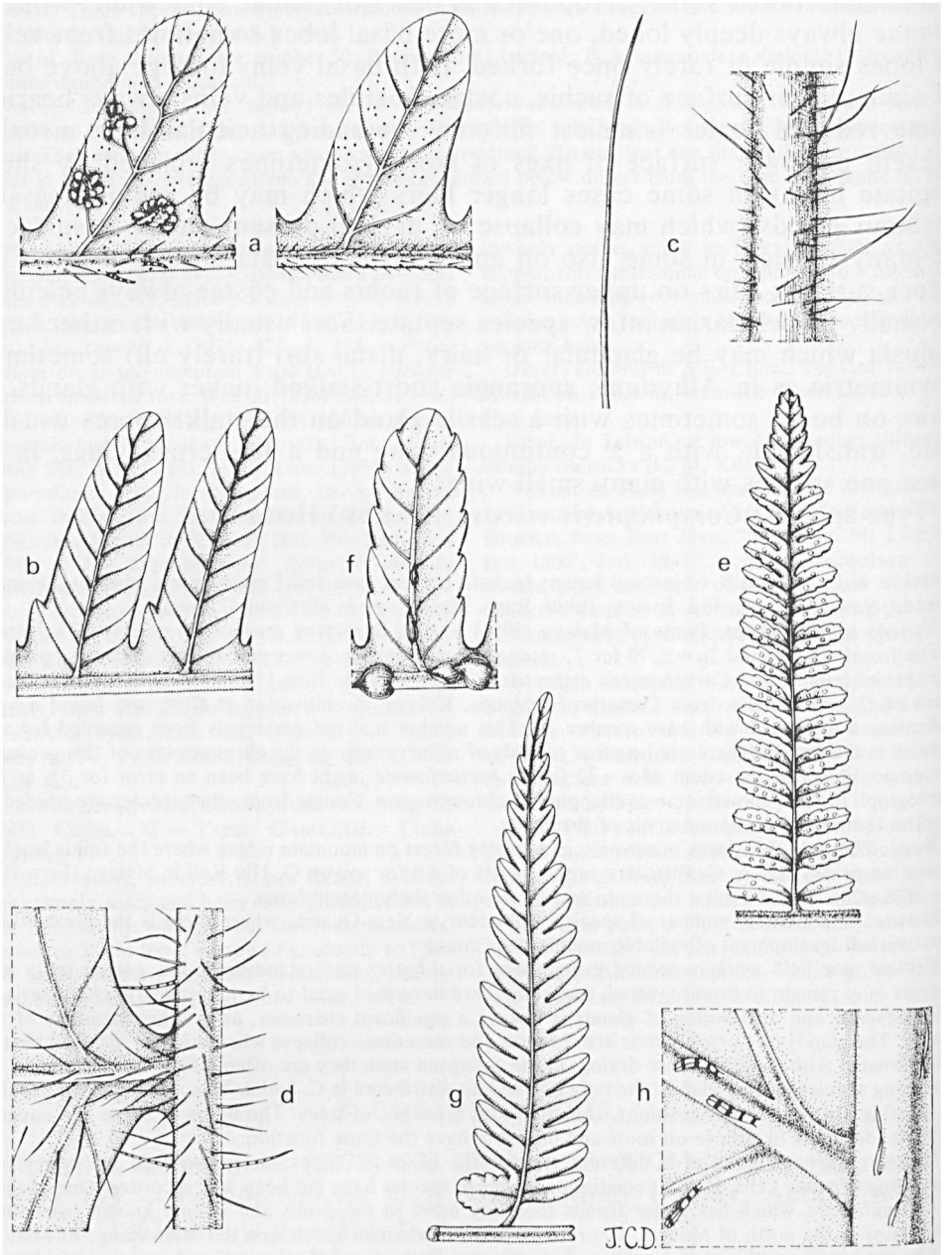

Fig. 4. *Coryphopteris viscosa* (BAK.) HOLTTUM. *a.* Lower and upper surface of pinna-lobes, showing glands, hairs and uniseriate scales, ×8. — *C. unidentata* (BEDD.) HOLTTUM. *b.* Middle lobes of basal pinna, ×3. — *C. hirsutipes* (CLARKE) HOLTTUM. *c.* Base of stipe, ×8 and part of one hair, ×32. — *C. multisora* (C. CHR.) HOLTTUM. *d.* Rachis and base of pinna, lower surface, showing septate hairs, ×8. — *C. habbemensis* (COPEL.) HOLTTUM. *e.* One pinna, ×1.5. — *C. klossii* (RIDL.) HOLTTUM. *f.* One pinna-lobe, ×6. — *C. badia* (v.A.v.R.) HOLTTUM. *g.* Basal pinna, ×1.5; *h.* costa and part of costule, showing acicular hairs and narrow scales, ×40 (*a* PIGGOTT 1896, *b* KUNSTLER 7434, *c–d* MOYSEY *s.n.*, *e* PULLEN 5248, *f* VINK 17207, *g–h* MATTHEW *s.n.*).

KEY TO THE SPECIES

1. Base of stipe bearing pale, firmly cylindrical multiseptate hairs.
2. Stipe and abaxial surface of rachis densely covered with spreading hairs many of which are septate (see also *n.* 14) . . . . . **1. C. unidentata**
2. Stipe above base and abaxial surface of rachis less densely hairy with few septate hairs.
3. Indusium glandular; scales at base of stipe to 10 × 3 mm . . . . . **2. C. multisora**
3. Indusia bearing acicular hairs; scales at base of stipe much smaller . . . . . **3. C. hirsutipes**
1. Base of stipe not bearing such hairs.
4. Sessile glands and/or acicular hairs abundant between veins on upper surface.
5. Scales on lower surface of costae at most 2 cells wide at base.
6. Stipe-scales thin, less than 1 mm wide above base; lower surface of costae bearing many acicular hairs.
7. Pinnae to 2.5 cm long, nearly all deflexed . . . . . **4. C. plumosa**
7. Pinnae to 5.5 cm long, a few basal ones deflexed.
8. Pinnae to 25 pairs or more; pinna-lobes mostly entire . . . . **5a. C. viscosa *var.* viscosa**
8. Pinnae 12–18 pairs; pinna-lobes mostly crenate . . . . . **5b. C. viscosa *var.* poiensis**
6. Stipe-scales firm, 1 mm or more wide; lower surface of costae bearing short capitate hairs and glands, acicular hairs lacking or very few.
9. Upper surface of pinnae lacking acicular hairs between veins **6a. C. gymnopoda *var.* gymnopoda**
9. Upper surface of pinnae bearing acicular hairs between veins.
10. Lower surface between veins, and indusia, lacking acicular hairs **6b. C. gymnopoda *var.* bintangensis**
10. Lower surface bearing copious short erect acicular hairs between veins **6c. C. gymnopoda *var.* humilis**
5. Scales on lower surface of costae widened at base.
11. Upper surface of pinnae lacking acicular hairs between veins.
12. Scales on lower surface of costae broadly ovate . . . . . **7. C. klossii**
12. Scales on lower surface of costae linear with a ± widened base.
13. Indusia bearing copious acicular hairs; stipe-scales 3 × 0.8 mm, firm, with many spherical outgrowths on dorsal surface . . . . . **8. C. iwatsukii**
13. Indusia lacking acicular hairs; stipe-scales to 7 × 1.5 mm, thin, smooth dorsally **9. C. atjehensis**
11. Upper surface of pinnae bearing acicular hairs between veins . . . . . **10. C. obtusata**
4. Sessile glands and acicular hairs lacking or rare between veins on upper surface of pinnae.
14. Sessile glands present on lower surface generally, or at least on costules.
15. Sori distinctly supramedial . . . . . **11. C. diaphana**
15. Sori medial to inframedial.
16. Basal half of lower pinnae bearing free or separately adnate pinnules . . **12. C. habbemensis**
16. At most one free pinnule present at base of largest pinnae.
17. Many septate hairs present on upper surface of rachis and costae.
18. Septate hairs on upper surface of rachis and costae less than 0.5 mm long; stipe-scales 3 mm long . . . . . **13. C. arthrotricha**
18. Septate hairs on upper surface of rachis and costae 1 mm or more long; stipe-scales much longer.
19. Stipe-scales to 10 × 3 mm, thin; hairs on upper surface of rachis and costae commonly 1–1.5 mm long . . . . . **2. C. multisora**
19. Stipe-scales to 7 × 1 mm, rigid, hair-pointed; hairs on upper surface of rachis and costae not over 1 mm long . . . . . **14. C. tahanensis**
17. Septate hairs absent or rare on upper surface of rachis and costae.
20. Sori mainly along one side of a vein, rarely reniform . . . . . **15. C. athyrioides**
20. Sori mainly reniform, distal ones sometimes ± athyrioid.
21. All pinna-lobes entire.
22. Pinnae thin, copiously hairy on costae beneath; costal scales few.
23. Hairs on lower surface of costae unicellular . . . . . **16. C. pectiniformis**
24. Pinnae *c.* 1.6 cm. wide; veins 7–8 pairs; hairs on lower surface of costae over 0.5 mm long . . . . . **16a. C. pectiniformis *var.* pectiniformis**
24. Pinnae *c.* 0.8 cm wide, veins 3–4 pairs; hairs on lower surface of costae *c.* 0.1 mm long **16c. C. pectiniformis *var.* minor**
23. Hairs on lower surface of costae to 1.5 mm long, septate **16b. C. pectiniformis *var.* hirsuta**
22. Pinnae rigid; costae sparsely hairy beneath and bearing many small scales **17. C. andersonii**

21. At least basal acroscopic lobes of middle pinnae dentate.
25. Lamina to 15 cm long; largest pinnae 3.0 × 0.8 cm . . . . . **18. C. andreae**
25. Lamina always much longer; pinnae in most cases to at least 5 × 1 cm.
26. Lower pinnae, at least 2 pairs, reduced; basal pinnae not wider than next above them.
27. Six or more pairs lower pinnae gradually reduced; lowest 1.5–2 cm long; stipe commonly to 15 cm long . . . . . **19. C. squamipes**
27. 2–4 pairs lower pinnae reduced, lowest larger; stipe 20–25 cm.
28. Fertile pinnae to 4.5 × 1.2 cm; stipe-scales to 2.5 mm wide . . . . . **20. C. borealis**
28. Fertile pinnae to 8.5 × 1.7 cm, stipe-scales 1 mm wide . . . . . **21. C. meiobasis**
26. Basal pinnae wider and not shorter than those next above them.
29. Basal acroscopic lobe of basal pinnae free.
30. Glands on lower surface usually confined to costules and veins; no hairs between veins on upper surface.
31. Lamina to 25 cm long; pinnae 12–15 pairs . . . **22a. C. pubirachis *var.* pubirachis**
31. Lamina to 40 cm long; pinnae to 20 pairs . . . . . **22b. C. pubirachis *var.* major**
30. Glands present between veins on lower surface and hairs between veins on upper surface.
32. Basal pinnae to 9 × 2 cm; most pinna-lobes almost entire **22c. C. pubirachis *var.* philippinensis**
32. Basal pinnae to 6 × 1.2 cm; most pinna-lobes dentate or crenate **22d. C. pubirachis *var.* sulawesica**
29. Basal acroscopic lobe of basal pinnae not free.
33. Stipe-scales less than 1 mm wide above dilated base.
34. Pinnae to 18 pairs; lower surface of rachis bearing capitate hairs only; many capitate hairs between veins on upper surface . . . . . **23. C. athyriocarpa**
34. Pinnae to 25 pairs; lower surface of pinna-rachis bearing acicular hairs; no hairs between veins on upper surface . . . . . **5c. C. viscosa *var.* borneensis**
33. Stipe scales at least 1 mm wide above base.
35. Pinna-lobes, except basal one, entire; glands present between veins on lower surface **17. C. andersonii**
35. Pinna-lobes all distinctly dentate; no glands between veins on lower surface **24. C. tanggamensis**
14. Sessile glands lacking on lower surface except in *C. fasciculata* which may have a few glands on costae.
36. Indusia lacking . . . . . **25. C. engleriana**
36. Indusia present.
37. Several pairs of free pinnules on lower pinnae . . . . . **26. C. stereophylla**
37. At most basal lobes free.
38. Upper surface bearing hairs between veins.
39. Hairs on upper surface between veins acicular.
40. Stipe bearing copious hairs 1 mm long . . . . . **27. C. horizontalis**
40. Stipe bearing hairs 0.5 mm long in groove only . . . . . **28. C. microlepigera**
39. Hairs on upper surface between veins capitate . . . . . **29. C. propria**
38. Upper surface between veins normally glabrous.
41. Lower surface of rachis bearing acicular hairs, costae usually also.
42. Some hairs on upper surface of costae septate . . . . . **30. C. lauterbachii**
42. Hairs on upper surface of costae unicellular.
43. Several pairs lower pinnae gradually reduced, longest 5.5 cm, lowest 1–2 cm **31. C. fasciculata**
43. Lower pinnae not or little reduced.
44. Texture rigid; pinnae to 3 cm long; hairs on lower surface of rachis 0.5 mm long **32. C. hubrechtensis**
44. Texture thin; pinnae to 6.5 cm long; hairs on lower surface of rachis 0.2 mm long **33. C. brevipilosa**
41. Lower surface of rachis and costae lacking (or almost lacking) acicular hairs.
45. Short capitate hairs present on lower surface of costae and costules and on indusia **34. C. oligolepia**
45. Capitate hairs lacking or rare on lower surface and indusia.
46. Sori supramedial; stipe-scales 8–10 mm long . . . . . **35. C. coriacea**
46. Sori medial or inframedial; stipe-scales not over 5 mm long.
47. Sori mostly athyrioid; pinnae to 2.5 cm long . . . . . **36. C. ledermannii**

47. Sori mostly not athyrioid; pinnae longer.
48. Caudex erect.
49. Pinnae thin; no tangled hairs at base of stipe.
50. Veins 3–4 pairs; pinna-lobes entire except basal acroscopic ones . . . **37. C. dura**
50. Veins *c.* 6 pairs; pinna-lobes mostly crenate.
51. Pinnae caudate-acuminate . . . . . **38. C. platyptera**
51. Pinnae short-acuminate . . . . . **39. C. subnigra**
49. Pinnae thick; tangled hairs often present at base of stipe . . . . . **40. C. badia**
48. Caudex slender, long-creeping . . . . . **41. C. inopinata**

1. **Coryphopteris unidentata** (BEDD.) HOLTTUM, Blumea 23 (1976) 26. — *Lastrea unidentata* BEDD. Handb. Suppl. (1892) 53. — *Dryopteris monodonta* C. CHR. Ind. Fil. (1905) 278, *nom. nov.*; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 388. — *Thelypteris unidentata* (BEDD.) HOLTTUM, Rev. Fl. Malaya 2 (1955) 251. — Type: KUNSTLER 7434, Gunung Bubu, Perak (K). — **Fig. 4b.**

Stipe to 60 cm long, bearing throughout spreading septate hairs 1 mm or more long; basal scales 10 × 1.5 mm. *Lamina* to 80 cm long; pinnae c. 25 pairs; basal pinnae narrowed at base, basal acroscopic lobe enlarged, dentate, free, some other lobes with a single tooth at basiscopic base; *largest pinnae* 18.5 × 2.6 cm, sessile, lobed to 1 mm from costa, lobes entire except basal ones; costules to 5 mm apart; veins to 10 pairs; lower surface of rachis and costae bearing septate hairs; sessile glands present on costae, costules and veins, fewer between veins, narrow scales on costae and costules; upper surface of costae bearing septate hairs, few on costules, no glands. *Sori* medial; indusia bearing short capitate hairs or glands.

Distr. *Malesia*: Malaya. Only known from G. Bubu, G. Bintang and G. Inas in Perak.

Note. The presence of a single large tooth at the basiscopic base of lobes of basal pinnae, which is denoted by the name *unidentata*, occurs only on the type collection. The others are smaller (the smallest frond has pinnae to 12 × 1.8 cm) but otherwise do not differ. The septate hairs at base of stipe are shorter than those on *C. hirsutipes*.

2. **Coryphopteris multisora** (C. CHR.) HOLTTUM, Blumea 23 (1976) 26. — *Dryopteris multisora* C. CHR. Gard. Bull. Str. Settl. 7 (1934) 241. — *Thelypteris multisora* (C. CHR.) REED, Phytologia 17 (1968) 295. — Type: HOLTTUM 25523, Sabah, Mt Kinabalu 2100 m (BM; BO, SING). — **Fig. 4d.**

Stipe to 45 cm, dark bearing sessile glands throughout and long septate hairs near base, also distally in the groove; scales thin, to 10 × 3 mm. *Lamina* to 55 cm long; pinnae to 25 pairs; basal pinnae to 2.1 cm wide in middle, narrowed to base with basal acroscopic lobe enlarged, dentate to deeply lobed, almost free, rarely to 15 mm long. *Pinnae above base* to 11 × 1.8 cm, acuminate; lobes not falcate, entire or nearly so; costules 3.5–4 mm apart; veins 6–7 pairs; glands present on lower surface of rachis, costae and costules, sparse septate hairs on rachis and costae (sometimes absent), many very narrow scales on costae and costules; upper surface of rachis bearing septate hairs 1–1.5 mm long, similar but shorter hairs on costae and costules; sometimes a few glands on costae and costules. *Sori* large, somewhat inframedial, filling lower surface at maturity; indusia glandular.

Distr. *Malesia*: Sabah (Mt Kinabalu), Sarawak (G. Mulu), 1350–3000 m, several collections.

Note. Long septate hairs are not present at the base of stipes in all specimens; the species therefore appears in two places in the key. CHRISTENSEN wrongly stated that glands are absent from lower surface of rachis and costae.

3. **Coryphopteris hirsutipes** (CLARKE) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 203; Blumea 23 (1976) 27. — *Nephrodium gracilescens var. hirsutipes* CLARKE, Trans. Linn. Soc. II Bot. 1 (1880) 514, t. 67, f. 1. — *Lastrea gracilescens sensu* BEDD. Handb. (1883) 234, *p.p.* — *Lastrea hirsutipes* (CLARKE) BEDD. Handb. Suppl. (1892) 52, *excl. var. didymochlaenoides.* — *Thelypteris hirsutipes* (CLARKE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 314. — *Parathelypteris hirsutipes* (CLARKE) CHING, Acta Phytotax. Sinica 8 (1963) 303. — Lectotype (HOLTTUM 1976): CLARKE 18968, Assam, Khasya Hills 1400 m (K).

Dryopteris indochinensis CHRIST in Morot J. Bot. 21 (1908) 263. — *Thelypteris indochinensis* (CHRIST) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 327; TARD. & C. CHR. Fl. Gén. I.-C 7, pt. 2 (1941) 361, f. 43, 1–2. — *Parathelypteris indochinensis* (CHRIST) CHING, Acta Phytotax. Sinica 8 (1963) 304. — Type: EBERHARDT, Tonkin, Massif du Tam Dao, 900 m (P).

Dryopteris gracilescens (Bl.) O. KTZE *var. chinensis* CHRIST, Not. Syst. 1 (1909) 40. — Type: HENRY 10111, Yunnan (P; K).

Dryopteris megalocarpa v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 199. — *Thelypteris megalocarpa* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 252. — Type: LÖRZING 7134, Sumatra, Patjoer-batoe near Lake Toba (BO).

Thelypteris angulariloba CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 323; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 160. —

Parathelypteris angulariloba (CHING) CHING, Acta Phytotax. Sinica 8 (1963) 304; C. M. KUO, Fl. Taiwan 1 (1975) 421, pl. 145. — *Wagneriopteris angulariloba* (CHING) LÖVE & LÖVE, Taxon 26 (1977) 325. — Type: N. K. CHUN 42644, Kwangtung (PE, not seen).

Thelypteris simozawae TAGAWA, Acta Phytotax. Geobot. 6 (1937) 157. — *Parathelypteris simozawae* CHING, Acta Phytotax. Sinica 8 (1963) 304. — Type: SIMOZAWA, Taiwan, 17 Oct. 1936 (KYO, not seen).

Thelypteris herbacea HOLTTUM, Gard. Bull. Sing. 11 (1947) 268; Rev. Fl. Mal. 2 (1955) 254, f. 145. — Type: HOLTTUM 20571, Malaya, Gunung Tahan, 915 m (SING; K). — **Fig. 4c.**

Stipe 20–30(–45) cm long, dark at base only, distal part and rachis pale reddish, at base spreading septate hairs 1–3 mm long; scales small, setose. *Lamina* 25–35 cm long, pinnae 15–20 pairs; basal pinnae narrowed near base, basal acroscopic lobe almost free but not elongate; texture thin. *Largest pinnae* commonly 7 × 1.5 cm (to 10 × 2 cm), acuminate, lobes oblong, entire or sometimes slightly toothed at ends of distal veins; costules 3.5–4.5 mm apart; veins 4–6 pairs; lower surface of rachis and costae bearing copious acicular hairs which are sometimes unicellular (types of *L. hirsutipes*, *D. megalocarpa*, *T. herbacea*) but sometimes few or many are elongate and septate; glands on lower surface absent or few (types of *L. hirsutipes* and *T. herbacea*), rarely abundant; some hairs on upper surface of rachis and costae always septate, slender unicellular hairs often present between veins. *Sori* medial or inframedial; indusia hairy, hairs sometimes septate.

Distr. S. Japan, Ryukyu Islands, Taiwan, S. China to N.E. India, Thailand; in *Malesia*: Malaya, Sumatra.

Notes. IWATSUKI discussed the variability of this species under *T. angulariloba*. I have not seen CHING's type of this, but at Kew are two specimens from Hong Kong cited by him; these and others from Hong Kong and Kwangtung show much variability in abundance of long septate hairs on lower surface, though these hairs are always less abundant than in the type of *D. indochinensis*. CHING stated that the type of *T. angulariloba* lacked glands, but some Hong Kong specimens (including one cited by CHING) have a few. Sumatran specimens are varied both in presence of glands and of septate hairs on lower surface.

4. Coryphopteris plumosa (C. CHR.) HOLTTUM, Blumea 23 (1976) 28. — *Dryopteris plumosa* C. CHR. Dansk Bot. Ark. 9, 3 (1937) 65. — *Thelypteris plumosa* (C. CHR.) REED, Phytologia 17 (1968) 305. — Type: MJÖBERG 7, Sarawak, Mt Murud 2700 m (BM).

Stipe 6–10 cm, base very dark with copious reddish firm scales 7 × 0.7 mm, upper part paler and finely short-hairy; rachis almost stramineous. *Lamina* 20 cm long, pinnae nearly 30 pairs, nearly all deflexed, middle ones largest; basal pinnae 2 cm long, slightly narrowed on basiscopic base, basal acroscopic lobe a little enlarged, dentate and free, texture firm. *Largest pinnae* 2.5 × 0.8 cm, lobes entire; costules 2 mm apart; veins 3–4 pairs, pale and prominent both sides; lower surface of rachis and costae bearing pale acicular hairs more than 0.5 mm long, small capitate hairs present on costae, costules and veins, some glands between veins, a few very narrow scales on costae; upper surface of costae hairy as lower, veins and costules with small capitate hairs, glands throughout. *Sori* supramedial; indusia small, thin, with capitate hairs.

Distr. *Malesia*: Borneo (Sarawak), only known from the type.

5. Coryphopteris viscosa (BAK.) HOLTTUM, Blumea 19 (1971) 33; Blumea 23 (1976) 29. *Lastrea viscosa* J. SM. in Hook. J. Bot. 3 (1841) 412, *nom. nud.* — *Nephrodium calcaratum* (BL.) HOOK. Spec. Fil. 4 (1862) 93, *var. ß tantum.* — *Nephrodium viscosum* BAK. Syn. Fil. (1867) 264, *excl. plant. Philip.* — *Lastrea viscosa* (BAK.) BEDD. Ferns Br. India (1870) t. 334; Handb. (1883) 238; RIDL. J. Mal. Br. R. As. Soc. 4 (1926) 65, *p.p.*; COPEL. Fern Fl. Philip (1960) 324, *excl. plant. Philip.* — *Dryopteris viscosa* (BAK.) O. KTZE, Rev. Gen. Pl. 2 (1891) 814; v.A.v.R. Handb. (1908) 186, *p.p.*; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 380, *p.p.*; *ibid.* 7 (1934) 240, *p.p.* — *Thelypteris viscosa* (BAK.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 215; HOLTTUM, Rev. Fl. Mal. 2 (1955) 252, *p.p.* — *Parathelypteris viscosa* (BAK.) CHING, Acta Phytotax. Sinica 8 (1963) 304. — Type: CUMING 401, Malacca, Mt Ophir (K; BM). — **Fig. 11, 4a.**

a. *var.* viscosa

Stipe 15–20 cm long, dark at base, paler upwards, basal scales 4 × 0.5 mm, thin; rachis dull reddish throughout. *Lamina* to 30 cm long, tapering very gradually distally, thin, pinnae 25 pairs or more, closely placed, a few lower ones deflexed; basal pinnae to 1.4 cm wide, narrowed to base, basal acroscopic lobe little or not dentate, not free. *Largest pinnae* 5.5 × 1.2 cm, sessile; base truncate with acroscopic lobe sometimes a little elongate; apex short-pointed, obtuse; lobes mostly entire; costules 2.5 mm apart; veins to 6 pairs; lower surface of rachis and costae bearing copious acicular hairs 0.5 mm long with some short capitate hairs and glands; scales on costae 1–2 cells wide; glands abundant between veins; glands throughout upper surface. *Sori* medial, distal ones ± athyrioid; indusia thin, with a few glands.

Distr. *Malesia*: Malaya (Mt Ophir), Borneo (Sarawak: Mt Poi).

b. *var.* **poiensis** HOLTTUM, Blumea 23 (1976) 29. — Type: BURTT & WOODS 2828, Poi Range (K).

Pinnae 12–18 pairs, pinna-lobes mostly crenate.

Distr. *Malesia*: Borneo (Sarawak: Poi Ra.), several collections.

c. *var.* **borneensis** HOLTTUM, Blumea 23 (1976) 29. — Type: RICHARDS 1702, Sarawak, Mt Dulit (K).

Upper surface of pinnae lacking glands.

Distr. *Malesia*: Borneo (Sarawak: Mt Dulit, several collections; G. Mulu; Mt Penrissen; Kalimantan: Mt Bengkaram).

6. **Coryphopteris gymnopoda** (BAK.) HOLTTUM, Blumea 23 (1976) 29. — *Nephrodium gymnopodum* BAK. Trans. Linn. Soc. Bot. 4 (1894) 252. — *Dryopteris gymnopoda* (BAK.) C. CHR. Ind. Fil. (1905) 269; Gard. Bull. Str. Settl. 7 (1934) 240. — Type: HAVILAND 1486, Mt Kinabalu 3200 m (K).

Lastrea ridleyi BEDD. Kew Bull. (1909) 423. — *Dryopteris ridleyi* (BEDD.) C. CHR. Ind. Fil. Suppl. (1913) 38. — Type: RIDLEY 7849, Selangor, Bukit Hitam, 1000 m (K).

Dryopteris subviscosa v.A.v.R. Bull. Jard. Bot. Btzg II, 26 (1915) 14; Handb. Suppl. (1917) 153. — Type: BECCARI 429, Sumatra, G. Singgalang 1700 m (BO; FI, K).

Dryopteris kinabaluensis COPEL. Philip. J. Sci. 12 (1917) Bot. 55. — Type: TOPPING 1719, Mt Kinabalu (Am. Fern Soc. Ann Arbor, not seen).

Lastrea robinsonii RIDL. J. Fed. Mal. St. Mus. 10 (1920) 156; J. Mal. Br. R. As. Soc. 4 (1926) 65, *p.p.* — *Dryopteris robinsonii* (RIDL.) C. CHR. Gard. Bull. Str. Settl. 4 (1929) 381. — *Thelypteris robinsonii* (RIDL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 254. — Type: F. M. Mus. Collector, Perak, G. Kerbau (K).

Dryopteris viscosa var. kamborangana C. CHR. Gard. Bull. Str. Settl. 7 (1934) 240. — HOLTTUM 25472, Mt Kinabalu 2130 m (BM; BO, K, SING).

Thelypteris viscosa sensu HOLTTUM, Rev. Fl. Mal. 2 (1955) 252, *p.p.*

a. *var.* **gymnopoda**

Stipe 15–20 cm long; scales 6–8 × 1–1.5 mm, dark, firm, bases not dilated. *Lamina* 25–30 cm long; pinnae 15–18 (rarely to 25) pairs, texture firm, well spaced; lowest pinnae wider than next, in largest fronds more than 2 cm wide with almost all lobes dentate, in smaller fronds lobes crenate. *Suprabasal pinnae* commonly 6 × 1.5 cm, on largest fronds 10 × 2 cm, acuminate to subcaudate, lobes mostly crenate; costules 3–3.5 mm apart; veins 6–7(–9) pairs; lower surface of rachis bearing some acicular hairs, of costae bearing many glands and capitate hairs, sometimes a few acicular hairs, scales all linear, 1–2 cells wide, glands present throughout lower surface; acicular hairs on upper surface of rachis and costae 0.5 mm long, few on costules and veins distally; abundant glands throughout. *Sori* medial, basal ones sometimes a little elongate and asymmetric, distal ones rarely athyrioid; indusia bearing short capitate hairs and glands.

Distr. Peninsular Thailand, in *Malesia*: Sabah (Mt Kinabalu, many collections), Sarawak; in Malaya on Gunung Tahan and at scattered localities on the Main Range, perhaps only in rather open places; Sumatra, Peninsular Thailand.

Notes. The type is a single small frond which has lost almost all its scales but owing to the many other collections its identity is not in doubt. Peninsular specimens have narrower scales than Bornean ones. *Lastrea ridleyi* and *L. robinsonii* appear to differ only in their small size.

b. *var.* **bintangensis** HOLTTUM, Blumea 23 (1976) 30. — Type: C. B. KLOSS, G. Bintang on Kedah-Perak boundary, June 1917 (K).

Upper surface between veins bearing a variable number of appressed acicular hairs 0.3–0.5 mm long.

c. *var.* **humilis** HOLTTUM, Blumea 23 (1976) 30. — Type: MOLESWORTH ALLEN 1026, Pahang, Cameron Highlands, Gunung Perdah, 2130 m (K).

Fronds small; upper and lower surfaces both covered with acicular hairs between veins.

Note. The type and another collection have pinnae 2.5 × 0.6 cm; small size and hairiness may be due to exposed position.

7. **Coryphopteris klossii** (RIDL.) HOLTTUM, Blumea 23 (1976) 31. — *Lastrea klossii* RIDL. Trans. Linn. Soc. Bot. 9 (1916) 257; COPEL. Philip. J. Sci. 78 (1951) 428. — *Dryopteris klossii* (RIDL.) v.A.v.R. Handb. Suppl. (1917) 501. — *Thelypteris klossii* (RIDL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 252. — Type: C. B. KLOSS, W. New Guinea, Wollaston Exped. to Mt Carstensz, Camp VIc, 1800 m (BM; K). — **Fig. 4f.**

Stipe 20–30 cm long, dark, glandular but not hairy except in the groove; scales 3–4 × 1–1.5 mm. *Lamina* to 30 cm or more long; pinnae *c.* 20 pairs separated by half their width; basal pinnae a little reduced or not, narrowed in basal third, basal acroscopic lobe a little enlarged and strongly crenate; texture rather rigid when dry. *Largest pinnae* of type 3.3 × 1.0 cm, of another specimen 6 × 1.3 cm; lobes slightly falcate, edges sinuate to toothed at ends of distal veins; costules 2.5–3.5 mm apart; veins 5–7 pairs, thick and slightly prominent; lower surface of rachis and costae bearing rather sparse acicular hairs, many ovate scales to 1 mm long on costae, smaller scales on costules, glands generally; upper surface of rachis and costae bearing short acicular hairs, glands and capitate hairs on surface between veins. *Sori* medial; indusia large, thin, bearing capitate hairs and glands, usually all symmetric.

Distr. *Malesia*: Throughout New Guinea at 1800–3200 m.

8. Coryphopteris iwatsukii HOLTTUM, Blumea 23 (1976) 31. — Type: K. IWATSUKI *et al.* S. 1012, Sumatra, Atjeh (K).

Caudex slender; *stipe* to 20 cm long, very dark at base, minutely hairy; scales rigid, 3 mm long, 0.8 mm wide at base, dorsally with small spherical outgrowths. *Lamina* 25 cm long, texture thin; pinnae 15 pairs; lowest pinnae narrowed at base, basal acroscopic lobe free, dentate, not elongate. *Suprabasal pinnae* to 6.0 × 1.4 cm, acuminate; lobes at right angles to costa, almost all dentate, separated by sinuses 1.5 mm wide; costules 3.5 mm apart; veins 5–6 pairs; lower surface of rachis with hairs 0.5 mm long, of costae with sparse hairs and many glands, larger scales on costae dilated at base, lamina between veins bearing glands and minute erect hairs; upper surface of rachis and costae bearing unicellular acicular hairs, few on costules and veins, surface between veins with many glands. *Sori* medial; indusia thin, bearing very short acicular hairs.

Distr. *Malesia*: N. Sumatra (Gajolands: Mt Kemiri), only known from the type.

Ecol. Mossy forest, 1800–2500 m.

9. Coryphopteris atjehensis HOLTTUM, Blumea 23 (1976) 32. — Type: K. IWATSUKI *et al.* S. 834, Sumatra, Atjeh, G. Kemiri, 900–1600 m, in evergreen forest (K).

Differs from *C. iwatsukii* as follows: scales on stipe 7 × 1.5 mm, smooth dorsally; pinnae to 9.5 × 1.9 cm, pinna-lobes mostly entire; costules 4–4.5 mm apart; indusia glabrous or with minute capitate hairs.

Distr. *Malesia*: N. Sumatra (Gajolands, Mt Kemiri), known only from the type and DE WILDE 13051.

10. Coryphopteris obtusata (v.A.v.R.) HOLTTUM, Blumea 23 (1976) 30. — *Dryopteris obtusata* v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 22. — *Thelypteris obtusata* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 253. — Type: C. J. BROOKS 339 S, Sumatra, Benkoelen, Lebong Simpang (BO; BM).

Dryopteris supravillosa C. CHR. Gard. Bull. Str. Settl. 7 (1934) 241. — Type: HOLTTUM 25471, Mt Kinabalu, 1800 m (BM; K, SING).

Stipe 15–25 cm long, dark at base, short-hairy, upper part and rachis dull reddish, scales to 5 × 1.5 mm. *Lamina* 20–35 cm long, pinnae 15–18 pairs; basal pinnae somewhat reduced on smaller fronds, narrowed at base, basal acroscopic lobe dentate, not free. *Largest pinnae* to 7.5 × 1.5 cm, short-acuminate; basal lobes dentate, others sometimes with slight teeth at ends of distal veins; costules 3–4 mm apart; veins 5–8 pairs; lower surface of rachis densely hairy, of costae less so, glands present on all parts of lower surface, those between veins sometimes small (type) or replaced by capitate hairs; scales on lower surface of costae widened at base; upper surface densely covered with short acicular hairs, some capitate hairs or glands also present. *Sori* medial to inframedial, distal ones sometimes asymmetric where small; indusia bearing glands and capitate hairs.

Distr. *Malesia*: Sumatra, Borneo, New Guinea.

Note. There is variability in Sumatran specimens in abundance of glands or capitate hairs on lower surface of pinnae; a specimen from W. New Guinea is very like the type. Specimens from eastern New Guinea have rather few glands and capitate hairs. The type of *D. supravillosa* is small (lamina 20 cm long) and has capitate hairs between veins on lower surface.

11. Coryphopteris diaphana (BRAUSE) HOLTTUM, Blumea 23 (1976) 32. — *Dryopteris diaphana* BRAUSE, Bot. Jahrb. 56 (1920) 80. — *Thelypteris diaphana* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 251. — Type: LEDERMANN 8903, N.E. New Guinea, Sepik Distr. (B; BM).

Stipe 10–15 cm long, dark, glossy, sparsely hairy; scales 2–3 × 0.8 mm, dark, rigid. *Lamina* to 25 cm long; pinnae 15–18 pairs; basal pinnae not or little reduced, a little narrowed at base, basal acroscopic lobe almost free, dentate, not elongate. *Suprabasal pinnae* to 4.5 × 1.2 cm, short-acuminate; lobes oblique, basal ones strongly dentate, rest ± toothed at ends of veins; costules 2.5–3 mm apart; veins 5–6 pairs; lower surface of rachis and costae with short spreading acicular hairs, glands on costae, costules and veins, a few dark narrow scales on costae; upper surface of costules and veins with scattered hairs, no glands nor hairs between veins. *Sori* supramedial; indusia glabrous.

Distr. *Malesia*: New Guinea. Known only from type collection and BRASS 13294 from Idenburg River.

Ecol. Type from 850 m, in moss cushions; BRASS 13294 from 900 m, in *Agathis* forest.

12. Coryphopteris habbemensis (COPEL.) HOLTTUM, Blumea 23 (1976) 32. — *Dryopteris habbemensis* COPEL. Un. Cal. Publ. Bot. 18 (1942) 216. — *Ctenitis habbemensis* (COPEL.) COPEL. Gen. Fil. (1947) 124; Philip. J. Sci. 78 (1951) 411, pl. 15. — Type: BRASS 9304, N.W. New Guinea, Lake Habbema 3225 m (MICH; BM). — **Fig. 4e.**

Stipe 25–30 cm long, base dark with short brown hairs, reddish distally; scales thin, 5 × 1.5 mm. *Lamina* to 30 cm long; pinnae 18 pairs; basal pinnae not much narrowed at base. *Largest pinnae* 7 × 2 cm, pinnate in basal half; 2–3 pairs pinnules quite free, rest ± adnate to costa, lobes of distal half of pinna connected by a very narrow wing; pinnules 7–12 mm long, 2–3 mm wide, larger ones deeply lobed near base and crenate distally; costules 3.5–4 mm apart; veins 5–8 pairs, forked in basal lobes of larger pinnules; lower surface of

rachis and costae copiously short-hairy, also on costae thin clathrate scales, the larger ones ovate; some sessile glands and smaller scales on costules; acicular hairs on upper surface of costae and costules, no glands. *Sori* medial; indusia thin, glabrous.

Distr. *Malesia*: Middle to east of New Guinea at 1800–3200 m.

Note. See note on 26. *C. stereophylla.*

13. Coryphopteris arthrotricha HOLTTUM, Blumea 23 (1976) 33. — Type: HOLTTUM 23345, Pahang, Cameron Highlands (K).

C. viscosa sensu HOLTTUM, Rev. Fl. Malaya 2 (1955) 252, *p.p.*

Stipe to 30 cm long, dark at base, paler distally, hairy only in groove, basal scales 3 mm long, thin. *Lamina* 25–45 cm long; pinnae 20 pairs, well spaced, lowest much narrowed at base with basal acroscopic lobe almost free but not elongate. *Suprabasal pinnae* commonly 8 × 1.6 cm, shortly caudate-acuminate; lobes entire to dentate; costules 3.5–4 mm apart; veins 6–10 pairs; lower surface of rachis and costae bearing minute acicular and capitate hairs, on costae also glands and linear scales, few glands between veins; upper surface of rachis and costae bearing hairs hardly 0.5 mm long which have 1–3 septa, surface between veins glabrous or with a few short acicular and capitate hairs. *Sori* medial; indusia small, bearing short capitate hairs and sometimes glands.

Distr. *Malesia*: Malaya, Sumatra, in ridge forest at 1220–1520 m. This is the common species on the Main Range in Malaya.

14. Coryphopteris tahanensis HOLTTUM, Blumea 23 (1976) 33. — Type: HOLTTUM 20694, Pahang, Gunung Tahan (K; SING).

Differs from *C. arthrotricha*: scales at base of stipe 7–8 × 1 mm, rigid, acuminate; lobes of pinnae, except basal ones, almost entire; rachis and costae of apical part of frond sometimes bearing multicellular hairs 1.5 mm long on lower surface, on upper surface septate hairs always 1 mm long; glands on costae in some cases rare.

Distr. *Malesia*: Malaya. Three collections from 1800 m on G. Tahan and two from Main Range.

Note. This is intermediate between *C. arthrotricha* and *C. multisora.* One specimen from G. Tahan has the lower surface of rachis and costae densely covered with hairs almost 2 mm long, and a few on costules and veins.

15. Coryphopteris athyrioides HOLTTUM, Blumea 23 (1976) 33. — Type: BRASS 24722, Papua, Goodenough Island, on mossy rock (BM; L, LAE).

Stipe to 20 cm long, black at base, reddish upwards, short-hairy throughout, basal scales thin, ovate, 3–4 × 1.5 mm. *Lamina* 30 cm long; pinnae 18–20 pairs; lowest pinnae sometimes a little reduced, basal acroscopic lobe not free. *Largest pinnae* 6.7 × 1.7 cm, short-acuminate; lobes falcate and slightly toothed; costules to 4 mm apart; veins 7–8 pairs, prominent on lower surface; rachis and costae on lower surface densely covered with erect acicular hairs and filiform scales, on rest of surface red glands; no glands on upper surface. *Sori* asplenioid, occupying almost whole length of all veins, some of them hooked as in *Athyrium*, rarely reniform; indusia bearing glands and sometimes a few short acicular hairs.

Distr. *Malesia*: Papua New Guinea (Goodenough I.), only known from the type.

16. Coryphopteris pectiniformis (C. CHR.) HOLTTUM, Webbia 30 (1976) 20; Blumea 23 (1976) 34. — *Dryopteris pectiniformis* C. CHR. Gard. Bull. Str. Settl. 4 (1929) 379. — *Thelypteris pectiniformis* (C. CHR.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 253; HOLTTUM, Rev. Fl. Mal. 2 (1955) 253, f. 144, 624, pl. 1 f. 8. — *Parathelypteris pectiniformis* (C. CHR.) CHING, Acta Phytotax. Sinica 8 (1963) 304. — Type: G. F. HOSE 293, Perak (P; K).

Thelypteris subglanduligera CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 323. — Type: WRAY 367, Perak, Gunung Batu Puteh (US; CAL, L).

a. *var.* pectiniformis

Stipe dark at base with thin setiferous scales to 7 × 1 mm, distally stramineous, throughout covered with short unicellular hairs. *Lamina* 40–45 cm long, texture thin; pinnae 15–20 pairs, well-spaced; basal pinnae narrowed near base, basal acroscopic lobe not enlarged, sometimes a little dentate. *Suprabasal pinnae* to 10 × 1.6 cm, acuminate; lobes entire, slightly falcate; costules to 3 mm apart; veins 7–8 pairs, very oblique; lower surface of rachis, costae and costules bearing short pale acicular hairs, glands and short erect acicular and capitate hairs on surface between veins; upper surface of costae bearing copious pale acicular hairs more than 0.5 mm long, few hairs on costules and veins, no other hairs. *Sori* medial; indusia with abundant capitate hairs, sometimes a few acicular hairs.

Distr. *Malesia*: Malaya (Taiping Hills, a few records from Main Range, G. Padang in Trengganu).

b. *var.* hirsuta HOLTTUM, Blumea 23 (1976) 34. — Type: HOLTTUM 21547, Pahang, Pine-tree hill, near Fraser's Hill (K; SING).

Differs from typical variety: smaller (pinnae to 6.5 cm long); lower surface of costules and veins bearing acicular hairs 1.5 mm long which are septate; indusia bearing acicular hairs 0.5 mm long.

Distr. *Malesia*: Malaya (only known from Pine-tree hill and the ridge connecting it to Fraser's Hill).

c. *var.* **minor** HOLTTUM, *var. nov.*

A typo speciei differt: *pinnis minoribus* (*usque* 4.2 × 0.8 *cm*); *venis* 3-*jugatis*; *rhachidi et costis subtus pilis* 0.1 mm *longis vestitis*; *paleis stipitis* 3 mm longis, 0.8 mm *latis*. Type: J. WINKLER *s.n.* 1912, Sumatra, Pea Radja, in Rosenst. Fil. sumatr. exsicc. *n.* 143 (P).

Distr. *Malesia*: Sumatra.

Note. This was distributed as *Dryopteris subviscosa* ROSENST., a name not published (not *D. subviscosa* v.A.v.R.). Another specimen (*n.* 154a) from the same locality, distributed as *D. japonica var. stricta*, has somewhat larger pinnae (MICH). The short pinna-lobes have broad tips, so that the pinnae are much like those of *C. hirsutipes* in aspect, but in other characters they agree with *C. pectiniformis*.

17. Coryphopteris andersonii HOLTTUM, Blumea 23 (1976) 38. — Type: J. A. R. ANDERSON 4535, Sarawak, Baram Distr., G. Mulu 2000 m (L; K).

Caudex to 30 cm tall; *stipes* 20 cm long, dark castaneous at base, paler distally, short-hairy, basal scales 4–5 × 1.5 mm; *rachis* stramineous. *Lamina* to 25 cm long, subcoriaceous, rigid when dry; pinnae 15 pairs, lowest not reduced but slightly narrowed at base with basal acroscopic lobe sometimes dentate, not free. *Suprabasal pinnae* to 5 × 1.2 cm, short-acuminate; lobes oblique, hardly falcate, with rounded tips, basal ones at most slightly dentate; costules 2 mm or little more apart; veins 6 pairs, very oblique, pale and prominent on both surfaces; lower surface of rachis covered with hairs 0.3 mm long; hairs on costae few or none, scales on costae narrowly linear or with dilated bases, glands present on and between veins; hairs on upper surface of costae 0.5 mm long, no other hairs nor glands on upper surface. *Sori* medial, symmetric; indusia thin, glabrous.

Distr. *Malesia*: Borneo (Sarawak: Mt Mulu), only known from type.

18. Coryphopteris andreae HOLTTUM, Blumea 23 (1976) 35. — Type: MILLAR & HOLTTUM NGF 15768, N.E. New Guinea, Morobe Distr., Wau Subdistr., Otibanda Creek 2150 m (LAE; K).

Stipe 5–6 cm long, black at base, paler upwards, short-hairy throughout, basal scales thin, 2 × 1 mm, not setiferous. *Lamina* 14 cm long; pinnae 12–15 pairs, lower 2–3 pairs deflexed and narrowed at base, their basal acroscopic lobes slightly enlarged and dentate, almost free. *Largest pinnae* 3.0 × 0.9 cm, apex abruptly acute, lobed almost to costa; lobes entire or slightly dentate; costules 2 mm apart; veins 4 pairs; lower surface of rachis and costae densely covered with short erect hairs, very narrow scales and sometimes small ovate ones also present; glands present on all lower surfaces; upper surface with hairs on costa, the rest glabrous or sometimes with a few hairs between veins. Sori medial; indusia large, thin, sometimes bearing short capitate hairs.

Distr. *Malesia*: Papua New Guinea (neighbourhood of Mt Kaindi, several collections; Ekuti Range 2200 m).

19. Coryphopteris squamipes (COPEL.) HOLTTUM, Blumea 23 (1976) 35. — *Dryopteris squamipes* COPEL. Philip. J. Sci. 56 (1935) 99, pl. 5. — *Lastrea squamipes* (COPEL.) COPEL. Fern Fl. Philip. (1960) 325. — *Thelypteris squamipes* (COPEL.) REED, Phytologia 17 (1968) 315. — Type: RAMOS & EDAÑO BS 38525, Mindanao, Bukidnon Prov., Mt Lipa, 2000 m (MICH; BO, US).

Stipe 5–15 cm long, dark at base, paler distally; scales thin, to 5 mm long, to 2.5 mm wide at base. *Lamina* to 28 cm long; pinnae more than 20 pairs, 6–8 lower pairs gradually smaller, lowest 1.5–2 cm long. *Largest pinnae* commonly 3.5 × 0.9 cm, short-acuminate; lobes oblong, mostly crenate, basal ones dentate; costules 2–2.5 mm apart; veins to 5 pairs; lower surface of rachis and costae bearing stiff unicellular hairs to 1 mm long, on costae many small scales sometimes widened at their bases, glands present on costules, veins and surface between veins; upper surface sometimes with a few glands on and near veins. *Sori* medial, distal ones mostly symmetric; indusia glabrous or with a few glands.

Distr. *Malesia*: Philippines (Mindanao, several coll.) and Papua New Guinea (New Ireland, J. R. CROFT 288, pinnae to 6 by 1.4 cm).

20. Coryphopteris borealis HOLTTUM, Blumea 23 (1976) 35. — Type: M. JACOBS 7588, Northern Luzon, Mt Tayaboc, 2300 m, on ridge in shade (K; L).

Caudex to 30 cm tall. *Stipe* 20–25 cm long, very dark at base, dark reddish distally; scales to 4 × 2.5 mm. *Lamina* to 45 cm long; pinnae 20 pairs or more; lower pinnae 2–4 pairs somewhat reduced, lowest 2.5–3 cm long. *Largest pinnae* 4.5 × 1.2 cm (fertile), 5.0 × 1.3 cm (sterile), abruptly narrowed at apex; lobes slightly oblique, subtruncate, toothed at ends of veins, lowest lobes of fertile pinnae strongly dentate; costules 3–3.5 mm apart; veins 4 pairs; lower surface of rachis and costae bearing hairs almost 1 mm long, scales on costae all very narrow, costules and veins bearing small glands; upper surface of pinnae glabrous apart from hairs on costae. *Sori* inframedial; indusia large, glabrous.

Distr. *Malesia*: Philippines (Luzon), type specimen only.

21. Coryphopteris meiobasis HOLTTUM, Blumea 23 (1976) 36. — Type: T. G. WALKER 8730, N.E. New Guinea, Morobe Distr., trail from Sewe to Freyburg Pass, 2300–2450 m (BM).

Stipe to 25 cm long, covered with pale slender

hairs, basal scales little more than 1 mm wide. *Lamina* to 40 cm long; pinnae 20 pairs, lower 3 pairs gradually smaller, lowest 3.5–4.5 × 1.1–1.3 cm, their basal acroscopic lobes not enlarged. *Largest pinnae* 9 × 1.9 cm (sterile), 8.5 × 1.7 cm (fertile), acuminate; lobes oblique, strongly dentate; costules 4.5–5.5 mm apart; veins to 7 pairs; lower surface of rachis with many hairs 1 mm long, similar but shorter hairs and very narrow scales on costae, glands on costules and veins, few glands between veins; upper surface glabrous apart from hairs on costae and a few on costules and veins, no glands. *Sori* inframedial, round; indusia thin, pale, with a few hairs.

Distr. *Malesia*: Papua New Guinea; known from type only.

22. Coryphopteris pubirachis (BAK.) HOLTTUM, Blumea 23 (1976) 37. — *Nephrodium pubirachis* BAK. J. Bot. 14 (1876) 344. — *Dryopteris pubirachis* (BAK.) C. CHR. Ind. Fil. (1905) 287; Bishop Mus. Bull. 177 (1943) 82. — *Thelypteris pubirachis* REED, Phytologia 17 (1968) 307. — Type: WHITMEE 202, Samoa (K).

Dryopteris mataanae BRAUSE, Notizbl. Bot. Gart. Berlin 8 (1922) 1939. — Type: VAUPEL 460, Samoa (B; BM).

a. *var.* pubirachis

Stipe 15–20 cm long, very dark throughout; scales to 5 × 1.5 mm, thin, lacking acicular hairs; *rachis* dark to light reddish. *Lamina* to 25 cm long; pinnae 12–15 pairs, well spaced; basal pinnae wider than next pair, narrowed to base on basiscopic side, basal acroscopic lobe free, strongly dentate, not elongate. *Suprabasal pinnae* to 7.5 × 1.8 cm, short-acuminate, lobes slightly oblique, almost all dentate at ends of veins, basal acroscopic lobe usually longer than rest; costules 4 mm apart; veins 6–7 pairs; lower surface of rachis and costae with slender acicular hairs less than 0.5 mm long, glands present on costae, costules and veins, none or few between veins, a few narrow scales widened at base present on costae; hairs on upper surface of rachis and costae longer and thicker than on lower surface, a few on costules and veins, not elsewhere. *Sori* inframedial, basal ones a little divergent; distal sori smallest, sometimes a little asymmetric; indusia bearing glands, a few hairs sometimes also present.

Distr. Polynesia: Samoa, Tahiti.

b. *var.* major HOLTTUM, Blumea 23 (1976) 37. — Type: BRAITHWAITE 4378, Solomon Islands, New Georgia Group, Kolombangara, 1650 m (K).

Differs from typical form: larger, with lamina to 40 cm long; pinnae to 20 pairs; largest suprabasal pinnae to 10 × 1.8 cm; hairs on lower surface of rachis and costae sometimes few.

Distr. Solomon Islands, Bougainville, in *Malesia*: New Ireland, New Guinea.

c. *var.* philippinensis HOLTTUM, Blumea 23 (1976) 37. — Type: RAMOS & EDAÑO BS 37959, Luzon, Mt Masapilid, Bontoc Subprov. (K).

Differs from type: larger, with basal pinnae to 9 × 2 cm; lower surface of pinnae between veins glandular, of upper surface bearing some acicular hairs; lobes of pinnae, apart from basal ones, almost entire.

Distr. *Malesia*: throughout Philippines, on mountains.

Note. Young plants appear to have lower pinnae somewhat smaller than next and have some resemblance to *C. squamipes*, but well-grown plants of the two, as collected in Mindanao, are distinct.

d. *var.* sulawesica HOLTTUM, Blumea 23 (1976) 38. — Type: T. G. WALKER 12354, Celebes, on ridge above river Pasir, 2000–2200 m (BM).

Differs from type: largest pinnae 1.2 cm wide; lower surface between veins bearing glands; upper surface between veins bearing acicular and capitate hairs.

Distr. *Malesia*: Celebes and Borneo (Sarawak: Mt Mulu), 1800–2200 m; two collections known.

23. Coryphopteris athyriocarpa (COPEL.) HOLTTUM, Blumea 23 (1976) 38. — *Dryopteris athyriocarpa* COPEL. Philip. J. Sci. 3 (1908) Bot. 344. — Type: BROOKS & HEWITT 2, Bongo Range, Sarawak (MICH).

Stipe to 21 cm long, base very dark, becoming reddish distally, rachis paler; basal scales to 5 mm long, base dilated with isodiametric cells, above base less than 1 mm wide with elongate cells. *Lamina* 20 cm long; free pinnae 18 pairs; basal pinnae largest, 5.5 × 1.8 cm, their lobes lobulate, 3–4 pairs basal lobes gradually shorter. *Suprabasal pinnae* to 4 × 1.2 cm, short-acuminate; basal pair of lobes lobulate, rest crenate; costules 3 mm apart; veins 4–5 pairs, very oblique; *lower surface* of rachis bearing short capitate hairs, of costae capitate hairs, glands and very narrow scales, acicular hairs lacking; *upper surface* of rachis bearing acicular hairs 0.5 mm long, shorter ones on costae and scattered on costules and veins, between veins many capitate hairs and a few short acicular hairs, no glands. *Sori* medial, distal ones athyrioid; indusia with a few glands, not hairs.

Distr. *Malesia*: Borneo (Sarawak; W. Kalimantan, Pontianak R., HANS WINKLER 534, in BM); only two collections known.

Note. This has the narrow scales of *C. viscosa* but smaller fronds and a different distribution of glands and hairs.

24. Coryphopteris tanggamensis HOLTTUM, Blumea 23 (1976) 38. — Type: M. JACOBS 8255, S. Sumatra, G. Tanggamus, 2000 m (L; K).

Caudex to 30 cm tall. *Stipe* 30 cm long,

glabrous, dark purplish at base, distally dull reddish, basal scales 5 × 1.2 mm. *Lamina* to 35 cm long; pinnae 22 pairs, widely spaced; two pairs lower pinnae deflexed but not reduced; lowest pair somewhat narrowed at base, basal acroscopic lobe elongate, dentate, not free. *Suprabasal pinnae* to 7 × 1.5 cm, acuminate; lobes oblique, falcate, margins at base dentate, apex rounded and entire; costules 3.5 mm apart; veins 6–7 pairs; lower surface of rachis bearing many capitate and fewer acicular hairs, of costae bearing capitate hairs or small glands and linear scales, no glands seen between veins; upper surface of rachis bearing hairs 0.7 mm long, those on costae shorter, costules and veins with sparse hairs, none between veins. *Sori* inframedial, distal ones mostly symmetric; indusia bearing capitate hairs.

Distr. *Malesia*: S. Sumatra (Mt Tanggamus), known from type only.

25. Coryphopteris engleriana (BRAUSE) HOLTTUM, Blumea 23 (1976) 40. — *Dryopteris engleriana* BRAUSE, Bot. Jahrb. 49 (1912) 19. — *Phegopteris engleriana* (BRAUSE) v.A.v.R. Handb. Suppl. (1917) 309. — *Thelypteris engleriana* (BRAUSE) REED, Phytologia 17 (1968) 274. — Type: L. SCHULTZE 330, N.E. New Guinea, Sepik Distr. (B).

Stipe and rachis dark; base of stipe not seen. *Lamina* to 50 cm long; pinnae 18 pairs, widely spaced; basal pinnae not reduced, narrowed gradually in basal half, basal pair of lobes free, not enlarged, not dentate. *Suprabasal pinnae* to 10.8 × 1.6 cm with stalks 1 mm long, apex narrowly acuminate; middle lobes somewhat falcate with rounded ends, separated by rather wide sinuses, edges slightly crenate; costules 4.5 mm apart; veins 7 pairs; lower surface lacking acicular hairs, costae bearing narrow scales (often uniseriate), no glands; upper surface with coarse brown hairs on rachis and costae, no others. *Sori* inframedial except basal ones, exindusiate; spores with many small wings.

Distr. *Malesia*: Papua New Guinea. Known only from type and one other collection from same locality.

26. Coryphopteris stereophylla (v.A.v.R.) HOLTTUM, Blumea 23 (1976) 40. — *Dryopteris stereophylla* v.A.v.R. Nova Guinea 14 (1924) 17. — *Thelypteris stereophylla* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 254. — Type: H. J. LAM 1785, W. New Guinea, Doormantop, 3200 m (L).

Stipe to 30 cm, base dark, rest flushed with red; hairs very short, thick, brownish; scales 3 × 1 mm, dark. *Lamina* to 25 cm long with 15–20 pairs well-spaced pinnae, texture thick, rigid when dry; lowest pinnae not reduced, narrowed a little at basiscopic base. *Suprabasal pinnae* to 7.5 × 1.5 cm, with 4–8 pairs of free or separately adnate pinnules in basal part, apical part lobed almost to costa; pinnules and lobes 1–2 mm wide, almost all crenate, separated by wide sinuses; costules 3 mm apart on type, to 4 mm on another specimen; veins 4–5 pairs, grooved on upper surface; lower surface of rachis covered with brown hairs 0.3 mm long and thin scales, costae with similar hairs and ovate-acute to lanceolate clathrate scales 1 mm long, no glands; upper surface bearing very short erect hairs on edges of grooved costa. *Sori* medial; indusia small, thin, glabrous.

Distr. *Malesia*: Papua New Guinea. Only known from the type and PULLE 883 from Mt Hellwig, 2000 m (L).

Note. This species is close to *C. habbemensis*, differing from the latter in more coriaceous texture, narrower pinnules and lack of glands on lower surface.

27. Coryphopteris horizontalis (ROSENST.) HOLTTUM, Blumea 23 (1976) 40. — *Athyrium horizontale* ROSENST. Nova Guinea 8 (1912) 722. — *Dryopteris horizontalis* (ROSENST.) v.A.v.R. Bull. Jard. Bot. Btzg II, 11 (1913) 10; Handb. Suppl. (1917) 151. — Type: VON ROEMER 1136, W. New Guinea, Hellwig Mts, 1350–1600 m (S-PA; BO).

Stipe 15 cm long, dark, densely covered with hairs 1 mm long and thin scales 3 × 1.5 mm. *Lamina* to 40 cm long; pinnae 18–20 pairs; lowest pinnae a little reduced and narrowed to base. *Suprabasal pinnae* to 7 × 1.5 cm, sessile, short-acuminate; lobes oblong, serrate-crenate, basal lobes most strongly so; costules to 4 mm apart; veins 6–7 pairs; rachis beneath bearing acicular hairs 1 mm long, shorter hairs on costae, sparse on costules, no glands; linear scales, sometimes dilated at base, on costules; hairs on upper surface of rachis as lower, on costae shorter, copious short hairs on surface between veins. *Sori* inframedial, mostly not athyrioid; indusia thin, short-hairy.

Distr. *Malesia*: Papua New Guinea. Known only from type and PULLE 633, Mt Dromedaris 1250 m (L).

28. Coryphopteris microlepigera HOLTTUM, Blumea 23 (1976) 41. — Type: PULLE 1078, W. New Guinea, Mt Treub, 2300 m (L; BM).

Stipe to 15 cm long, very dark; hairs in groove 0.5 mm long, basal scales 2–3 mm long, thin; rachis dark reddish. *Lamina* to 28 cm long; pinnae 20 pairs; lower pinnae 1–3 pairs somewhat reduced. *Largest pinnae* 5.5 × 1.1 cm, short-acuminate; basal lobes conspicuously dentate, rest with ± sinuous margins; costules 3 mm apart; veins 4–5 pairs; lower surface of rachis covered with brown hairs 0.5–0.8 mm long, acicular hairs on costae shorter, costules and veins bearing very short capitate hairs, scales on costae lanceolate, at base 5–10 cells wide; upper surface of rachis with hairs

as lower surface, hairs on costae shorter, surface between veins covered with short acicular hairs. *Sori* a little supramedial, sometimes slightly athyrioid; indusia glabrous.

Distr. *Malesia*: Western New Guinea and Moluccas (Amboina).

Note. A second New Guinea collection, from Mt Nettoti at 1800 m (VAN ROYEN & SLEUMER 8226) differs in shorter narrower pinnae with few hairs between veins on upper surface; a specimen collected by TEYSMANN on Mt Toena, Amboina (BO) is similar.

29. Coryphopteris propria (v.A.v.R.) HOLTTUM, Blumea 23 (1976) 41. — *Dryopteris propria* v.A.v.R. Bull. Jard. Bot. Btzg 16 (1914) 10; Handb. Suppl. (1917) 152. — Type: RACHMAT 496, Central Celebes, Tondo-Tondo (BO; L).

Stipe to 13 cm long, dark; scales 3 × 1 mm, thin. *Lamina* to 14 cm long; pinnae 10 pairs; basal pinnae largest, to 4 × 1.3 cm, a little narrowed at base, basal acroscopic lobe enlarged, dentate, free. *Suprabasal pinnae* to 3.5 × 1.1 cm, short acuminate, lobes entire or with slight teeth at ends of distal veins; costules to 3 mm apart; veins 4 pairs; abundant very short capitate hairs on lower surface of rachis, costae, costules, veins and surface between veins; sparse short acicular and many short capitate hairs on upper surface of costae, very short acicular hairs on costules and veins, short capitate hairs between veins. *Sori* medial, basal ones often somewhat athyrioid; indusia bearing many capitate hairs and sometimes a few acicular ones.

Distr. *Malesia*: Central Celebes; known from type collection only.

30. Coryphopteris lauterbachii (BRAUSE) HOLTTUM, Blumea 23 (1976) 41. — *Dryopteris lauterbachii* BRAUSE, Bot. Jahrb. 49 (1912) 18; v.A.v.R. Handb. Suppl. (1917) 150. — *Thelypteris lautĕrbachii* (BRAUSE) REED, Phytologia 17 (1968) 287. — Type: L. SCHULTZE 273, N.E. New Guinea, Sepik Distr. (B).

Stipe to 25 cm, dark, upper part and rachis dull reddish; soft pale hairs on abaxial surface; scales 3–4 × 1 mm, thin. *Lamina* to 43 cm long; pinnae to 24 pairs; basal pinnae a little reduced, slightly narrowed at base, basal lobe not free. *Suprabasal pinnae* 7.5 × 1.7 cm, sessile, base truncate and a little dilated both sides, apex acuminate; lobes slightly oblique, slightly crenate; costules 3.5 mm apart; veins to 8 pairs; rachis and costae beneath bearing short acicular hairs, few on costules, very small capitate hairs on surface between veins, many small scales on costae and costules; hairs on upper surface of costae longer, some consisting of 2 cells, sparse hairs on costules and veins. *Sori* medial; indusia large, thin, short-hairy.

Distr. *Malesia*: Papua New Guinea, known from type only.

31. Coryphopteris fasciculata (FOURN.) HOLTTUM, Blumea 23 (1976) 42. — *Aspidium fasciculatum* FOURN. Ann. Sci. Nat. V, 18 (1873) 295. — *Nephrodium fasciculatum* (FOURN.) BAK. Ann. Bot. 5 (1891) 320. — *Thelypteris fasciculata* (FOURN.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 251; BROWNLIE in Aubrév. Fl. Nouv. Cal. 3 (1969) 210, pl. xxvii. — Type: BALANSA 3568, New Caledonia, Mt Humboldt (P).

Nephrodium macgregorii BAK. Ann. Bot. 5 (1891) 320, new name for *N. simulans* BAK. J. Bot. 28 (1890) 106, *non* BAK. 1874 *nec* BAK. 1888. — *Dryopteris conterminoides* C. CHR. Ind. Fil. 258, *nom. nov. superfl.* — *Lastrea macgregorii* (BAK.) RIDL. Trans. Linn. Soc. Bot. 9 (1916) 257. — *Dryopteris macgregorii* (BAK.) C. CHR. Ind. Fil. Suppl. III (1934) 90. — *Lastrea conterminoides* (C. CHR.) COPEL. Philip. J. Sci. 78 (1951) 424. — *Thelypteris conterminoides* (C. CHR.) REED, Phytologia 17 (1968) 269. — Type: W. MCGREGOR 18, Papua, Mt Knutsford (K).

Dryopteris engleriana var. hirta C. CHR. Brittonia 2 (1937) 296. — Type: BRASS 5032, Papua, Mt Tafa, 2400 m (BM; K, NY).

Stipe 12–20 cm long, dark at base only, reddish upwards, bearing hairs 1 mm long; scales 3 × 1 mm or somewhat larger. *Lamina* 30–40 cm long; pinnae 25–30 pairs; up to 8 pairs lower pinnae deflexed and gradually reduced, lowest 1–2 cm long. *Largest pinnae* 4–5.5 × 0.8–1.3 cm, short acuminate; lobes ± dentate at vein-ends, basal lobes most strongly; costules 2.5–3 mm apart; veins 3–4 pairs; lower surface of rachis and costae bearing rather thick acicular hairs 1 mm long, linear scales present on costae and costules, rarely a few glands on costae only, short erect hairs sometimes present between veins; copious acicular hairs on upper surface of rachis and costae, few on costules and veins, sometimes short capitate hairs present between veins. *Sori* inframedial; indusia thin with short capitate hairs and few to many short acicular hairs.

Distr. New Caledonia, *East Malesia*: New Guinea, Celebes, at 1800–3000 m.

Note. The type of *N. macgregorii* BAK. is a poor specimen with basal pinnae lacking; it agrees well with other specimens in pubescence. Some specimens from both east and west New Guinea have a few glands on lower surface of costae, others agree with the type in having none. All Celebes specimens have some short hairs between veins on both sides.

32. Coryphopteris hubrechtensis HOLTTUM, Blumea 23 (1976) 42. — Type: VERSTEEG 2433, W. New Guinea, Mt Hubrecht 3000 m (BM; L).

Stipe to 35 cm long, very dark, glossy, glabrous except near apex which is dull reddish. *Lamina* 20 cm long; pinnae 18 pairs, rigid, several lower ones deflexed, lowest 1–2 pairs slightly reduced. *Largest pinnae* 3 cm long, to 1 cm wide, apex

obtuse; lobes almost entire, basal acroscopic lobe slightly enlarged, almost free and slightly dentate; costules 2.5 mm apart; veins 4–5 pairs, sometimes forked in the basal acroscopic lobe; lower surface of rachis bearing copious acicular hairs 0.5 mm long, of costae bearing narrow scales 0.5–0.8 mm long, minute uniseriate scales also on costules and veins, no glands; upper surface glabrous apart from costae. *Sori* near costules; indusia rather large, glabrous.

Distr. *Malesia*: West New Guinea, *c.* 3000 m. Besides the type, 2 collections by BRASS from Lake Habbema.

33. Coryphopteris brevipilosa HOLTTUM, Blumea 23 (1976) 43. — Type: PULLE 532, W. New Guinea, Mt Perameles, 900 m, on limestone (L).

Stipe 16–24 cm long, very dark at base, paler upwards, covered with hairs 0.3 mm long; scales 3 × 1 mm, thin. *Lamina* to 30 cm long, thin; pinnae 15–18 pairs; lowest pinnae not or little shorter than next, 1.8 cm wide, with acroscopic basal lobe free and strongly dentate. *Suprabasal pinnae* to 6.5 × 1.5 cm, with winged stalk 1 mm long; apex acuminate, lobes almost all dentate and separated by distinct sinuses; costules 3.5 mm apart; veins 6 pairs; rachis and costae beneath covered with hairs 0.2 mm long, costae bearing also subsessile glandular hairs and narrow scales, rest of lower surface glabrous; upper surface of rachis with hairs 0.5 mm long, those on costae 0.2 mm long. *Sori* medial, upper ones always athyrioid; indusia thin, glabrous.

Distr. *Malesia*: West New Guinea (Mt Perameles, 900 m), known from type only.

34. Coryphopteris oligolepia (v.A.v.R.) HOLTTUM, Blumea 23 (1976) 43. — *Dryopteris oligolepia* v.A.v.R. Nova Guinea 14 (1924) 17. — *Thelypteris oligolepia* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 253. — Type: LAM 1977, W. New Guinea, Doormantop 2520 m (L).

Stipe 12–20 cm long, dark glossy, scales 2–3 × 1 mm. *Lamina* to 25 cm long; pinnae 20 pairs; lowest pinnae deflexed and reduced, their basal lobes free and dentate. *Largest pinnae* 4.0 × 1.3 cm, short acuminate, with stalks hardly 1 mm long; lobes oblique, crenulate; costules 3–4 mm apart; veins 3–5 pairs; lower surface of rachis castaneous, glabrous, all other lower surfaces bearing scattered very small capitate hairs, some linear scales on costae; upper surface hairy on edges of groove of rachis and costae, few hairs on costules. *Sori* near costules, sometimes asymmetric; indusia small with some capitate hairs.

Distr. *Malesia*: Western New Guinea, several collections.

Ecol. Twice recorded as an epiphyte; at 1800–2500 m.

35. Coryphopteris coriacea (BRAUSE) HOLTTUM, Blumea 23 (1976) 43. — *Dryopteris coriacea* BRAUSE, Bot. Jahrb. 56 (1920) 63. — *Thelypteris coriacea* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 251. — *Lastrea coriacea* (BRAUSE) COPEL. Philip. J. Sci. 78 (1951) 428. — Type: LEDERMANN 10965, N.E. New Guinea, Sepik Distr., Hunsteinspitze 1300 m (B).

Dryopteris coriacea var. elata BRAUSE, *l.c.* — Type: LEDERMANN 11291, same locality.

Stipe dark, glossy, 8–12 cm long, hairs on adaxial side short; scales 8–10 × 1.5–2 mm; *rachis* reddish, green towards apex. *Lamina* to 26 cm long; pinnae 12 pairs; lower 3–5 pairs pinnae deflexed and short-stalked, narrowed at base on both sides. *Largest pinnae* 5.5 × 1.5 cm (of *var. elata* 8.5 × 2.0 cm), short-acuminate; lobes oblique (except basal ones) and slightly falcate, almost or quite entire; costules 3.5 mm apart; veins to 6 pairs, grooved above and flat beneath; lower surface quite glabrous, some small dark scales present on costae; upper surface hairy on rachis and costae, scattered hairs on margins of lobes. *Sori* near margin; indusia thin, glabrous.

Distr. *Malesia*: Papua New Guinea. Known only from the two LEDERMANN collections.

36. Coryphopteris ledermannii (HIERON.) HOLTTUM, Blumea 23 (1976) 44. — *Athyrium ledermannii* HIERON. Bot. Jahrb. 56 (1920) 133. — Type: LEDERMANN 11906, N.E. New Guinea, Schraderberg, 2070 m (B).

Stipe dark, glossy, hairy in groove only, 15 cm long. *Lamina* to 20 cm long; pinnae well spaced, to 13 pairs, texture thin; basal pinnae short-stalked, somewhat reduced. *Largest pinnae* 2.5 × 0.8 cm, apex obtuse, in the middle lobed about half-way to costa, towards base more deeply, lobes entire or slightly dentate; costules to 3 mm apart; veins 3–4 pairs in basal lobe, 2 pairs in middle lobes; lower surfaces quite glabrous, no scales seen; upper surface with short hairs on rachis and costae only. *Sori* medial, almost all athyrioid; indusia glabrous.

Distr. *Malesia*: Papua New Guinea, only known from the type.

Ecol. Epiphyte in moss-forest.

37. Coryphopteris dura (COPEL.) HOLTTUM, Blumea 23 (1976) 44. — *Dryopteris dura* COPEL. Leafl. Philip. Bot. 3 (1910) 805; v.A.v.R. Handb. Suppl. (1917) 148. — *Lastrea dura* (COPEL.) COPEL. Gen. Fil. (1947) 135; Fern Fl. Philip. (1960) 323. — *Thelypteris dura* (COPEL.) REED, Phytologia 17 (1968) 274. — Type: ELMER 11674, Mindanao, Mt Apo, 2600 m (MICH; BM, E, L).

Stipe dark near base, paler distally, 20–30 cm long, glabrous except for groove of upper part; scales 5 × 1–2 mm, acuminate. *Lamina* to 25 cm long; pinnae 18 pairs, rather thick; basal pinnae sessile, sometimes slightly reduced, a little narrowed at base, basal acroscopic lobe free, orbi-

cular, a little dentate. *Largest pinnae* 4.5 × 1.1 cm, apex blunt, lobed at base to 1 mm from costa, less deeply towards apex, lobes rounded, entire except basal acroscopic ones; costules 3–3.5 mm apart; veins 3–4 pairs, slightly prominent on both sides; lower surfaces hairless apart from edges of lobes, scales on costae 2–3 cells or more wide at base; short thick hairs on upper surface of rachis and costae. *Sori* near costules; indusia glabrous, sometimes a little athyrioid.

Distr. Malesia: Philippines (Mindanao: Mt Apo), 2600 m.

38. Coryphopteris platyptera (COPEL.) HOLTTUM, Blumea 23 (1976) 45. — *Dryopteris platyptera* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 219. — *Lastrea platyptera* (COPEL.) COPEL. Gen. Fil. (1947) 139; Philip. J. Sci. 78 (1951) 433, pl. 17. — *Thelypteris platyptera* (COPEL.) REED, Phytologia 17 (1968) 304. — Type: BRASS 11328, N. New Guinea, Bele River (MICH; L).

Stipe 20–25 cm, dark and glossy throughout; scales ovate, cordate, 2 × 1 mm, thin. *Lamina* 30 cm long; pinnae to 18 pairs, well spaced, many distinctly stalked; basal pinnae slightly reduced, stalked 1 mm, basal acroscopic lobe quite free, a little dentate. *Largest pinnae* 5.5–7 cm long, 1.3–2 cm wide, caudate-acuminate (cauda 7–15 mm long, entire), deeply lobed throughout, lobes in basal part of pinna ± crenate-dentate; costules 3.5–4 mm apart; veins to 6 pairs; lower surface hairless apart from edges of lobes, ovate-acute scales present on costae, very small filamentous scales on costules and veins; stiff dark hairs on upper surface of rachis and costae. *Sori* inframedial; indusia small, glabrous.

Distr. *Malesia*: New Guinea. Known only from type collection.

Ecol. On rocky banks of stream at 2200 m.

39. Coryphopteris subnigra (BRAUSE) HOLTTUM, Blumea 23 (1976) 45. — *Dryopteris subnigra* BRAUSE, Bot. Jahrb. 56 (1920) 82. — *Thelypteris subnigra* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 254. — *Lastrea subnigra* (BRAUSE) COPEL. Gen. Fil. (1947) 140; Philip. J. Sci. 78 (1951) 427. — Type: LEDERMANN 11962, N.E. New Guinea, Sepik Distr. (B).

Stipe to 24 cm long, very dark, glabrous apart from hairs in groove; scales 3–4 × 1 mm. *Lamina* to 25 cm long; pinnae 12 pairs, well spaced; lower pinnae stalked hardly 1 mm, narrowed to base on basiscopic side, basal acroscopic lobe free (also on all other free pinnae) and dentate. *Largest pinnae* 5–6 × 1.4 cm, short-acuminate, where sterile lobed to 1 mm from costa, where fertile more deeply; lobes ± dentate, most strongly where fertile, oblique; costules 3–3.5 mm apart; veins to 6 pairs, prominent and slender on both surfaces; lower surfaces lacking acicular hairs, a few short capitate hairs sometimes on costae, scales with widened base present on costae, uniseriate scales on costules; short acicular hairs on upper surface of rachis and costae. *Sori* near costules; indusia small, glabrous, sporangia often with a red glandular cell on stalk.

Distr. *Malesia*: Papua New Guinea. Many collections, 1500–3000 m. Misima I., 1000 m.

Ecol. The type grew as an epiphyte in moss cushions; no others so reported.

40. Coryphopteris badia (v.A.v.R.) HOLTTUM, Blumea 23 (1976) 44. — *Dryopteris badia* v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 9; Handb. Suppl. (1917) 149. — *Thelypteris badia* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 250. — Type: MATTHEW 674, Sumatra, Mt Tandikat (BO; E).

Dryopteris linearis COPEL. Philip. J. Sci. 12 (1917) Bot. 56. — Type: CLEMENS 11069, Mt Kinabalu, Marei Parei ridge (MICH; BM, BO, K).

Dryopteris villosipes GEPP in Gibbs, Dutch N.W. New Guinea (1917) 70. — Type: L. S. GIBBS 5627, W. New Guinea, Arfak Mts (BM).

Dryopteris rigidifolia v.A.v.R. Nova Guinea 14 (1924) 18. — *Thelypteris rigidifolia* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 254. — Lectotype (HOLTTUM 1976): LAM 1562, W. New Guinea, Doormantop (BO). — **Fig. 4g–h.**

Stipe varying much in length according to habitat (extremes 10 cm, 70 cm), dark, glossy, with hairs in groove only, at base often bearing a tangled mass of slender hairs which are glossy golden brown when dry; scales narrow, varying with size of frond; rachis also dark throughout. *Lamina* varying from 10 cm long (type of *D. villosipes*) to 65 cm (specimen from Atjeh); pinnae 15 pairs on small plants, to 30 pairs on large ones, texture always thick, rigid when dry; nearly all pinnae distinctly stalked; basal pinnae sometimes a little reduced, little narrowed at base, basal acroscopic lobe free or nearly so. *Largest pinnae* commonly 5–6 × 1.2–1.5 cm (extremes 1.7 × 0.5, 8 × 2 cm), lobed to about 1 mm from costa; lobes entire or nearly so, deciduously ciliate on edges; costules less than 2 mm apart on small plants, 3–3.5 mm on large ones; veins commonly 4–5 pairs (extremes 2 and 6 pairs), sometimes grooved on both sides; lower surfaces usually quite glabrous apart from hair-like scales on costae and costules (a few acicular hairs on costae of type of *D. linearis*, Fig. 4h); upper surface of rachis and costae bearing rigid dark brown hairs. *Sori* near costules; indusia glabrous, sporangia sometimes bearing 2–3 slender non-glandular hairs on their stalks.

Distr. *Malesia*: Sumatra, Malaya, Sarawak, Sabah, Celebes, New Guinea.

Ecol. In mossy forest at 1400–2500 m, usually in moss cushions, several times reported in moss cushions on tree-branches. The largest specimen

seen, from Atjeh, was an epiphyte. The slender hairs at base of stipes resemble root-hairs, and perhaps have the same function, absorbing water from moss-cushions.

41. Coryphopteris inopinata HOLTTUM, *sp. nov.*

Caudex gracilis longe-repens; lamina usque 11.5 *cm longa; pinnae usque* 2.1 × 0.6 *cm, lobis dentatis; costae subtus pilis acicularibus destitutae, eglandulosae, paleis linearibus praeditae; pagina superior pinnarum inter venas glabra; indusia glabra.* — Type: J. R. CROFT, LAE 65849, Telefomin Subdistr. West Sepik Distr., N.E. New Guinea, 2700 m (LAE; K, NSW).

Caudex a slender black rhizome 1.5–2.0 mm diameter, bearing fronds 1–3 cm apart; scales *c.* 4 × 1 mm; *stipe* 12–20 cm long, dark at base, paler distally, slender hairs present on adaxial side only. *Lamina* to 11.5 cm long; pinnae 12 pairs; basal pinnae narrowed towards their bases, basal acroscopic lobe 2 mm long, free or nearly so, basal basiscopic lobe smaller with decurrent base; fifth pair of pinnae with almost symmetric base and winged stalk 0.5 mm long. *Largest pinnae* 2.3 × 0.7 cm; apex subabruptly narrowed and rounded; edges lobed to 1 mm from costa, lobes obliquely quadrate with teeth at ends of veins; costules 2.5 mm apart; veins 3 on acroscopic side of costule, 2 on basiscopic side; *lower surface* of rachis and pinnae lacking hairs of any kind, glands also absent, scales on costae narrowly linear (2–4 cells wide at base); *upper surface* lacking hairs between veins. *Sori* near base of veins; indusia small, glabrous.

Distr. *Malesia*: Papua New Guinea (Telefomin, 2700 m).

Note. Apart from the rhizome, this is near *C. subnigra* but has much smaller pinnae. No other known *Coryphopteris* has this habit. The NSW isotype has fronds closer together on the caudex, which appears to be decumbent; it has a branch near its base.

6. PARATHELYPTERIS

(H. ITO) CHING, Acta Phytotax. Sinica 8 (1963) 300, *p.p.* — *Thelypteris sect. Parathelypteris* H. ITO in Nakai & Honda, Nov. Fl. Jap. *n.* 4 (1939) 127, *excl. T. hirsutipes et T. simozawae.* — *Thelypteris* group 2 CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 246, *excl. T. hirsutipes.* — *Thelypteris subg. Thelypteris sect. Thelypteris* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 157, groups of *T. glanduligera* and *T. japonica p.p.* — *Wagneriopteris* LÖVE & LÖVE, Taxon 26 (1977) 325 *excl. W. ogasawarensis*; HOLTTUM, Acta Phytotax. Geobot. 29 (1978) 16. — **Fig. 5a–b.**

Rather small ferns; caudex slender, creeping, sometimes much elongate; scales bearing superficial unicellular hairs, either spherical, capitate or acicular; basal pinnae in most species not or little reduced, in *P. beddomei* several pairs progressively smaller; pinnae deeply lobed, basal one or more lobes sometimes free; basal acroscopic lobe or leaflet often somewhat enlarged and dentate; veins free, basal ones both reaching margin above base of sinuses between lobes; some acicular hairs on lower surface of costae of *P. beddomei* septate, on upper surface always unicellular; scales on lower surface of costae never large or abundant; sessile glands almost always present on lower surfaces; sori indusiate; sporangia short-stalked, never with glands or setae near annulus, a sessile gland sometimes present on the stalk; spores opaque with a narrow wing as seen by the light microscope, covered with a finely reticulate perispore as seen with S.E.M.

Type species: *Parathelypteris glanduligera* (KUNZE) CHING.

Distr. *c.* 15 species; tropical and subtropical S.E. Asia and Malesia, N. America.

Cytol. n = 27 (*P. cystopteroides* (EATON) CHING, *P. noveboracensis* (L.) CHING); n = 31 *P. beddomei*); n = 32 or 31 (*P. simulata* (DAVENP.) NIEUWL.).

Taxon. In his original list of species, CHING included several which I have separated as *Coryphopteris*, also *Aspidium immersum* BL. (*Amphineuron immersum* HOLTTUM). In addition to species

from Asia, he added *P. noveboracensis* from North America which in habit is similar to *P. beddomei* of Malesia. He did not include another North American species, originally named *Aspidium simulatum* DAVENP. which is very similar to the type species *P. glanduligera* and has been made the type of a new genus *Wagneriopteris* by LÖVE and LÖVE, who reported a chromosome number 31 for it, though two previous authors had reported 32. In any event, the species here brought together are certainly not uniform in chromosome number, and it seems probable that the genus should be subdivided, but a new comprehensive study of all characters (including gametophytes) is necessary before this can be satisfactorily effected.

KEY TO THE SPECIES

1. Basal pinnae, several pairs, gradually reduced, lowest 3–5 mm long . . . . . **1. P. beddomei**
1. Basal pinnae, at most 2 pairs, slightly reduced.
2. Pinnae to 7.5 cm long; basal pinnae much narrowed at base . . . . . **2. P. glanduligera**
2. Pinnae to 2.0 cm long; basal pinnae not narrowed at base . . . . . **3. P. grammitoides**

1. Parathelypteris beddomei (BAK.) CHING, Acta Phytotax. Sinica 8 (1963) 302; C. M. KUO, Fl. Taiwan 1 (1975) 421, pl. 146. — *Lastrea gracilescens sensu* BEDD. Ferns S. India (1863) t. 110. — *Nephrodium beddomei* BAK. Syn. Fil. (1867) 267, *nom. nov.* — *Lastrea beddomei* (BAK.) BEDD. Ferns Brit. India corr. (1870) 2; Handb. (1883) 239; COPEL. Fern Fl. Philip. (1960) 321. — *Dryopteris beddomei* (BAK.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 191; BACKER & POSTH. Varenfl. Java (1939) 37. — *Thelypteris beddomei* (BAK.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 308; HOLTTUM, Rev. Fl. Mal. 2 (1955) 240; MANTON & SLEDGE, Phil. Tr. R. Soc. B, 238 (1954) 137; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 166. — Type: BEDDOME *s.n.* Nilgiri Mts, S. India (K).

Phegopteris smithii v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 18 (1908) 15; Handb. (1908) 490. — Type: Java, Gedeh, Herb. Bog. 4170 (BO).

Dryopteris beddomei var. nadiwonensis v.A.v.R. Bull. Jard. Bot. Btzg II, 7 (1912) 13. — Type: VERMOESEN, Java, Ngadiwono (BO).

Dryopteris microcarpa v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 147. — *Thelypteris microcarpa* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 252. — Type: BÜNNEMEIJER 5636, Sumatra, Padang Highlands (BO). — **Fig. 5a–b.**

KEY TO THE VARIETIES

1. Rhizome long-creeping; septate hairs many on lower surface.
2. Pinnae commonly 3–5 cm long **a. *var.* beddomei**
2. Pinnae not over 2 cm long. **b. *var.* eugracilis**
1. Rhizome usually short-creeping; few septate hairs . . . . . **c. *var.* brassii**

a. *var.* beddomei — Fig. 5a–b.

Rhizome long-creeping, 2.5 mm diameter, bearing fronds 2–4 cm apart; scales broad, entire, with superficial capitate hairs only. *Stipe* 5–10 cm long, green; *rachis* with capitate hairs on lower surface, usually also acicular hairs. *Lamina* commonly 20–25 cm long; pinnae many pairs, several pairs towards base gradually smaller, lowest less than 1 cm long. *Largest pinnae* 3–5 cm long, 6–8(–10) mm wide, incised almost to costa into oblique ± dentate lobes 1.5–2.0 mm wide (basal lobes of largest pinnae sometimes almost free and rather deeply lobed, as in *var. nadiwonensis* v.A.v.R.); *lower surface* of costa, costules and veins bearing erect slender hairs 1 mm long, many consisting of several cells, and scattered very short capitate hairs or larger sessile yellow glands; *upper surface* sometimes also with sessile glands between veins; *veins* pinnate in the pinna-lobes, very oblique, simple or (in largest lobes) forked. *Sori* small, close to margin; indusia small bearing short capitate hairs.

Distr. Southern India & Ceylon; Taiwan; throughout *Malesia.*

Ecol. On mountains at 1500–2000 m, in rather open places, on sloping ground where there is a seepage of water; becoming more abundant with increased felling of mountain forest.

Note. Specimens from Japan and China named *T. beddomei* in Herb. Kew. appear to me to be *P. nipponica* (Fr. & SAV.) CHING; they have pinna-lobes which are flat when dried and at maturity are covered beneath with sori, and their septate hairs are shorter, consisting of at most 3 cells.

b. *var.* eugracilis (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris gracilis* COPEL. Philip. J. Sci. 40 (1929) 294, *non* DOMIN, 1929. — *Lastrea eugracilis* COPEL. Gen. Fil. (1947) 138, *nom. nov.*; Fern Fl. Philip. (1960) 321. — *Thelypteris eugracilis* (COPEL.) REED, Phytologia 17 (1968) 275. — Type: ELMER 11520, Mindanao, Mt Apo (MICH; K, L).

Differs from *var. beddomei*: pinnae 1.4–1.6 cm long, 4–6 mm wide near base.

Distr. *Malesia*: Philippines (Mindanao), 2 collections, 1700–1800 m.

c. *var.* brassii (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris brassii* C. CHR. Brittonia 2 (1937)

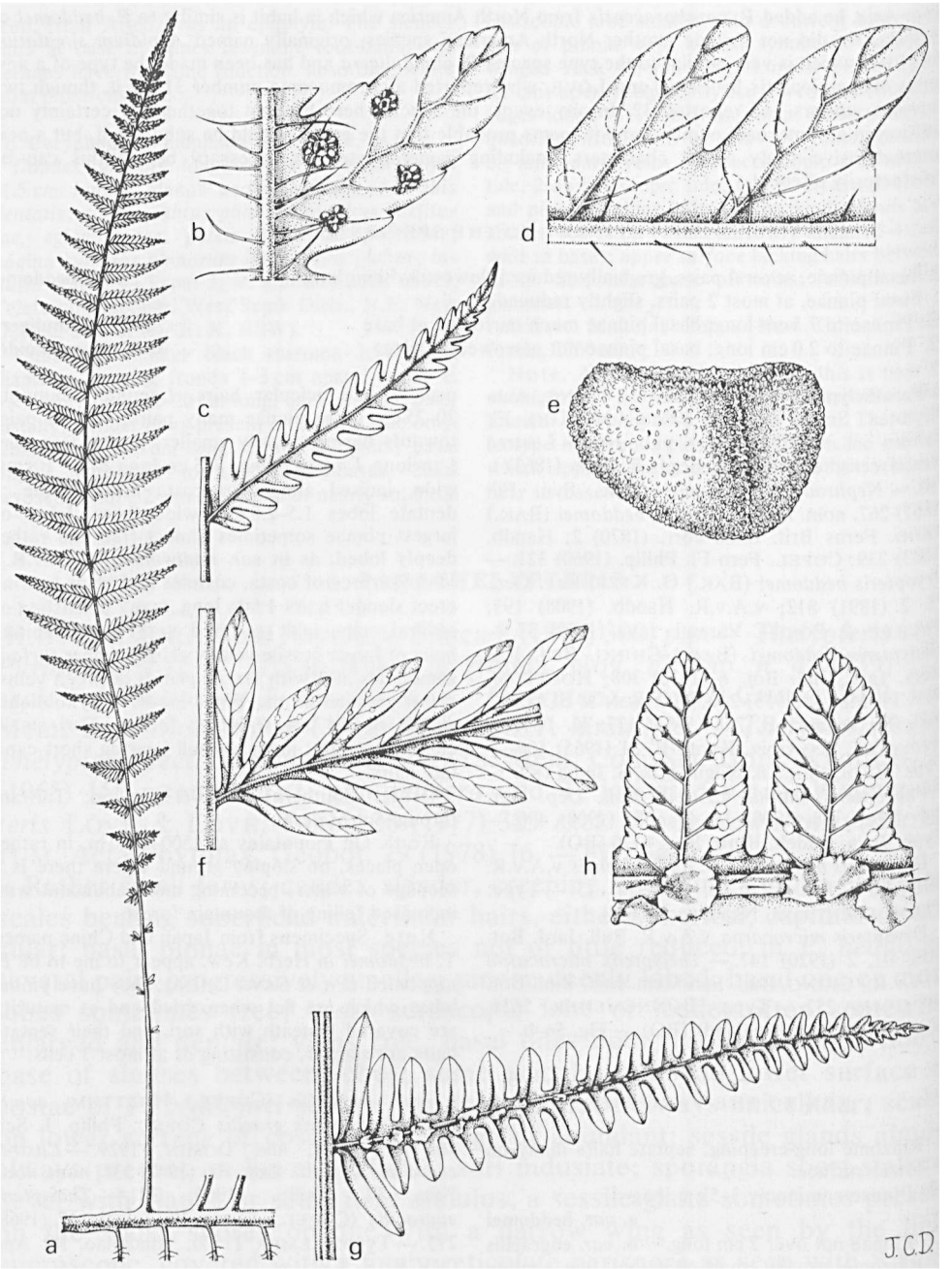

Fig. 5. *Parathelypteris beddomei* (BAK.) CHING. *a.* Rhizome and frond, ×$\frac{1}{3}$; *b.* pinna-lobe, ×12. — *Trigonospora ciliata* (BENTH.) HOLTTUM. *c.* One pinna, ×1.5; *d.* 2. pinna-lobes, ×8; *e.* spore, ×650. — *T. calcarata* (BL.) HOLTTUM. *f.* One pinna, ×2. — *Thelypteris confluens* (THUNB.) MORTON. *g.* One pinna, ×2; *h.* part of fertile pinna, ×8 (*a–b* HOLTTUM 26217, *c–e* HOLTTUM 31306, *f* Java in Herb. Hook., *g–h* IWATSUKI *et al.* 155).

295. — *Lastrea brassii* (C. CHR.) COPEL. Philip. J. Sci. 78 (1951) 424. — *Thelypteris brassii* (C. CHR.) REED, Phytologia 17 (1968) 265. — Type: BRASS 4937, Papua, Mt Tafa, 2400 m (BM).

Differs from *var. beddomei*: rhizome usually short, with fronds ± tufted; septate hairs on lower surface few and shorter.

Distr. *Malesia*: Eastern New Guinea, at 2000–3500 m.

Note. Some specimens have a partly creeping rhizome but in almost all cases some fronds are in rather dense tufts. It is possible that this variety represents an adaptation to conditions at higher altitudes and in more exposed places than the normal habitats for *var. beddomei* in Western Malesia. CHRISTENSEN wrongly stated that the type is exindusiate.

2. Parathelypteris glanduligera (KUNZE) CHING, Acta Phytotax. Sinica 8 (1963) 303; HOLTTUM, Kalikasan 5 (1976) 113. — *Aspidium glanduligerum* KUNZE, Analecta Pterid. (1837) 44. — *Lastrea gracilescens var. glanduligera* BEDD. Handb. Suppl. (1892) 51. — *Dryopteris glanduligera* (KUNZE) CHRIST, J. de Bot. 21 (1908) 231. — *Thelypteris glanduligera* (KUNZE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 320; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 167. — Type: C. W. PETERSEN, near Canton ("Herb. Lehmann et propria"; not found among KUNZE specimens at B).

Dryopteris repentula CHRIST, Notul. Syst. 1 (1909) 29. — Lectotype (CHING, *l.c.* 1936): HENRY 13077, Yunnan (K).

Rhizome to 3 mm diameter. *Stipe* to 30 cm long, slender, with many capitate and sometimes acicular hairs. *Lamina* 20–30 cm long; pinnae 15–20 pairs, well spaced; basal pinnae not reduced, distinctly narrowed towards their bases, basal acroscopic lobe often ± elongate and sometimes dentate. *Largest pinnae* 6–8.5 cm long, 1.3–1.5 cm wide, acuminate, lobed to 0.5 mm from costa; lobes entire, subacute, falcate; costules 2–3 mm apart; veins to 8 pairs, usually simple; *lower surface* of rachis and costae densely hairy, hairs erect, of varied length to 1 mm; hairs on costules and veins more sparse, also some small scales with swollen red terminal cell; large orange-red glands present on and between veins; *upper surface* lacking hairs and glands between veins. *Sori* near apices of veins, rather small, distal ones sometimes asymmetric; indusia small, bearing glands (often many) and short hairs.

Distr. Nepal eastwards to S. China, Korea and Japan, and south to Thailand and *N. Malesia*: Philippines (N. Luzon).

Note. The only known Malesian specimens are from Baguio at 1200 m (M. G. PRICE 1583) and Zambales Province, above Palauig (PRICE 2828, 2850). In 1976 I wrongly referred the Zambales specimens to *P. grammitoides*.

3. Parathelypteris grammitoides (CHRIST) HOLTTUM, Kalikasan Philip. J. Biol. 5 (1976) 114. — *Aspidium grammitoides* CHRIST, Bull. Herb. Boiss. 6 (1898) 193. — *Thelypteris grammitoides* (CHRIST) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 317. — *Lastrea grammitoides* (CHRIST) COPEL. Fern Fl. Philip. (1960) 320. — Type: LOHER 890, Nov. 1893, Luzon, Mt Mariveles (P; K).

Athyrium hyalostegium COPEL. Philip. J. Sci. 1 (1906) Suppl. 253. — Lectotype: COPELAND 2033, Luzon, Mt Mariveles (MICH; P, US).

Rhizome to 2 mm diameter. *Stipes* not widely-spaced, 3–10 cm long, with acicular hairs 0.3 mm long throughout; basal scales narrow, 1.5 mm long, bearing small glands, distal ones bearing also short acicular hairs. *Lamina* 5–8 cm long; pinnae 6–8 pairs; lowest pinnae not or little smaller than next pair, not narrowed at base, basal acroscopic lobe always free and ± crenate, basal basiscopic lobe usually also free; apex of lamina gradually attenuate. *Largest pinnae* 2.0 × 0.8 cm, lobed almost to costa; basal acroscopic lobe almost at right angles to costa, basiscopic and other acroscopic lobes at *c.* 45°, with sinuous edges; apex of pinna evenly attenuate; costules to 3 mm apart; veins 4–5 pairs in largest lobes; *lower surface* of rachis and costae bearing scattered slender hairs of mixed length to 1 mm long, glands present on and between veins; hairs on *upper surface* of costae 0.5 mm long, few hairs on costules. *Sori* supramedial to medial; indusia small, thin, with rather long slender hairs and a few glands.

Distr. *Malesia*: Philippines (Luzon).

Ecol. At 900–1400 m; on Mt San Cristobal found "at edge of crater lake, in shade with mosses" (M. G. PRICE).

Note. This species is closely allied to *P. angustifrons* (MIQ.) CHING from the Ryukyu Islands and Taiwan, but the Philippine plants appear always to be much smaller than those from Taiwan. *P. crystopteroides* (EATON) CHING in Japan and the northern Ryukyu Islands is also closely related.

7. TRIGONOSPORA

HOLTTUM, Blumea 19 (1971) 29; Reinwardtia 8 (1974) 503. — *Pseudocyclosorus* CHING, Acta Phytotax. Sinica 8 (1963) 322, *p.p.* — **Fig. 5c–f.**

Caudex short, erect; lamina of fronds commonly to 20 cm long, lacking

reduced basal pinnae; veins in Malesian species free, unbranched, lowest acroscopic vein ending beside short sinus-membrane, basal basiscopic vein to edge above base of sinus; acicular unicellular hairs variously developed on lower surface; sori indusiate; glands and hairs lacking on body of sporangium, on its stalk usually a hair of several cells ending in a gland; spores trilete, minutely papillose.

Type species: *Trigonospora ciliata* (BENTH.) HOLTTUM.

Distr. Ceylon, India except north-west, Burma to Kwangtung and southwards to Malesia; in *Malesia*: Malaya northwards from 4°N, N. Sumatra, S. Sumatra and Java, N. Celebes. About 8 species, not yet all described.

Ecol. On rocks in and beside streams in mountain forest.

Cytol. Base chromosome number 36: *T. ciliata* diploid in Malaya; species of uncertain identity diploid and tetraploid in Ceylon and S. India.

Notes. This is the only group of species in the family in which trilete spores are normal, though such have been observed as occasional in *Macrothelypteris* (P. CHANDRA, Amer. Fern J. 63, 1973, 9). In their shape and in their minutely papillose perispore they are closely similar to the spores of the monotypic African genus *Menisorus* ALSTON which are either spherical or monolete with a short laesura. Plants of *Menisorus* also have a short erect caudex and grow on rocks in streams; I believe that the two genera are related. An unnamed species in Ceylon has short capitate hairs, like those of *Pseudocyclosorus*, on the lower surface and on indusia.

In India and Ceylon this genus is much diversified in shape and size of fronds and of their pinnae, and in pubescence, but (apart from *T. zeylanica* CHING) individual species have not yet been clearly distinguished, probably because intermediates bridge some of the gaps between them. The existence of a tetraploid in S. India indicates hybridization; the habitat on wet rocks would facilitate this. One Ceylon specimen is very like *T. calcarata* of Java in shape of pinnae but much larger; others in Ceylon are very different. Hooker included most Indian specimens in *Nephrodium calcaratum*; BEDDOME added *N. falcilobum* HOOK. (*Pseudocyclosorus falcilobus* CHING) as a variety, though it differs in its reduced basal pinnae. HOOKER cited the type of *T. zeylanica* as a variety under *N. falcilobum* and expressed uncertainty as to a distinction between *N. calcaratum* and *N. falcilobum*.

Thelypteris khamptorum HOLTTUM (Kew Bull. 26, 1971, 82) has crenate pinnae and anastomosing veins, but agrees in spores with *Trigonospora*; two collections are known from Upper Burma.

KEY TO THE SPECIES

1. Edges of pinnae lobed to less than 1 mm from costa, lobes narrow with wide sinuses between them; indusia glabrous.
   2. Pinnae 3-4 cm long, 10–12 mm wide above auricled base; lobes (except basal acroscopic one) not narrowed towards their bases . . . . . **1. T. calcarata**
   2. Pinnae to 8×2 cm, basal acroscopic lobe not much elongate; pinna-lobes widest 1/3 from their apices . . . . . **2. T. koordersii**
1. Edges of pinnae lobed to 1.5–2 mm from costa; lobes wider than sinuses between them; indusia hairy . . . . . **3. T. ciliata**

1. Trigonospora calcarata (BL.) HOLTTUM, Reinwardtia 8 (1974) 506. — *Aspidium calcaratum* BL. Enum. Pl. Jav. (1828) 159; RACIB. Fl. Btzg 1 (1898) 170. — *Nephrodium calcaratum* (BL.) HOOK. Spec. Fil. 4 (1862) 93, *p.p.* — *Dryopteris calcarata* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 185, *p.p.*; BACKER & POSTH. Varenfl. Java (1939) 38. — *Thelypteris calcarata* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 288. — Type: BLUME, Java (L).

Aspidium reinwardtianum KUNZE *ex* METT. Farngatt. IV (1858) 86. — Lectotype (HOLTTUM 1974): ZOLLINGER 1600 (B; FI, G).

Dryopteris marthae v.A.v.R. Bull. Jard. Bot. Btzg II, 1 (1911) 7. — Type: BACKER 262, G. Slamat, 900 m (BO). — **Fig. 5f.**

Stipe 8-20 cm long, dark at base, glabrescent except in groove. *Lamina* 10–20 cm long; pinnae to 12 pairs. *Largest pinnae* 3–4 cm long, 10–12 mm wide above base, lobed to less than 1 mm from costa; lobes *c.* 8 pairs, narrow, very oblique except basal acroscopic one which is elongate, close to rachis and almost free; veins *c.* 6 pairs; rachis, costae and costules sparsely hairy on lower surface. *Sori* near costules; indusia dark, firm, glabrous; sporangia lacking gland-bearing hairs on their stalks.

Distr. Ceylon and *Malesia*: throughout Java at

100–1000 m, southern Sumatra and north to Padang Highlands.

2. **Trigonospora koordersii** (CHRIST) HOLTTUM, Reinwardtia 8 (1974) 506. — *Aspidium koordersii* CHRIST, Ann. Jard. Bot. Btzg 15 (1897) 128, t.15, f.17. — *Dryopteris koordersii* (CHRIST) C. CHR. Ind. Fil. (1905) 273; v.A.v.R. Handb. (1908) 181. — Type: KOORDERS 1700, Celebes, near Karawutu, 50 m (P; BO, L).

Stipe 15 cm, glabrous. *Lamina* to 24 cm long; pinnae 8 pairs. *Largest pinnae* 8 × 2 cm, distinctly stalked, lobed almost to costa; lobes at 45°, to 15 mm long, 1½–2 mm wide, widest 1/3 from apex and narrowed towards base, basal acroscopic lobe not much longer than next; sparse rather thick hairs on lower surface of costules only; veins 8–12 pairs. *Sori* medial; indusia firm, dark, glabrous; sporangia short-stalked, lacking a glandular hair on the stalk.

Distr. *Malesia*: N.E. Celebes; only known from the type.

3. **Trigonospora ciliata** (BENTH.) HOLTTUM, Blumea 19 (1971) 29. — *Lastrea ciliata* HOOK. J. Bot. Kew Misc. 9 (1857) 338, *non* LIEBM. — *Aspidium ciliatum* BENTH. Fl. Hongkong. (1861) 455. — *Lastrea calcarata var. ciliata* BEDD. Handb. (1883) 235, *p.p.* — *Dryopteris ciliata* (BENTH.) C. CHR. *ex* WU *et al.* Bull. Dept. Biol. Sunyatsen Univ. *n.* 3 (1922) 30, pl. 6. — *Thelypteris ciliata* (BENTH.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 289; C.C. WOOD, J. Linn. Soc. Bot. 67, Suppl. 1 (1973) pl. 2C. — *Pseudocyclosorus ciliatus* (BENTH.) CHING, Acta Phytotax. Sinica 8 (1963) 324. — Lectotype (HOLTTUM 1974): "BOWMAN" (BOWRING), Hong Kong (K).

Dryopteris pinnata COPEL. Univ. Cal. Publ. Bot. 14 (1929) 373. — *Thelypteris pinnata* (COPEL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 253. — Type: BARTLETT 6641, Sumatra, Asahan river (UC; L). — **Fig. 5c–e.**

Stipe of sterile fronds 10-15 cm, of fertile to 25 cm long. *Lamina* to 20 cm long; pinnae *c.* 14 pairs. *Largest pinnae* 4–5 cm long, 1.0–1.2 cm wide above the base, lobed to 1.5–2 mm from costa; lobes oblique, rather triangular, basal acroscopic lobe a little elongate; veins 5–6 pairs; lower surface of rachis and costae bearing copious soft pale spreading hairs 1 mm long, shorter ones on costules and veins. *Sori* near costules; indusia large, very hairy; stalk of sporangium bearing a hair of 3 cells, end cell glandular.

Distr. N. India and S. China southwards to *Malesia*: N. Malaya and Sumatra.

8. THELYPTERIS

SCHMIDEL, Icon. Pl. ed. Keller (1763) 45, t. 11, 13, *nom. cons.*; FERNALD, Rhodora 31 (1929) 27–36, pl. 179–180; CHING, Acta Phytotax. Sinica 8 (1963) 297 *excl. T. grisea* (BAK.) CHING; HOLTTUM, Taxon 17 (1968) 330; Blumea 19 (1971) 28; A.F. TRYON, Rhodora 73 (1971) 444. — **Fig. 5g–h.**

Rhizome long-creeping, in wet ground; fronds simply pinnate with deeply lobed pinnae, basal ones not reduced; veins free, usually forked, all reaching margin; flat thin scales present on lower surface of costae; sori indusiate; sporangia bearing short capitate hairs; perispore of spores varied (see A.F. TRYON *l.c.*).

Type species: *Thelypteris palustris* SCHOTT.

Distr. North temperate Eurasia, in Asia south to Himalayas; eastern temperate and subtropical N. America; Africa south of the Sahara; S. India; N. Thailand; in *Malesia*: Sumatra and New Guinea; New Zealand. Two species, northern and southern, the former with geographically distinct subspecies.

Cytol. Base chromosome number 35; many observations in north temperate regions, all diploid.

Notes. This genus, as restricted by CHING but excluding his *T. grisea*, is the temperate counterpart of *Cyclosorus* (in the restricted sense here adopted). Both are rhizomatous ferns growing in open fresh-water swamps. They also agree in having fronds with unreduced basal pinnae and in bearing flat scales on lower surface of costae, a character uncommon in the family. In the present work, *Cyclosorus* is associated with *Ampelopteris* and *Mesophlebion*; from these three *Thelypteris* differs in (a) capitate hairs on sporangia, (b) lack of red glands at the ends of hairs on sporangium-stalk, (c) chromosome number 35, (d) basiscopic vein always from costule, not from costa. But I suggest that *Thelypteris* is nearest to this group of genera.

CHING included *Nephrodium griseum* BAK. (see BEDD. Ferns Brit. India t.335, Handb. 241) as a species of his restricted *Thelypteris*. The type of this is a specimen at Kew from Cochin which resembles *T. palustris* in its forked veins but in little else. BEDDOME wrote a note on it in his own Herbarium (now at Kew) and suggested that it was probably an abnormal form of *Lastrea calcarata var.*

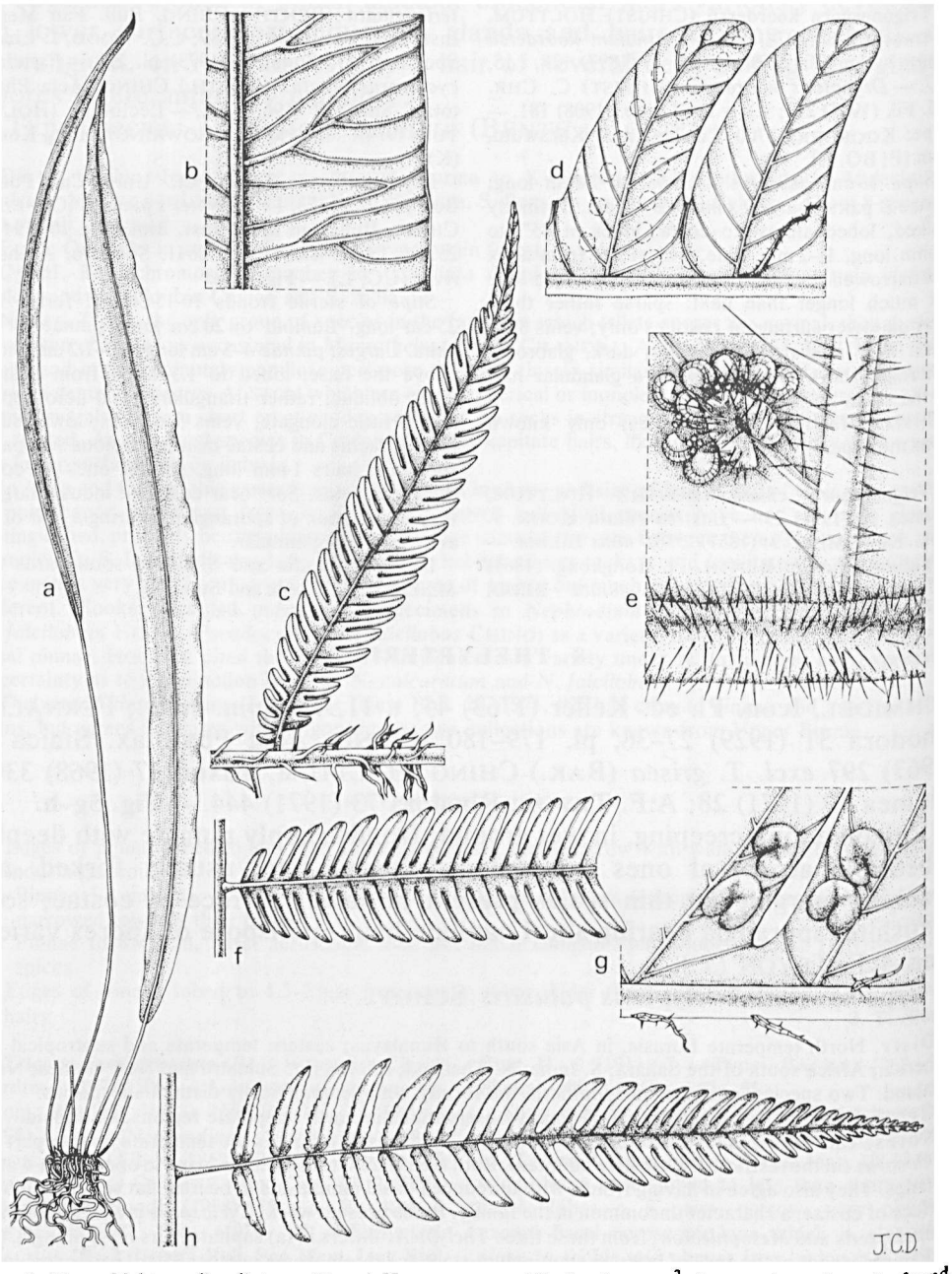

Fig. 6. *Mesophlebion oligodictyon* (BAK.) HOLTTUM. *a.* Whole plant, ×⅔; *b.* venation of sterile frond, ×4. — *M. trichopodum* (C. CHR.) HOLTTUM. *c.* Rachis and basal pinna, ×⅔; *d.* two pinna-lobes, hairs omitted, ×4; *e.* costa, costule and sorus, ×24. — *M. beccarianum* (CESATI) HOLTTUM. *f.* Suprabasal pinna, ×⅔; *g.* venation and sori, ×8. — *M. endertii* (C. CHR.) HOLTTUM. *h.* One pinna, ×⅓ (*a* JACOBS 5600, *b* C. HOSE 210, *c–e* MATTHEW *s.n.*, *f–g* LEE & MAHMUD UL37, *h* ENDERT 4433).

ciliata (*Trigonospora ciliata* of the present work) but in my opinion it is an abnormal form of a species of *Pseudocyclosorus*.

The best account of the genus in the northern hemisphere is by FERNALD, *l.c.*

1. **Thelypteris confluens** (THUNB.) MORTON, Contr. U.S. Nat. Herb 38 (1967) 71; SCHELPE, Fl. Zambes. Pterid. (1970) 190, t. 55E; HOLTTUM, J.S. Afr. Bot. 40 (1974) 150; Allertonia 1 (1977) 180. — *Pteris confluens* THUNB. Prodr. Fl. Cap. (1800) 171. — Type: THUNBERG, S. Africa (UPS).

Aspidium thelypteris var. squamigerum SCHLECHTEND. Adumb. Fil. Prom. B. Spei (1825) 23, t.11. — *Aspidium squamigerum* FÉE, Mém. Fam. Foug. 8 (1857) 104. — *Lastrea thelypteris var. squamigera* BEDD. Handb. Suppl. (1892) 54. — *Dryopteris thelypteris var. squamigera* C CHR. Ind. Fil. (1905) 297. — *T. palustris var. squamigera* WEATH. Contr. Gray Herb. n.s. 73 (1924) 40. — *T. squamigera (err. typ. squamulosa)* CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 329; TARD. in Humbert, Fl. Madag. 5e Fam. 1 (1958) 282. — Type: SCHLECHTENDAL, Cape Peninsula (HAL).

Nephrodium squamulosum HOOK. *f.* Fl. New Zeal. 2 (1855) 39. — *Nephrodium thelypteris var. squamulosum* HOOK. Spec. Fil. 4 (1862) 88. — Type: COLENSO, New Zealand (K).

Lastrea fairbankii BEDD. Ferns Br. Ind. (1867) t.254; Handb. (1883) 240. — Type: BEDDOME, S. India, Pulney Hills (K). — **Fig. 5g-h.**

Rhizome 2 mm diameter (dry). *Stipe* stramineous, 15–50 cm long. *Lamina* 25–50 cm long; pinnae to 20 pairs or more, dimorphous. *Sterile pinnae* commonly 4–6 × 1.5 cm, *fertile* 6–9 mm wide; lowest pinnae slightly reduced, sometimes with a free basal acroscopic lobe; middle pinnae not dilated at base, lobed to less than 1 mm from costa; veins in sterile fronds mostly forked, in fertile often simple; lower surface of costae bearing slender hairs and ovate-orbicular flat ciliate scales 0.5–1 mm long and wide; lower surface between veins bearing a variable number of slender acicular and short capitate hairs; hairs on upper surface of costa short. *Sori* near costules; indusia with short marginal hairs.

Distr. Africa south of the equator and to 7°N in Ethiopia and Sudan; Madagascar; S. India; N. Thailand and Laos; in *Malesia*: N. Sumatra in Atjeh, near Lake Toba and near G. Kerinci; Western New Guinea on Arfak Mts, Eastern New Guinea in W. Highlands; New Zealand (North Island).

Ecol. In N. Sumatra at 1180–1330 m, in W. New Guinea at 1750–1900 m, in E. New Guinea at 2500 m; in all cases in swampy open ground near lakes.

9. MESOPHLEBION

HOLTTUM, Blumea 19 (1971) 29 (new name for *Mesoneuron* CHING, *non* DESF.), *excl. subg. Plesioneuron.* — Group of *Dryopteris crassifolia* (BL.) O. KTZE, C. CHR. Gard. Bull. Str. Settl. 4 (1929) 381; of *Thelypteris crassifolia* (BL.) CHING, HOLTTUM, Rev. Fl. Mal. 2 (1955) 245–249, f. 139–141. — *Mesoneuron* CHING, Acta Phytotax. Sinica 8 (1963) 325, *excl. M. attenuatum.* — *Thelypteris subg. Glaphyropteridopsis sect. Mesoneuron* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 30, *excl. Pseudocyclosorus* CHING. — **Fig. 1k, 6.**

Caudex creeping, sometimes elongate; scales narrow, rather rigid but never spine-like, bearing short acicular hairs; similar scales at base of stipe, in a few species throughout stipe and basal part of abaxial surface of rachis. Fronds simply pinnate (in *M. oligodictyon* simple, in *M. endertii* partly bipinnate), sometimes dimorphic; basal pinnae not reduced but ± narrowed towards their asymmetric bases; aerophores often distinctly swollen on living fronds, collapsing on drying; all pinnae lobed, in some cases deeply; veins all simple and free (except casually in *M. oligodictyon* and *M. motleyanum*), basal basiscopic vein arising from costa near the base of the costule to which it belongs; basal veins from adjacent costules usually both passing to base of sinus between their lobes, touching sides of the sinus-membrane, which may be slightly decurrent between them as a hairy ridge; lower surface of costae, costules and veins always bearing many narrow

scales in various degrees of reduction (smallest of 2 or 3 cells) in addition to a varied complement of acicular unicellular (sometimes also capitate) hairs and in some cases sessile spherical orange glands; upper surface hairy on costa only; sori in almost all cases indusiate, the indusia in most cases thin and sometimes small; young sporangia often pale violet-purple; large spherical orange-red glands attached directly or by a hair to stalks of sporangia, no glands nor hairs on body of sporangia; spores in most species with a thin continuous wing and a few cross-wings, papillose without a wing in *M. beccarianum* and *M. chlamydophorum.*

Type species: *Mesophlebion crassifolium* (BL.) HOLTTUM.

Distr. Peninsular Thailand and southern Burma, *Malesia*: except E. Java and Lesser Sunda Islands (greatest diversity in Borneo), few specimens from New Guinea.

Ecol. In forest, apart from *M. teuscheri and M. arenicola* (on wet sandstone in exposed places) and *M. oligodictyon* (in rocky stream-beds), at 0–1500 m.

Cytol. Base chromosome number 36; *M. crassifolium* and *M. trichopodum* both tetraploid in Malaya (MANTON in Holttum 1955), *M. falcatilobum* diploid in Sarawak (T. G. WALKER, new obs.)

Taxon. Species of this genus were first recognized as forming a distinct group by CHRISTENSEN (1929). CHING transferred two of them to *Thelypteris* in 1936, and the species of Malaya were treated under that genus by HOLTTUM in 1955. In 1963 CHING established the genus *Mesoneuron* for them, but as *Mezonevron* DESF. has also been spelled *Mesoneuron* I proposed the new name *Mesophlebion* in 1971; in doing so I included *Plesioneuron* as a subgenus.

Mesophlebion agrees with *Cyclosorus* (in the strict sense of the present account) and *Ampelopteris* in the large red glands which occur at the ends of hairs on stalks of sporangia and sometimes on the lower surface of veins, also in the presence of scales on the lower surface of costae. In my judgement, these two genera and *Thelypteris* are the only near relatives of *Mesophlebion.*

In tropical America occur two species which CHRISTENSEN (Monogr. Dryopteris 1, 1913, 170–173) placed with doubt in *Dryopteris subg. Steiropteris*; BAKER confused *Mesophlebion motleyanum* with one of these and was copied by other authors. The American species differ from *Mesophlebion* in having a long sinus-membrane and long aerophores, and in the absence of red glands.

Several species of *Mesophlebion* are variable, and it is possible that a complex of diploids, triploids and tetraploids may exist. Experimental studies are needed to clarify this situation. I judge that the species here recognized are reasonably distinct, though probably not all of equal status, and hybrids may occur. Several plants of both *M. motleyanum* and *M. falcatilobum*, from Gunong Mulu in Sarawak, have shown consistently distinct characters in cultivation at Kew.

It is notable that, as in *Plesioneuron* and *Chingia*, a few species of this genus have abundant scales throughout the stipe and at least the basal part of the rachis. This development in the three genera appears to be a case of parallel evolution; a similar condition occurs in one non-Malesian species of *Christella* (*C. crinipes* (HOOK.) HOLTTUM) to which RIDLEY referred specimens of *M. trichopodum.*

KEY TO THE SPECIES

1. Stipe and lower part of rachis bearing numerous stiff spreading scales.
 2. Pinnae to 12 cm long.
  3. Stipe-scales dark, to 1 mm wide; veins 7–10 pairs . . . . . **1. M. echinatum**
  3. Stipe-scales medium brown, to 2 mm wide; veins 12–17 pairs . . . . **2. M. persquamiferum**
 2. Pinnae of well-grown plants much longer.
  4. Costae, costules and veins beneath bearing short hairs only; stipe-scales to 6 mm long.
   5. Lower pinnae not auricled; no glands on lower surface of costules . . . . . **3. M. hallieri**
   5. Lower pinnae strongly auricled; copious glands on lower surface of costules . . **4. M. caroli**
  4. Costae, costules and veins beneath bearing hairs 1 mm or more long, at least on sterile fronds; stipe-scales 10 mm or more long . . . . . **5. M. trichopodum**
1. Upper part of stipe and rachis lacking large scales.
 6. Fronds simple . . . . . **6. M. oligodictyon**
 6. Fronds pinnate or partly bipinnate.
  7. Pinnae not more than 3 cm long.
   8. Pinnae lobed less than half-way to costa; acroscopic bases of pinnae auricled **7. M. teuscheri**
   8. Pinnae lobed more than half-way to costa, not auricled . . . . . **8. M. arenicola**

7. Pinnae much longer.
9. Largest pinnae with several pairs of pinnules . . . . . **9. M. endertii**
9. Largest pinnae with at most one free basal lobe.
10. Sterile pinnae lobed not more than half-way to costa, except sometimes basal pinnae.
11. Pinnae 6–8(–10) pairs; young fronds red . . . . . **10. M. motleyanum**
11. Pinnae 14–18 pairs; young fronds not red . . . . . **11. M. falcatilobum**
10. Sterile pinnae lobed more than half-way to costa.
12. Pinnae to 6.5 cm wide, lower ones with stalks 3-4 cm long . . . . . **12. M. dulitense**
12. Pinnae not more than 4 cm wide, lower ones with stalks to 1.5 cm long.
13. Hairs on lower surface of costae and costules *c.* 1 mm long.
14. All pinnae distinctly stalked; copious short hairs and glands between veins on lower surface . . . . . **13. M. auriculiferum**
14. Pinnae sessile; sparse erect hairs 0.5 mm long and no glands between veins on lower surface **5. M. trichopodum**
13. Hairs on lower surface of costae and costules not over 0.3 mm long.
15. Indusia firm, glabrous, covering the sorus almost to maturity; fertile pinnae lobed to 1–1½ mm from costa . . . . . **14. M. beccarianum**
15. Indusia small, not covering developing sori, or ± hairy; fertile pinnae lobed less deeply.
16. Fertile pinnae lobed to 2 mm from costa; indusia small, firm, glabrous . **15. M. rufescens**
16. Fertile pinnae lobed less deeply; indusia usually with some hairs, thin and almost obscured by sporangia if small.
17. Fronds rarely dimorphic; pinnae thin, rarely more than 2 cm wide; indusia always conspicuous, firm, bearing a variable number of short hairs . **16. M. chlamydophorum**
17. Fronds usually dimorphic; pinnae rigid, fertile to 3 cm, sterile to 4 cm wide; indusia varied in size, thin and shrivelling when dried . . . . . **17. M. crassifolium**

1. Mesophlebion echinatum (METT.) HOLTTUM, Blumea 22 (1975) 226. — *Aspidium echinatum* METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 230; MIQUEL, *ibid.* 4 (1868) 157. — *Dryopteris echinata* (METT.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 182; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 386. — *Mesoneuron echinatum* (METT.) CHING, Acta Phytotax. Sinica 8 (1963) 326. — *Thelypteris echinata* (METT.) REED, Phytologia 17 (1968) 274. — Type: KORTHALS 498, G. Prarawin, near Bandjermasin, Kalimantan (L, *n.* 908, 335–575).

Caudex short-creeping; *stipe* to 30 cm long, bearing throughout (also basal part of rachis and near bases of costae on lower surface) spreading dark scales to 10 mm long, those of stipe 1 mm wide at base, on rachis narrower. *Lamina* of type 30 cm long (of another specimen 70 cm); basal pinnae slightly narrowed at base with stalks 2 mm long. *Largest pinnae* 11–15 cm long, 1.5–2.0 cm wide, acuminate with subentire cauda 10–15 mm long, lobed to less than 2 mm from costa; costules 3.5 mm apart, at more than 60° to costa; veins 7–10 pairs, basal basiscopic vein arising from costa near base of its costule; rachis and costae densely short-hairy on *lower surface*, hairs sparse on costules and veins, large red glands present on costules. *Sori* inframedial; indusia small, firm, caducous, with a few short hairs or glabrous.

Distr. *Malesia*: + Borneo (Kalimantan, Sarawak), N. Sumatra.

Ecol. Lowland forest.

Note. The Sumatran specimen (DE WILDE 12635) has the basal basiscopic vein arising from the costa rather far from the base of its costule.

2. Mesophlebion persquamiferum (v.A.v.R.) HOLTTUM, Blumea 22 (1975) 226. — *Dryopteris persquamifera* v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 10; Handb. Suppl. (1917) 149. — *Mesoneuron persquamiferum* (v.A.v.R.) CHING, Acta Phytotax. Sinica 8 (1963) 326. — Type: RACHMAT 489, Somalilah, Celebes (BO; L).

Aspidium echinatum sensu CHRIST, Ann. Jard. Bot. Btzg 15 (1898) 128.

Stipe 35–40 cm long, densely scaly; scales medium brown, to 8 × 2 mm, with thick persistent bases; similar scales on rachis. *Lamina* 50 cm long; pinnae *c.* 20 pairs; basal pinnae slightly narrowed at base, short-stalked. *Largest pinnae* 12.5 × 2.0–2.5 cm; base slightly dilated, apex short-acuminate; edges lobed to 2 mm from costa, lobes falcate; costules to 4 mm apart, at more than 60°; veins 12–17 pairs, basal basiscopic vein from costa distant from its costule; rachis scaly beneath almost throughout; costae and costules almost hairless beneath with many narrow scales and sessile glands, some glands also on surface between veins. *Sori* inframedial; indusia small, short-hairy, often caducous.

Distr. *Malesia*: Central Celebes, 2 collections (SARASIN 952, Takale Kadjo, 900 m; BAS).

3. Mesophlebion hallieri (CHRIST) HOLTTUM, Blumea 22 (1975) 227. — *Aspidium hallieri* CHRIST, Ann. Jard. Bot. Btzg 20 (1905) 106. — *Dryopteris hallieri* (CHRIST) C. CHR. Ind. Fil. (1905) 269; Gard. Bull. Str. Settl. 4 (1929) 387; v.A.v.R. Handb. (1908) 184. — *Mesoneuron hallieri* (CHRIST) CHING, Acta Phytotax. Sinica 8 (1963) 326. — *Thelypteris hallieri* (CHRIST) REED, Phy-

tologia 17 (1968) 281. — Type: HALLIER 3204, Amai Ambit, W. Kalimantan (P; BO, L).

Stipe densely covered with short reddish hairs, also scaly throughout; scales to 6 × 1 mm. *Lamina* slightly dimorphous, to 100 cm long; pinnae to 25 pairs; lowest pinnae not seen. *Largest pinnae* 23 cm long, sterile ones to 3 cm wide, fertile narrower; base of middle pinnae truncate, somewhat dilated both sides; apex acuminate with cauda to 2 cm long; edges lobed to 3 mm from costa, lobes falcate at tips; costules 4.5–5 mm apart, at more than 60°; veins 12–15 pairs, pale and very prominent beneath, basal basiscopic vein arising far from its costule; rachis densely short-hairy on lower surface, with scales as stipe, costae short-hairy with smaller scales, some short hairs on veins and surface. *Sori* inframedial; indusia small, thin, hairy.

Distr. *Malesia*: West Borneo.

4. Mesophlebion caroli HOLTTUM, Blumea 22 (1975) 227. — Type: C. HOSE 712, Baram district, Sarawak (K; BM).

Caudex not seen; *scales* on upper part of stipe and rachis medium brown, firm, 6 × 0.5 mm. *Basal pinnae* much narrowed towards base both sides, with enlarged almost free basal acroscopic lobe 9 mm long, basal basiscopic lobe attached 3 mm from base of pinna; suprabasal pinnae with basal acroscopic lobe to 1.8 cm long, basiscopic 0.9 cm; upper pinnae with slightly elongate basal acroscopic lobes, basiscopic ones not reduced. *Largest pinnae* 25 × 2.5 cm, caudate-acuminate with cauda 3.0 cm long, 5 mm wide; edges lobed to 2.5 mm from costa; lobes slightly falcate with rounded tips; costules 5–5.5 mm apart; veins to 13 pairs, basal veins touching sides of short sinus-membrane, basal basiscopic vein arising far from its costule; lower surface of rachis and costae bearing narrow scales 2–4 mm long and sparse short spreading hairs, many large red glands present on costae and costules, much-reduced scales of various sizes on costules and veins. *Sori* inframedial; indusia firm, of medium size, glabrous or rarely with a short hair.

Distr. *Malesia*: Borneo. Two collections, the second near Sambas in N.W. Kalimantan.

5. Mesophlebion trichopodum (C. CHR.) HOLTTUM, Blumea 22 (1975) 226. — *Dryopteris trichopoda* C. CHR. Ind. Fil. (1905) 298, new name for *Nephrodium polytrichum* BAK. J. Bot. 29 (1891) 107, *non* SCHRAD. 1824; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 397. — *Dryopteris polytricha* v.A.v.R. Handb. (1908) 187. — *Mesoneuron trichopodum* (C. CHR.) CHING, Acta Phytotax. Sinica 8 (1963) 326. — Type: G. F. HOSE *s.n.* Lingga Mts, Sarawak (K).

Dryopteris paleata COPEL. Phillip. J. Sci. 9 (1914) Bot. 228; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 383, 387. — *Thelypteris paleata* (COPEL.) HOLTTUM, Rev. Fl. Mal. 2 (1955) 249, f. 141. — *Mesoneuron paleatum* (COPEL.) CHING, Acta Phytotax. Sinica 8 (1963) 326. — Type: BROOKS 136, Lebong Tandai, Benkoelen, Sumatra (MICH).

Nephrodium crinipes sensu RIDL. J. Mal. Br. R. As. Soc. 4 (1926) 74. — **Fig. 6c–e.**

Caudex thick, short-creeping; *stipe* 60 cm long, 1.2 cm diameter at base, densely scaly throughout, scales dark brown, rigid, commonly 10 mm long, 1–1.5 mm wide at base, some of them narrowed above base, many small scales also present. *Lamina* to 100 cm long; pinnae 20-25 pairs; basal pinnae narrowed a little near their bases, those of type 30 × 4.3 cm (sterile). *Suprabasal pinnae* commonly to 20 cm long, 2.5–3.5 cm wide (sterile wider than fertile), caudate-acuminate, lobed to 3–4 mm from costa, lobes falcate, basal basiscopic lobe much longer than acroscopic and curved; costules 4.5–5 mm apart (fertile) 6–7.5 mm (sterile); veins to 23 on basiscopic side of largest sterile lobe, to 18 on fertile lobes (to 15 on acroscopic side), basal basiscopic vein arising from costa far from its costule, ends of basal veins closely parallel to each other on either side of a narrow sinus-membrane; *lower surface* of rachis densely scaly in basal part, throughout with close short hairs, costae similar, veins on sterile pinnae bearing slender hairs 1 mm long (sometimes shorter on fertile pinnae) and very short capitate hairs, sometimes also red glands. *Sori* inframedial; indusia small but conspicuous, thin, with many hairs 0.3 mm long.

Distr. *Malesia*: Borneo, Malaya, Sumatra.

Ecol. Near streams in forest, at 0–1000 m.

Notes. Specimens from Malaya are all smaller than those from Borneo and Sumatra but are otherwise not different. Some specimens from G. Mulu, Sarawak, have fewer, smaller, stipe-scales and many glands on the lower surface of veins.

6. Mesophlebion oligodictyon (BAK.) HOLTTUM, Blumea 22 (1975) 227. — *Acrostichum oligodictyon* BAK. J. Linn. Soc. Bot. 24 (1887) 261. — *Leptochilus oligodictyus* (BAK.) C. CHR. Ind. Fil. (1905) 387; v.A.v.R. Handb. (1908) 735. — *Dryopteris oligodictya* (BAK.) C. CHR. Mitt. Inst. Allgem. Bot. Hamb. 7 (1928) 148. — *Cyclosorus oligodictyus* (BAK.) HOLTTUM, Blumea 11 (1962) 530. — *Thelypteris oligodictya* (BAK.) REED, Phytologia 17 (1968) 298. — Type: C. HOSE 110, Sarawak, Niah (K).

Syngramma angusta COPEL. Philip. J. Sci. 3 (1909) Bot. 348; v.A.v.R. Handb. Suppl. (1917) 330. — Type: BROOKS *s.n.* July 1908, Bidi, Sarawak (MICH; BM, K). — **Fig. 6a–b.**

Caudex short-creeping, diameter 2.5–3 mm, scales 2 mm long; *stipes* closely seriate, of sterile fronds to 7 cm long, of fertile 14–18 cm. *Lamina* simple, dimorphous, gradually attenuated to both ends, entire or with slightly sinuous edges which are strongly cartilaginous. *Sterile lamina* 20–28 cm

long, 1.5–1.9 cm wide; veins thick and prominent on lower surface, usually 3 pairs to each group, basal basiscopic vein arising from midrib of frond below the rest (lowest acroscopic one also sometimes from midrib), basal veins of adjacent groups anastomosing irregularly near margin; *lower surface* quite glabrous apart from small narrow scales at the base of each group of veins. *Fertile lamina* 20–24 cm long, 5–6 mm wide; sporangia borne all along the veins, without indusia.

Distr. *Malesia*: Borneo (Sarawak, Brunei, Kalimantan), at least 6 collections.

Ecol. On rocks in river bed, low altitudes.

Notes. The evidence that this species belongs to the genus *Mesophlebion* is provided by the gland-bearing hairs on sporangium stalks, also by the basal veins of each group arising from the midrib in the same way that basal veins of pinnate species arise from the costae below the costules.

7. Mesophlebion teuscheri (v.A.v.R.) HOLTTUM, Blumea 22 (1975) 228. — *Dryopteris teuscheri* v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 18 (1908) 6; Handb. (1908) 183; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 383, *p.p.* — *Mesoneuron teuscheri* (v.A.v.R.) CHING, Acta Phytotax. Sinica 8 (1963) 326. — *Thelypteris teuscheri* (v.A.v.R.) KEED, Phytologia 17 (1968) 319. — Type: TEUSCHER, W. Kalimantan (BO).

Caudex suberect; stipe 5–10 cm long, densely short-hairy, basal scales narrow. *Lamina* 15–20 cm long; pinnae 20 pairs; 2–3 pairs lower pinnae gradually a little narrowed towards their bases, basal acroscopic lobe of lowest pinnae free, entire, obovate. *Largest pinnae* 2.2 cm long, 8 mm wide above auricled base; apex obtuse; edges lobed 1/3–1/2 towards costae; costules to 2.5 mm apart; veins to 3 pairs, basal veins not quite meeting at sinus; *lower surfaces* short-hairy throughout, with some large red glands. *Sori* medial; indusia densely hairy; sporangia with a sessile gland on the stalk.

Distr. *Malesia*: W. Borneo; known from type collection only.

Note. CHRISTENSEN's description of 1929 was based on the original description and on small specimens of *M. beccarianum* from Borneo and *M. arenicola* from Sumatra; he had not seen TEUSCHER's specimen.

8. Mesophlebion arenicola HOLTTUM, Blumea 22 (1975) 228. — Type: W. MEIJER 4478, Pajakumbuh-Taram, Harau Canyon, Sumatra (L).

Caudex short, suberect; *stipe* 5–15 cm long, minutely hairy with scattered longer hairs, basal scales very small, dark, with short stiff hairs. *Lamina* to 25 cm long; pinnae to 15 pairs; basal pinnae slightly reduced with stalks to 1 mm long. *Largest pinnae* 3.5 × 1.3 cm (sterile) 3.0 × 0.8 cm (fertile); base truncate, not auricled; apex a short broad tip; edges lobed to 1 mm from costa or more deeply, lobes oblique; costules to 2.5 mm apart; veins 4 pairs, basal ones in lobes near base of pinnae both to sides of a short sinus-membrane, in distal lobes both to edge above base of sinus; *lower surface* of rachis and costae covered with short hairs and scattered long ones, whole lower surface of pinnae closely covered with erect short hairs, among them many sessile orange glands. *Sori* medial, filling lower surface of fertile pinnae; indusia densely hairy; sporangia with short stalks, hairs on stalks commonly of 3 cells with terminal gland.

Distr. *Malesia*: Central Sumatra (3 collections).

Ecol. On sandstone rocks with dripping water, at 500 m.

Note. The type is a small specimen with pinnae to 1.3 × 0.5 cm.

9. Mesophlebion endertii (C. CHR.) HOLTTUM, Blumea 22 (1975) 228. — *Dryopteris endertii* C. CHR. Dansk Bot. Ark. 9, 3 (1937) 60, pl. V, f. 7–10. — Type: ENDERT 4433, W. Kutai, Kemul, Kalimantan (BO). — **Fig. 6h.**

Stipe 80 cm long, glabrous above base; *lamina* more than 100 cm long; pinnae 12–14 pairs, lower ones 9 cm apart. *Basal pinnae* 43 cm long with stalks 4 cm long and 15 pairs of free pinnules *c.* 1.5 cm apart, then some separately adnate lobes, distal part of pinnae deeply pinnatifid; basal pinnules very unequal (basiscopic 2 cm, acroscopic 4 cm long); *largest pinnules* 5 × 1 cm, in basal half lobed halfway to costule; veins to 25 pairs, lower ones pinnate in the pinnule-lobes, thick and prominent, distal ones simple; short hairs present on lower surface of costae; upper pinnae normal for genus *Mesophlebion*. *Sori* small; indusia very small with a few short hairs.

Distr. *Malesia*: Borneo (E. Kalimantan: W. Kutai) known from type only.

10. Mesophlebion motleyanum (HOOK.) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 209; Blumea 22 (1975) 229. — *Nephrodium motleyanum* HOOK. Syn. Fil. (1867) 266. — *Dryopteris motleyana* (HOOK.) C. CHR. Ind. Fil. (1905) 278; Gard. Bull. Str. Settl. 4 (1929) 385. — *Dryopteris crassifolia* (BL.) O. KTZE *var. motleyana* (HOOK.) v.A.v.R. Handb. (1908) 182. — *Thelypteris crassifolia* (BL.) CHING *var. motleyana* CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 286. — *Thelypteris motleyana* (HOOK.) HOLTTUM, Rev. Fl. Mal. 2 (1955) 247, f. 140. — Type: MOTLEY, Labuan (K).

Dryopteris vinosicarpa v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 198. — *Thelypteris vinosicarpa* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 255. — *M. vinosicarpum* (v.A.v.R.) HOLTTUM, Blumea 22 (1975) 229. — Type: cult. Hort. Bog. leg. BROOKS, origin Lebong Tandai, Sumatra (BO; L).

Dryopteris motleyana var. dulitensis C. CHR. Gard. Bull. Str. Settl. 4 (1929) 386. — Type: MJÖBERG, Mt Dulit, Sarawak (BM).

Nephrodium brachyodus sensu BAK. Syn. Fil. (1867) 295, *p.p. quoad pl. Malacc. tantum*; BEDD. Ferns Brit. India Suppl. (1876) 19, pl. 379; Handb. (1883) 281, *p.p. excl. typ.*; RIDL. J. Mal. Br. R. Asiat. Soc. (1926) 74, *p.p.* — *Dryopteris brachyodus sensu* v.A.v.R. Handb. (1908) 220, 819, *p.p.* (all descriptions based partly on specimens from Malaya).

Caudex short-creeping; *stipe* of sterile fronds 15–35 cm long, of fertile fronds to 50 cm, glabrescent; basal scales few, 2–3 mm long. *Lamina* red when young, 20–50 cm or more long; pinnae 6–8(–10) pairs, almost opposite; basal pinnae slightly narrowed near base which is almost symmetric, with stalks 2–10 mm long; upper pinnae sessile and often more asymmetric at base. *Largest sterile pinnae* to 20 × 4 cm, acuminate, lobed about half-way to costa, lobes falcate; costules 6–10 mm apart; veins to 10 on acroscopic side, to 14 on basiscopic, basal veins from adjacent groups almost parallel for some distance below the sinus, basiscopic veins arising from the costa far from their costules and sometimes anastomosing with the veins next above them; *lower surface* of rachis and costae short-hairy, many small scales also present on costae, sparse short hairs and rudimentary scales on costules. *Fertile fronds* smaller than sterile; largest pinnae 12.5 × 2.5 cm, usually lobed a little more than half-way to costa; orange-red glands often present on lower surface of costules, minute scales consisting of 2–3 cells, the terminal one glandular, present on young fronds on and between veins. *Sori* medial, lower ones divergent, often somewhat elongate along veins; indusia very small, often hidden by sporangia, short-hairy.

Distr. Peninsular Thailand, in *Malesia*: Malaya, Sumatra, Borneo.

Ecol. In forest, at 0–1200 m.

Notes. The type of *Dryopteris vinosicarpa* v.A.v.R. was a small plant but fertile. In 1975 I associated with it some small plants from mid-mountain forest in Malaya, restricting the name *M. motleyanum* to larger lowland plants which were thinner in texture. But plants from Sarawak, now in cultivation at Kew, bridge the gap between the two forms. Some specimens may represent hybrids between this species and *M. crassifolium*, but in general the two species appear to be distinct.

11. Mesophlebion falcatilobum HOLTTUM, *sp nov.*

Frondes dimorphae; *pinnae usque* 18-*jugatae, inferiores stipitulatae, steriles usque* 14 × 2.5 *cm, fertiles usque* 11.5 × 1.7 *cm, omnes dimidio costam versus lobatae, lobis falcatis*; *venae infimae* 2-3 *mm infra sinum conniventes*; *indusia minuta, glabra, sporangiis fere obtecta.* — Type: JERMY 13694, Sarawak, G. Mulu (BM).

KEY TO THE VARIETIES

1. Sterile pinna-lobes with obtuse to rounded apices . . . . . **a. var. falcatilobum**
1. Sterile pinna-lobes with apiculate apices **b. *var.* apiculatum**

a. *var.* falcatilobum

Caudex short-creeping; *stipe* 45 cm long, glabrous, scales short, not persistent, glabrous, sometimes with red glands on margin near apex. *Lamina* 45–50 cm long (sterile and fertile about equal); pinnae *c.* 18 pairs, several lower pairs with stalks, stalks of lowest 5–6 mm, somewhat narrowed towards base; aerophores swollen on living fronds, collapsing on drying. *Sterile pinnae* to 14 × 2.5 cm; apex evenly attenuate, apical 2.5 cm entire; edges lobed half-way to costa or a little less deeply, lobes falcate with obtuse to rounded forward-pointing apices; costules 7 mm apart; veins to 11 on basiscopic side, 8 on acroscopic, basal basiscopic vein arising from costa far from its costule, basal veins from adjacent lobes converging to touch the sinus-membrane 2–3 mm below the sinus; *lower surface* of rachis and costae bearing a variable number of short hairs, many narrow scales on costae and a few glands; hairs on *upper surface* of rachis and costae pale, thin, 0.3 mm long, rather sparse. *Sori* a little supramedial, lower ones divergent; indusia very small, glabrous; spores winged. *Chromosomes*: 2n = 72 (T. G. WALKER, plant from type collection cult. Kew).

Distr. *Malesia*: Borneo (Sarawak: Mt Mulu): besides type, several other plants in cultivation which are smaller than the wild plant but otherwise similar.

b. *var.* apiculatum HOLTTUM, *var. nov., a typo speciei differt*: *pinnis sterilibus usque* 9 × 1.6 cm, 1/3 costam versus lobatis, lobis valde apiculatis. — Type: JERMY 13611, G. Mulu, Sarawak, in forest at 100–180 m (BM).

Pinnae *c.* 14 pairs, sterile to 9 × 1.6 cm, fertile to 6.5 × 1.0 cm, lobed less than half-way to costa; lobes of sterile pinnae very oblique with acute tips; lobes of fertile pinnae crenulate; sori all inframedial; lower surfaces of pinnae quite glabrous.

Distr. *Malesia*: Borneo (Sarawak: Mt Mulu), only known from the type.

12. Mesophlebion dulitense HOLTTUM, Blumea 22 (1975) 229. — Type: C. HOSE *s.n.* 1894, Mt Dulit, Sarawak. (K; P).

Caudex not seen; stipe more than 75 cm long, glabrescent with dull reddish flush, basal scales

15 mm or more long, thin, narrow. *Lamina* incomplete, probably more than 75 cm long, texture very firm. *Largest pinnae* probably 30–40 cm long, 6.5 cm wide, with stalks 3–5 cm long; base very asymmetric with one basal lobe almost free and separated from the rest; edges lobed to 3 mm from costa; lobes slightly falcate, slightly narrowed distally; costules 10 mm apart, almost at right angles to costa; veins to 25 pairs, rather thick and prominent on both sides, basal basiscopic vein arising near base of its costule in basal part of pinna, remote from costule in distal part; *lower surface* of rachis and costae sparsely short-hairy, when young with many scales to 2 mm long. *Sori* inframedial distally on lobes, basal ones divergent; indusia very small, caducous, bearing 1–2 short hairs.

Distr. *Malesia*: Borneo. Known from type locality, and G. Mulu, and Mt Kinabalu (2 collections).

Note. The Kinabalu plants, from 1500 m, are smaller than the type (pinnae to 20 × 5 cm, with stalk to 3.5 cm long) but agree in scales, hairs and indusia.

13. Mesophlebion auriculiferum (v.A.v.R.) HOLTTUM, Blumea 22 (1975) 231. — *Dryopteris auriculifera* v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 197. — *Thelypteris auriculifera* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 250. — Type: BÜNNEMEIJER 6905, Lingga Is., Mt Tanda (BO; L).

Caudex short; *stipe* 50–60 cm long, when young densely hairy, basal scales rigid, to 7 × 1 mm. *Lamina* 50 cm long; pinnae 17–20 pairs, all stalked, mostly not opposite; basal pinnae with stalks to 7 mm long, basal acroscopic lobe short and often free, basal basiscopic lobe attached further from rachis than acroscopic; texture firm, brittle when dry. *Largest pinnae* 15 × 2 cm; base cuneate with reduced lowest lobes, apex acuminate with cauda to 2 cm long; edges lobed to 2 mm from costa, lobes falcate; costules 4–4.5 mm apart; veins 10–11 pairs, basal acroscopic vein passing to side of short sinus-membrane, basal basiscopic vein to edge just above base of sinus; *lower surface* of costae bearing many spreading pale hairs to 1 mm long, similar hairs more sparse on costules and veins, no scales seen; surface between veins bearing many short slender erect hairs and sessile glands. *Sori* inframedial; indusia thin, pale, with many short capitate and acicular hairs, also a few glands like those on surface between veins; a small glandular cell at end of short hair on stalk of sporangium; spores not seen.

Distr. *Malesia*: N.E. Sumatra (Lingga Is.). Known from type collection only, in forest at 600 m.

Note. The pubescence of the lower surface of this plant most nearly resembles that of *M. teysmanneri* and *M. arenicola*; the latter are much smaller plants, growing apparently in a different kind of habitat.

14. Mesophlebion beccarianum (CESATI) HOLTTUM, Blumea 22 (1975) 230. — *Nephrodium beccarianum* CESATI, Atti Acad. Napoli 7, *n.* 8 (1876) 23. — *Dryopteris beccariana* (CESATI) C. CHR. Ind. Fil. (1905) 254; v.A.v.R. Handb. (1908) 185; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 384. — *Thelypteris beccariana* (CESATI) REED, Phytologia 17 (1968) 263. — Type: BECCARI *s.n.*, Sarawak (FI).

Dryopteris pallescens BRAUSE, Bot. Jahrb. 56 (1920) 88. — *Thelypteris pallescens* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 253. — *Mesophlebion pallescens* (BRAUSE) HOLTTUM, Blumea 22 (1975) 230. — Type: LEDERMANN 9146, N.E. New Guinea, Sepik Distr. (B; BM). — **Fig. 6f-g.**

Caudex short- to long-creeping, to 8 mm diameter; *stipe* to 50 cm or more long, glabrescent, basal scales firm, to 7 mm long, 1 mm or more wide at base with filiform apex. *Lamina* to 50 cm long, firm, usually drying greenish; pinnae 20 pairs or more, often almost opposite, basal pinnae with stalks 5–10 mm long, basal pair of lobes often much reduced, basal acroscopic lobe sometimes almost free. *Largest pinnae* 12–18 cm long, 1.6–2.5 cm wide (sterile often wider than fertile); base broadly cuneate to subtruncate; apex acuminate with cauda 2–2.5 cm long; edges lobed to 1–1.5 mm from costa, lobes oblique and slightly falcate, tips rounded or broadly pointed; costules 3.5–4.5 mm apart; veins 10–12(–15) pairs, basal basiscopic vein arising from costa near base of its costule, often ending just above base of sinus; *lower surface* of rachis hairless or nearly so, of costae often with sparse hairs 0.2 mm long, costal scales 1–2 mm long, very narrow with a few marginal hairs, early caducous. *Sori* inframedial; indusia large, firm, purplish, glabrous; spores minutely papillose.

Distr. *Malesia*: Southern Malaya, Sarawak, West and East New Guinea.

Ecol. In forest on sloping ground or ridges at 200–1200 m.

Note. The type of *Dryopteris pallescens* has rather numerous short hairs on costae; in other respects it differs little from the type of *M. beccarianum*. A specimen from Western New Guinea is almost glabrous. Some specimens from Malaya are intermediate between this and *M. chlamydophorum*, having hairs on the lower surface of costae and on indusia; Sarawak specimens seen are very uniform, and the species seems locally abundant there.

15. Mesophlebion rufescens HOLTTUM, Blumea 22 (1975) 230. — Type: BRASS 27957, Sudest Island (K; BO, L, LAE).

Caudex "stout, horizontal" (BRASS); *stipe* 50–

80 cm long, lightly flushed with red, basal scales rigid, dark, 4 × 1 mm, distal part of stipe short-hairy. *Lamina* 42 cm long, texture firm, red-brown when dry; pinnae 12 pairs, mostly opposite; basal pinnae with stalks 10 mm long, basal pair of lobes much reduced; fourth pair of pinnae truncate to full width at base. *Largest pinnae* 12 × 2.8 cm; apex with cauda 1 cm long; edges lobed to 2.5–3 mm from costa, lobes slightly falcate with obtuse to rounded tips; costules 5 mm apart (fertile), 6 mm (sterile); veins 12–14 pairs, pale and prominent both sides, basal basiscopic vein arising from costa near base of its costule, usually ending just above base of sinus; *lower surface* of rachis and costae bearing copious slender pale hairs 0.3 mm long and many narrow scales, on costules and veins sparse hairs, smaller narrow scales and large red glands, short erect hairs on surface between veins. *Sori* medial, lower ones divergent; indusia very small, glabrous, early caducous; glands on stalk of sporangia very large.

Distr. *Malesia*: Philippines (Biliran: SULIT PNH 20240; Luzon: Sierra Madre, JACOBS 7625) and New Guinea (Sudest I. and Geelvink Bay, SCHÖNIAN *s.n.* 1929 in B).

Ecol. In forest at 300 m.

16. Mesophlebion chlamydophorum (C. CHR.) HOLTTUM, Blumea 22 (1975) 321. — *Dryopteris chlamydophora* ROSENST. Med. Rijksherb. *n.* 31 (1917) 5, *nom. nud.*; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 384. — *Thelypteris chlamydophora* (C. CHR.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 287; HOLTTUM, Rev. Fl. Malaya 2 (1955) 246, f. 139. — *Mesoneuron chlamydophorum* (C. CHR.) CHING, Acta Phytotax. Sinica 8 (1963) 325. — Lectotype (HOLTTUM 1975): KORTHALS *s.n.* Borneo (L, sheet *n.* 908, 342–57).

Lastrea nephrodioides BEDD. Ferns Brit. Ind. (1866) t. 199, *non* MOORE 1858; BEDD. Handb. (1883) 238. — Type: PARISH, Burma (K, fragment only).

Caudex short to rather long-creeping, diameter commonly 5 mm; *stipe* to 60 cm or more long, basal scales 3–4 mm long. *Fronds* of mature plant usually all fertile, with lamina to 80 cm long, drying brown-olivaceous; pinnae 15–20 pairs, lower pinnae with stalks 2–3 mm or sometimes longer, 1–3 pairs of basal lobes reduced. *Largest pinnae* commonly 15 × 2 cm, to 20 × 2.5 cm; apex acuminate; edges lobed to 2–3 mm from costa, lobes falcate; costules 4–5.5 mm apart; veins commonly 10–12 pairs, basal pair of veins passing to either side of sinus-membrane, basal basiscopic vein arising nearer to its costule than in *M. crassifolium* (variable); *lower surface* of rachis, costae and costules bearing very short hairs and narrow scales, rudimentary scales (some consisting of 2–3 cells with glandular end-cell) on all parts of lower surface, shrivelling and caducous with age. *Sori* not very close to costules, basal ones divergent; indusia fairly large, firm, bearing a variable number of very short acicular hairs; spores papillose.

Distr. S. Burma and Peninsular Thailand, in *Malesia*: Malaya, Sumatra, Borneo, Celebes, ? New Guinea.

Ecol. In lowland forest, especially freshwater swamp-forest.

Note. ROSENSTOCK published no description and cited "*Aspidium crassifolium* METT. (*non* BL.)", but METTENIUS also published no description. The type selected is a specimen named by ROSENSTOCK.

17. Mesophlebion crassifolium (BL.) HOLTTUM, Blumea 22 (1975) 232. — *Aspidium crassifolium* BL. En. Pl. Jav. (1828) 158; RACIB. Fl. Btzg I (1898) 169. — *Lastrea crassifolia* (BL.) MOORE, Ind. Fil. (1858) 89; COPEL. Fern Fl. Philip. (1960) 325. — *Dryopteris crassifolia* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 182, *excl. var. motleyana*; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 385; *ibid.* 7 (1934) 242, *incl. var. purpureo-lilacina*; BACKER & POSTH. Varenfl. Java (1939) 39. — *Thelypteris crassifolia* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 285; HOLTTUM, Rev. Fl. Malaya 2 (1955) 246. — *Mesoneuron crassifolium* (BL.) CHING, Acta Phytotax. Sinica 8 (1963) 325. — Type: BLUME, Java (L, sheet *n.* 908,342–64).

Aspidium latum KUNZE *ex* METT. Farngatt. IV (1858) 95. — Type: CUMING 266, Luzon (B; BM, G, K).

Dryopteris divergens ROSENST. in Fedde Repert. 13 (1914) 218. — *Thelypteris divergens* (ROSENST.) REED, Phytologia 17 (1968) 273. — Type: J. WINKLER 36a, 1910, Sumatra (not seen).

Dryopteris subdimorpha COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Lastrea subdimorpha* (COPEL.) COPEL. Gen. Fil. (1947) 140; Philip. J. Sci. 78 (1951) 432, pl. 20. — *Thelypteris subdimorpha* (COPEL.) REED, Phytologia 17 (1968) 317. — Type: BRASS 13666, Idenburg River, New Guinea (MICH). — **Fig. 1k.**

Caudex creeping, diameter to 8 mm or more; *stipe* to 80 cm or more long on fertile fronds, on sterile shorter, basal scales rigid, to 10 mm or more long, with cordate base to 1.5 mm wide. *Lamina* to 70 cm long, ± dimorphous, texture very firm; pinnae to 20 pairs, subopposite, rather widely spaced; basal pinnae with stalks 3–15 mm long, basal 1–3 pairs of lobes reduced. *Largest fertile pinnae* 15 × 3 cm (sterile to 25 × 4.5 cm), apex acuminate and sometimes caudate; edges lobed to 3–4(–5) mm from costa, lobes falcate; costules 4–6 mm apart (to 8 mm in largest sterile pinnae), at a wide angle to costa; veins 12–15 pairs, pale and prominent both sides, basal veins from adjacent costules curved upwards so that their distal parts are close together on either side of the sinus-membrane, basal basiscopic vein usually arising far from its costule; *lower surface*

of rachis and costae copiously short-hairy, bearing also narrow brown scales and sometimes glands on costules. *Sori* inframedial, lower ones somewhat divergent; indusia usually rather large but thin, shrivelling when dried, bearing short hairs, less commonly quite small.

Distr. *Malesia*, except Java and Lesser Sunda Islands.

Ecol. In forest on hill slopes at 700–1800 m.

Notes. This species is variable as regards development of large sterile fronds and as regards length of stalks of lower pinnae. Some specimens appear to be intermediate between typical *M. crassifolium* and *M. motleyanum* or *M. beccarianum*; one from Malaya has spores with perispore intermediate between the winged type normal in this species and the papillose spores of *M. beccarianum*. Most specimens from Malaya and Borneo have rather large but thin indusia, but a few have quite small indusia; specimens from the Philippines (Luzon, Negros, Leyte) have all quite small indusia.

10. CYCLOSORUS

LINK, Hort. Reg. Bot. Berol. 2 (1833) 128; HOLTTUM, SEN & MITTRA, Blumea 18 (1970) 200, 212; HOLTTUM, Blumea 19 (1971) 27; Allertonia 1 (1977) 181; of most other authors *p.p. min.* — **Fig. 1r, 7a–c.**

Caudex long-creeping; scales proportionally broad, their hairs almost all marginal; lowest pinnae not reduced; all pinnae lobed; basal veins always anastomosing with a long excurrent vein to the sinus; lower surfaces

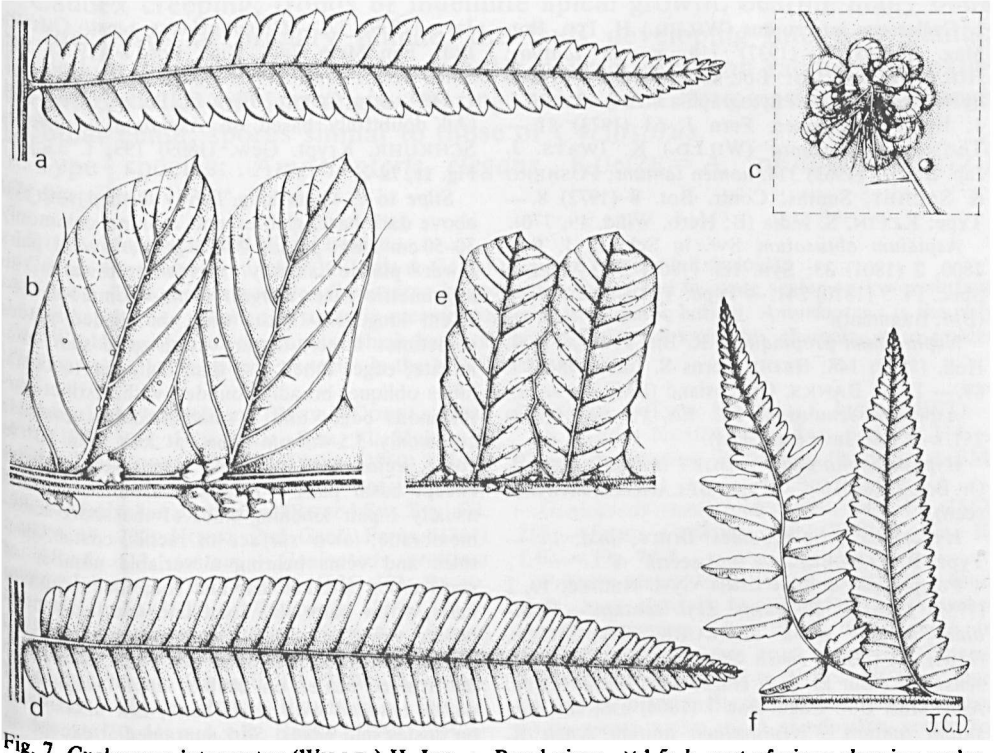

Fig. 7. *Cyclosorus interruptus* (WILLD.) H. ITO. *a.* Basal pinna, × 1.5; *b.* part of pinna showing scales, hairs, glands and position of sori, × 8; *c.* sorus, showing glands among sporangia, × 32. — *Ampelopteris prolifera* (RETZ.) COPEL. *d.* One primary pinna, × 1; *e.* two pinna-lobes showing venation, scales and position of sori, × 3; *f.* first frond of a young plant proliferating from axil of primary pinna, × ⅔ (*a–c* T. LOBB 19, *d–f* MATTHEW *s.n.*)

variously hairy, broad flat scales always present on costae, rather large red spherical glands on costules and veins; sori indusiate; no glands nor hairs on body of sporangia, long hairs with terminal red glands on sporangium-stalks; spores closely and irregularly spinulose.

Type species: *Cyclosorus gongylodes* (SCHKUHR) LINK.

Distr. Pantropic; probably 3 species.

Ecol. Always in freshwater swamps or edges of lakes, in full sun or light shade.

Cytol. All Indian and African records diploid, with $n = 36$; in the W. Indies and S. America some plants tetraploid.

Taxon. In his monograph of *Dryopteris* (1913) CHRISTENSEN adopted the name *Cyclosorus* with subgeneric status for a group of tropical American species, most of which are not closely related to *C. gongylodes* (of which the type specimen came from Guiana). CHING extended the use of the name, with generic rank, to cover species of the Old World some of which are related to the atypical American species of CHRISTENSEN. COPELAND (Gen. Fil. 1947) followed CHING, distinguishing *Cyclosorus* from *Lastrea* (= *Thelypteris sensu* CHING) solely by anastomosing/free venation, but this does not result in a natural division. In my judgement, *Cyclosorus* (as here restricted) is most nearly related to *Ampelopteris* (see HOLTTUM, SEN & MITTRA 1970) and *Thelypteris s. str.* (all have the same aquatic habitat and a wide distribution), probably also to *Mesophlebion*, not closely to any other group. As here restricted, *Cyclosorus* is a complex which can only be resolved by extensive cytotaxonomic study of plants from the whole of its range. The fronds of W. Indian tetraploids are large, firm and almost hairless on the lower surface; South African plants, originally named *Polypodium tottum* THUNB., have a similar aspect. Seventeen binomials, with different types, are based on specimens belonging to this complex.

1. Cyclosorus interruptus (WILLD.) H. ITO, Bot. Mag. Tokyo 51 (1937) 714, *nomen tantum*; HOLTTUM, J. S. Afr. Bot. 40 (1974) 152. — *Pteris interrupta* WILLD. Phytographia (1794) 13, t.10 f. 1; HOLTTUM, Amer. Fern J. 63 (1973) 81. — *Thelypteris interrupta* (WILLD.) K. IWATS. J. Jap. Bot. 38 (1963) 314, *nomen tantum*; FOSBERG & SACHET, Smiths. Contr. Bot. 8 (1972) 8. — Type: KLEIN, S. India (B; Herb. Willd. 19, 770).

Aspidium obtusatum SW. in Schrad. J. Bot. 1800, 2 (1801) 33; Syn. Fil. (1806) 248; WILLD. Spec. Pl. 5 (1810) 241. — Type: THUNBERG, Java (BM, fragment).

Nephrodium propinquum R. BR. Prodr. Fl. N. Holl. (1810) 148; BEDD. Ferns S. India (1863) t. 89. — Type: BANKS, Queensland (BM; not seen).

Aspidium venulosum BL. En. Pl. Jav. (1828) 151. — Type: Java (not seen).

Hypopeltis marginifera BORY in Bél. Voy. Ind. Or. Bot. 2 (1833) 69. — Type: BÉLANGER, Java (not seen).

Hypopeltis propinquoides BORY, *ibid. l.c.* — Type: BÉLANGER, Java (not seen).

Polypodium unitum LINN. Syst. Nat. ed. 10, 2 (1759) 1326 *quoad Burm. Zeyl. tantum.* — *Aspidium unitum sensu* SCHKUHR, Krypt. Gew. (1804) 34, t. 33b; *sensu* SW. Syn. Fil. (1806) 47; *sensu* BL. En. Pl. Jav. (1828) 150; *sensu* METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 230, *var. hirsutum tantum.* — *Nephrodium unitum sensu* R. BR. Prodr. Fl. N. Holl. (1810) 148; *sensu* BEDD. Handb. (1883) 268; *sensu* RACIB. Fl. Btzg I (1898) 182.

Dryopteris gongylodes sensu v.A.v.R. Handb. (1908) 212; *sensu* BACKER & POSTH. Varenfl. Java (1939) 57. — *C. gongylodes sensu* CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 186; *sensu* HOLTTUM, Rev. Fl. Malaya 2 (1955) 261, f. 148; *sensu* COPEL. Fern Fl. Philip. (1960) 360. (All doubtfully based on *Aspidium gongylodes* SCHKUHR, Krypt. Gew. (1809) 193, t. 33c). — **Fig. 1r, 7a–c.**

Stipe to *c.* 45 cm long, lightly flushed with red above dark base, glabrescent. *Lamina* commonly 30–50 cm long; pinnae 20–25 pairs; several pairs lower pinnae slightly narrowed towards an asymmetric base. *Largest pinnae* commonly 10–15 cm long, 1.0–1.8 cm wide, in shaded places sometimes larger, texture firm; apex short-acuminate; edges lobed less than half-way to costa, lobes oblique, broadly rounded with distinct cartilaginous edges and a small apiculus; costules commonly 3.5–4.5 mm apart, at less than 60° to costa; veins 8–10 pairs or more, very oblique except basal pair, 1–1½ pairs anastomosing and usually 1 pair touching sides of the short sinus-membrane; *lower surface* of rachis, costae, costules and veins bearing a variable number of short erect pale acicular and sometimes capitate hairs, a few hairs also sometimes on surface between veins, a variable number of large red glands scattered on costules and veins, broad thin flat fringed scales on costae; *upper surface* of rachis covered with short hairs, few short hairs on costae and edges. *Sori* supramedial except on distal veins, absent from basal pair of veins; indusia thin, bearing short acicular hairs and sometimes capitate hairs.

Distr. Tropics and subtropics.

Notes. It seems probable that *Aspidium*

gongylodes SCHKUHR was a tetraploid; his specimens at B and his illustration agree with known tetraploids. But some other tropical American specimens are not clearly distinct from the plants of Asia and Africa known to be diploid. The morphological distinctions of the tetraploid need to be established, and the type of *Pteris polypodioides* POIR. (1804), an earlier name, needs to be examined; also *P. tottum* THUNB. (1800) from South Africa must be taken into consideration. In any case, the name *gongylodes* is incorrect for the Malesian plants.

WILLDENOW's type was misconstrued by CHING, who identified it with the species here named *Amphineuron terminans* (HOOK.) HOLTTUM, and his identification was copied by many subsequent authors. In 1801 SWARTZ published the name *Aspidium obtusatum* with *Pteris interrupta* WILLD. as a synonym; this identification was accepted by WILLDENOW in 1810.

The nature and distribution of hairs on the lower surfaces of pinnae of Malesian plants varies greatly. Specimens with many short capitate hairs have been collected in Sabah and Sarawak, also in Mainland Asia from Peninsular Thailand to Assam and also Hainan.

11. AMPELOPTERIS

KUNZE, Bot. Zeit. 6 (1848) 114; COPEL. Gen. Fil. (1947) 143; CHING, Acta Phytotax. Sinica 8 (1963) 330; HOLTTUM, SEN & MITTRA, Blumea 18 (1970) 196, 214; HOLTTUM, Blumea 19 (1971) 25. — *Meniscium sect. Ampelopteris* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 39. — *Thelypteris subg. Meniscium sect. Ampelopteris* REED, Phytologia 17 (1968) 255. — **Fig. 7d–f.**

Caudex creeping; fronds of indefinite apical growth, bearing many buds at the bases of primary pinnae, the buds developing into new plants; forked or branched unicellular acicular hairs present on rachis; sori exindusiate; stalks of sporangia bearing hairs each terminating in a large globular gland; spores similar to those of *Cyclosorus*.

Type species: *Ampelopteris elegans* KUNZE = *A. prolifera* (RETZ.) COPEL.

Distr. Monotypic. Old World tropics.

Cytol. Chromosome number 36 (India & Ceylon), several records (all diploid).

Notes. This genus resembles *Cyclosorus* in sporangia, spores and in ovate scales on lower surface of costae; the two genera also agree in creeping rhizome and aquatic habitat. *Ampelopteris* is the only Old World member of the family which has branched acicular hairs; in this character it resembles *Goniopteris*, a genus of many species in the New World.

1. **Ampelopteris prolifera** (RETZ.) COPEL. Gen. Fil. (1947) 144; HOLTTUM, Rev. Fl. Malaya 2 (1955) 299; COPEL. Fern Fl. Philip. (1960) 377. — *Hemionitis prolifera* RETZ. Obs. Bot. 6 (1791) 38. — *Meniscium proliferum* (RETZ.) SW. Syn. Fil. (1806) 19, 207; HOOK. 2nd Cent. Ferns (1861) t. 15, f. 1–3, *tantum*. — *Goniopteris prolifera* (RETZ.) PRESL, Tent. Pterid. (1836) 183; BEDD. Ferns S. India (1864) t. 172; Handb. (1883) 296. f. 153. — *Polypodium luxurians* KUNZE, Linnaea 23 (1850) 28, *nom. nov.* — *Phegopteris luxurians* (KUNZE) METT. Farngatt. IV (1858) 25. — *Phegopteris prolifera* (RETZ.) KUHN in v. Decken Reise (1879) 44; v.A.v.R. Handb. (1908) 504. — *Dryopteris prolifera* (RETZ.) C. CHR. Ind. Fil. (1905) 286; BACKER & POSTH. Varenfl. Java (1939) 55. — *Cyclosorus proliferus* (RETZ.) TARD. & C. CHR. Notul. Syst. 14 (1952) 346. — *Thelypteris prolifera* (RETZ.) REED, Phytologia 17 (1968) 306. — Type: KOENIG, S. India (GOET).

A. elegans KUNZE, Bot. Zeit. 6 (1848) 114. — Type: ZOLLINGER 2360, Java (isotypes at BM, G, P, W).

Goniopteris meniscioides FÉE, Gen. Fil (1852) 253. — Type: CUMING 168 (P; FI-W, G, K, LE). — **Fig. 7d–f.**

Primary pinnae to 20 × 2 cm, often with a short stalk; base truncate to subcordate; apex rather evenly attenuate; edges lobed to a depth of 2 mm; costules 3–4 mm apart; veins 10–12 pairs, 5–6 pairs anastomosing to form a zig-zag excurrent vein; lower surfaces hairless, costae bearing ovate ciliate scales. *Sori* exindusiate, somewhat elongate, on distal parts of veins. Fronds on plants formed by proliferation from buds much smaller, usually with pinna-like terminal lamina; pinnae sometimes fertile from a size of 3.5 × 0.8 cm.

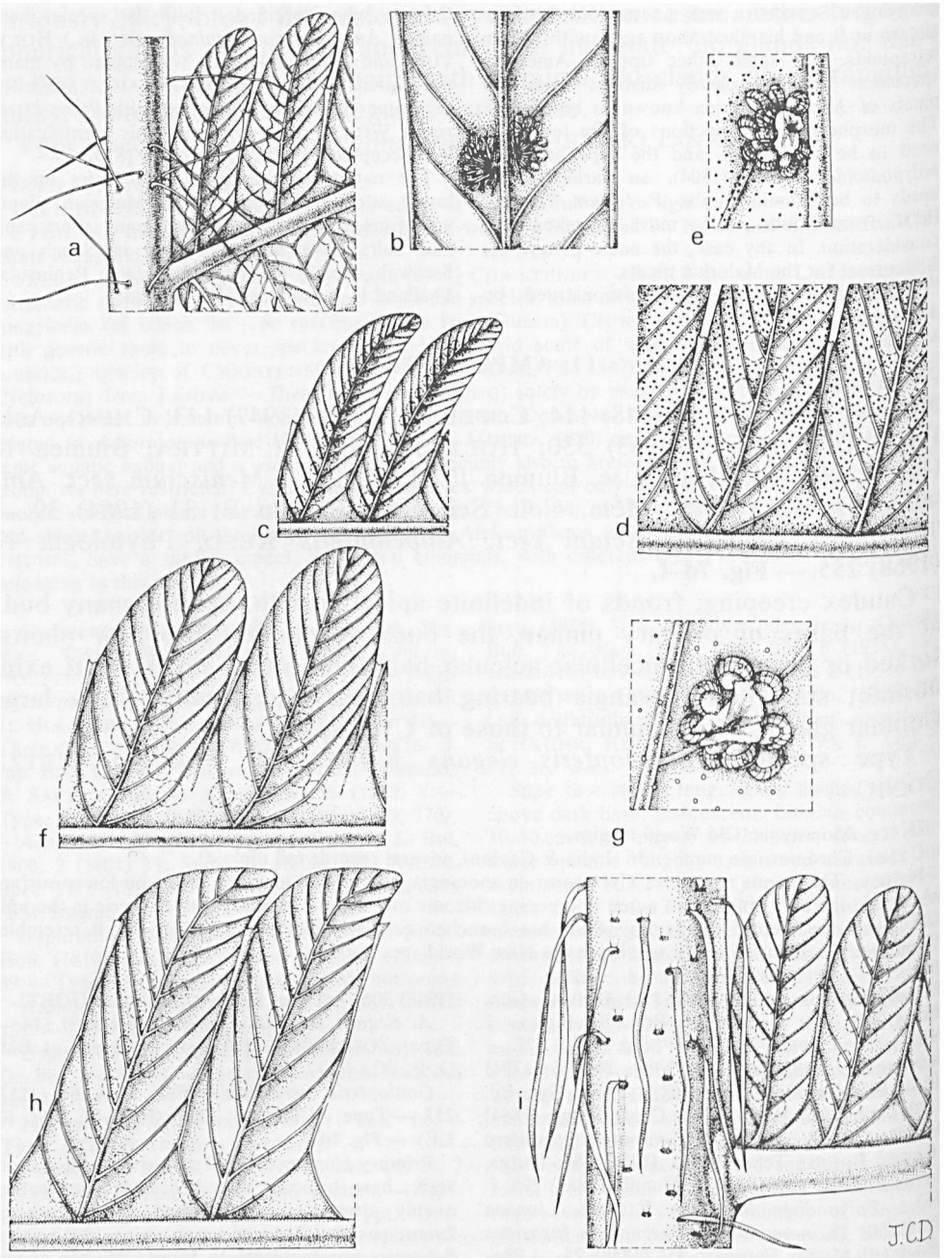

Fig. 8. *Chingia ferox* (BL.) HOLTTUM. *a.* Rachis with terete scales and base of a pinna bearing coalescent sori, ×4; *b.* two old sori, ×12. — *C. sakayensis* (ZEILLER) HOLTTUM. *c.* Two pinna-lobes, ×2; *d.* part of a pinna showing glands and position of sori, ×4; *e.* one sorus, ×10. — *C. pricei* HOLTTUM. *f.* Two pinna-lobes, showing venation and position of sori, ×4; *g.* one sorus, ×16. — *C. christii* (COPEL.) HOLTTUM. *h.* Two pinna-lobes, ×4. — *C. clavipilosa* HOLTTUM *var. javanica* HOLTTUM. *i.* Rachis with flat scales and base of a pinna, ×4 (*a–b* MOUSSET *s.n.*, *c–e* DAY *s.n.*, *f–g* PRICE 512, *h* ELMER 10187, *i* CLEMENS 30514).

Distr. West Africa to N.E. Australia (to 30°S) and New Caledonia; widely in tropical mainland Asia; throughout *Malesia* but not often collected.

Ecol. On banks of rivers and ditches, sometimes forming thickets.

Notes No distinct varieties have been observed. The unnumbered figure of a complete small plant on HOOKER's plate (1861) represents *Pronephrium hosei* (BAK.) HOLTTUM.

12. CHINGIA

HOLTTUM, Blumea 19 (1971) 31; Kalikasan 3 (1974) 13–28. — **Fig. 8.**

Caudex massive, erect, sometimes forming a trunk 30–100 cm tall. Fronds usually rather rigid in texture, commonly 150–250 cm long including stipe, axes usually drying red-brown; basal pinnae not reduced; aerophores not enlarged; at least the base of the stipe, in many cases the whole of it and part or all of the rachis persistently scaly, scales at base of stipe narrow, often rigid, setiferous, in some species grading into quite terete spine-like scales above base of stipe. Pinnae crenate to deeply lobed, in most species to 30 cm or more long; veins numerous, all except the basal pair very oblique, basal 1–3 pairs anastomosing (except in *C. pricei*), the next 1–3 or more pairs passing to sides of a long sinus-membrane; some acicular hairs often present on lower surfaces, sometimes only on young plants or those growing in exposed places; capitate glandular hairs or small sessile glands abundant in some species on lower or both surfaces of pinnae. Sori near costules except the lowest 1–2 pairs which may be divergent; indusia small or lacking; young sporangia in some species bearing small sessile glands or capitate hairs, in one species rarely setae; spores dark, covered with minute papillae or wings.

Type species: *Chingia ferox* (BL.) HOLTTUM.

Distr. *Malesia* and the Pacific (to Tahiti); in Mainland Asia only to Peninsular Thailand; in all 20 species.

Ecol. Usually on hill slopes in moderately exposed places, at 300–2000 m, sometimes locally abundant (used for thatching in Mindoro).

Cytol. Chromosome number 36 (*C. atrospinosa*, *C. urens*, both diploid).

Notes. This very natural group appears to be closely related to *Plesioneuron* but not to any other genus of the present arrangement. CHING and COPELAND placed the species known to them in *Cyclosorus* without distinguishing them as a natural group. The nature and distribution of scales are distinctive in the various species, and some early collections do not show these characters adequately. New information has recently been added by the collections of M. G. PRICE in the Philippines where seven species occur. Chemical investigation might yield interesting results; two species are recorded as malodorous, and one (*C. urens*) as causing a mild burning sensation in contact with human skin.

Plants of *Glaphyropteridopsis* CHING (type species *G. erubescens* (HOOK.) CHING, distributed from N.E. India to S. China) are similar to *Chingia* in frond-form, but the veins are always free, aerophores swollen, and the spores and scales are very different; the two are probably not very nearly related.

KEY TO THE SPECIES

1. Abaxial surface of rachis bearing slender terete spine-like scales.
2. Pinnae crenate to a depth of 1 mm . . . . . **1. C. acutidens**
2. Pinnae much more deeply lobed.
3. Pinnae 8–12 pairs, 6 cm or more apart . . . . . **2. C. atrospinosa**
3. Pinnae to 20 or more pairs, closer together.
4. Sori all elongate; veins not prominent on lower surface . . . . . **3. C. muricata**
4. At most basal sori elongate; veins rather thick and prominent beneath.

5. Pinnae not over 3 cm wide, lobed 1/4–2/5; basal sori only divergent but not elongate **4. C. ferox**
5. Pinnae to 3.5 cm or more wide, lobed 2/5–3/5; basal 2–3 pairs of sori divergent and lowest elongate . . . . . **5. C. imponens**

1. Abaxial surface of rachis in most species lacking scales; scales, if present in this position, distinctly flat.
6. Basal veins not meeting but passing to sides of the sinus-membrane which is decurrent below their junction with it . . . . . **6. C. pricei**
6. Basal veins anastomosing or at least meeting below base of sinus-membrane which is not decurrent.
7. Stipe scaly throughout; at least lower part of rachis scaly on abaxial side.
8. Pinnae to 3 cm wide, thin, drying light greenish; small indusia present . . . **7. C. sakayensis**
8. Pinae not over 2.5 cm wide, firm, drying brown-olivaceous; no indusia . . . **8. C. clavipilosa**
9. Capitate hairs abundant on lower surface of costae and costules; capitate hairs and sessile glands between veins . . . . . **8a. C. clavipilosa *var.* clavipilosa**
9. Glands mainly sessile, lacking between veins . . . . . **8b. C. clavipilosa *var.* javanica**
7. Stipe scaly near base only; rachis not scaly on abaxial surface.
10. Rachis bearing slender terete scales on adaxial surface . . . . . **9. C. bewaniensis**
10. Rachis lacking scales on adaxial surface, or such scales flat.
11. Pinnae crenate to a depth of 1.5–3 mm; no indusia.
12. Lower surfaces covered with slender erect acicular hairs . . . . . **10. C. lorzingii**
12. Lower surfaces glabrous.
13. Pinnae thin; veins not prominent beneath; sori close to costules except lowest **11. C. sambasensis**
13. Pinnae firm; veins prominent beneath; several pairs of lower sori gradually divergent **12. C. christii**
11. Pinnae lobed 1/3 towards costa or more deeply; indusia present in most cases.
14. Lower surface bearing sessile glands . . . . . **13. C. paucipaleata**
14. Lower surface bearing acicular and/or capitate hairs.
15. Lower surface densely acicular-hairy throughout, lacking capitate hairs; no capitate hairs on sporangia . . . . . **14. C. horridipes**
15. Lower surface bearing short capitate hairs at least on costules and veins; capitate hairs (rarely setae) present on sporangia.
16. Pinnae thick and rigid; veins prominent on lower surface, grooved on upper surface **15. C. perrigida**
16. Pinnae thin; veins not prominent on lower surface nor grooved on upper surface.
17. Basal pair of veins anastomosing to form a slender excurrent vein which is joined by the second acroscopic vein before entering base of sinus-membrane . **16. C. supraspinigera**
17. Basal pair of veins meeting, or not quite meeting, at base of sinus-membrane.
18. Pinnae lobed less than half-way to costa; sori indusiate . . . . . **17. C. urens**
18. Pinnae lobed more than half-way to costa; sori exindusiate . . . . . **18. C. tenerior**

1. Chingia acutidens HOLTTUM, Kalikasan 3 (1974) 17. — Type: ALSTON 15708, Mt Manimporok, Soputan Mts, Minahassa, Celebes (BM).

Stipe more than 85 cm long, rather copiously black-muricate throughout (bases of former scales), abaxial surface of rachis similarly but less prominently muricate. *Lamina* 170 cm long, apex pinna-like; pinnae nearly 40 pairs; basal pinnae narrowed to base on basiscopic side, acroscopic base truncate and slightly auricled. *Suprabasal pinnae* to 42 × 2.4 cm; base broadly cuneate; apex acuminate with slender cauda to 6 cm long; edges crenate-serrate to a depth of 1 mm; costules 4.5–5 mm apart, at more than 60°; veins to 10 pairs, 2 pairs anastomosing, 3 or more pairs passing to sides of sinus-membrane; *lower surface* of pinnae glabrous apart from sparse hairs on sinus-membrane and edge; *upper surface* with short hairs on costae only. *Sori* rather large, distinctly free from costules, at least basal ones elongate; no indusia; no glands on sporangia.

Distr. *Malesia*: N. Celebes (type and POST HUMUS 2566).

2. Chingia atrospinosa (C. CHR.) HOLTTUM, Kalikasan 3 (1974) 19. — *Dryopteris atrospinosa* C. CHR. Bot. Jahrb. 66 (1933) 43. — *Thelypteris atrospinosa* (C. CHR.) REED, Phytologia 17 (1968) 261. — Type: KJELLBERG 3652, Rante Lemo, Celebes (S-PA; BO).

Stipe to 75 cm long, stramineous; basal scales 10 mm long, hardly 1 mm wide, dark brown, glossy, with short spreading hairs; above base throughout bearing many short black spines (bases of former scales); lower surface of rachis bearing also scattered spines or terete dark scales. *Lamina* to 75 cm long, apex almost pinna-like; pinnae 8–12 pairs, widely spaced, rigid; basal pinnae narrowed gradually to their bases, with stalks 2–3 mm long. *Suprabasal pinnae* 25–30 cm long, 2.5–3.0 cm wide; base broadly cuneate; apex acuminate with sharp-toothed cauda 3 cm or more long; edges

lobed 1/3 towards costa, lobes falcate, narrowed to acute tip; costules 5 mm apart; veins 10–11 pairs, slightly prominent both sides, 2 pairs anastomosing, 2 pairs to sides of sinus-membrane; *lower surface* of costae and costules bearing stiff spreading slender hairs 0.5–1 mm long, scattered hairs on and between veins; *upper surface* hairy on costa and edges only. *Sori* near costules, exindusiate, spreading a little along veins; no glands on sporangia.

Distr. *Malesia*: Celebes (N to SW); Sabah.

Ecol. At 1000–2000 m, in open places, in some cases near streams.

3. Chingia muricata (BRAUSE) HOLTTUM, Kalikasan 3 (1974) 20. — *Dryopteris muricata* BRAUSE, Bot. Jahrb. 56 (1920) 106, *excl. var. marginata et var. obscura.* — *Cyclosorus imponens sensu* COPEL. Philip. J. Sci. 78 (1951) 457, *p.p.* — *Thelypteris muricata* (BRAUSE) REED, Phytologia 17 (1968) 295. — Type: LEDERMANN 12720, Sepik Distr., New Guinea (B).

Stipe 45 cm long, densely covered with spines 1–2 mm long and scales; scales to 24 × 1 mm, hair-pointed, bearing short setae, grading in distal part of stipe to terete hairy spines 8 mm long. *Lamina* c. 100 cm long; pinnae closely spaced; basal pinnae somewhat narrowed to their bases and short-stalked; texture coriaceous. *Largest pinnae* of type 35 × 3.3 cm; base subtruncate, apex acuminate, not caudate; edges lobed 1/3–2/5 towards costa, lobes close, falcate; costules to 5.5 mm apart; veins 10–12 pairs, grooved on upper surface, hardly evident on lower when dry, 1½ pairs anastomosing, 2 pairs to sides of sinus-membrane; *lower surface* of rachis with slender terete bristles to 8 mm long, of pinnae glabrous apart from a few hairs on sinus-membrane and edges. *Sori* all somewhat elongate (elliptic in outline), distal ones near costule, lower ones a little divergent, exindusiate; no glands on sporangia.

Distr. *Malesia*: New Guinea, from Idenburg River to Morobe District.

Ecol. Type from wet rocky place; others from secondary forest, at 850–1500 m.

4. Chingia ferox (BL.) HOLTTUM, Blumea 19 (1971) 31; Kalikasan 3 (1974) 21. — *Aspidium ferox* BL. En. Pl. Jav. (1828) 153. — *Nephrodium ferox* (BL.) MOORE, Ind. Fil. (1858) 91; HOOK. Spec. Fil. 4 (1862) 77, *excl.* Wallich, Kamaon; RACIB. Fl. Btzg I (1898) 192. — *Phegopteris ferox* (BL.) METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 224. — *Dryopteris ferox* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 221, 819, *excl. var. calvescens*; BACKER & POSTH. Varenfl. Java (1939) 62. — *Cyclosorus ferox* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 167; COPEL. Fern Fl. Philip. (1960) 347. — *Thelypteris ferox* (BL.) TAGAWA & K. IWATS. Acta Phytotax. Geobot. 23 (1968) 54. — Type: BLUME, West Java (L, sheet *n.* 908, 331–305).

Polypodium scabrum ROXB. Calc. J. Nat. Hist. 4 (1844) 491. — Type: WALLICH Cat. 2225, Amboina (isotype K; ill. as *Nephrodium ferox* by BEDD. Ferns Br. India t. 129).

Goniopteris barbata FÉE, Gen. Fil. (1852) 252. — *Phegopteris barbata* (FÉE) METT. Farngatt. IV (1858) 24. — *Polypodium barbatum* (FÉE) HOOK. Spec. Fil. 5 (1864) 10. — Type: CUMING 172, Luzon (orig.?; isotypes BM, K, L, SING). — **Fig. 8a–b.**

Caudex to 20 cm or more tall; *stipe* commonly 100 cm long, largest basal scales 25 × 1.5 mm, thin, glossy, setiferous, medium brown; scales on upper part of stipe and on rachis terete or nearly so, hairless, dark, 5–10 mm long, often broken leaving warts or short spines. *Lamina* 100–200 cm long, texture varying with altitude and exposure; basal pinnae slightly narrowed at their bases which are slightly auricled on acroscopic side. *Largest pinnae* 18–40(–50) cm long, 1.6–3.0 cm wide, narrowly acuminate; edges lobed 1/4–2/5 towards costa; lobes with acute falcate tips; costules 3.5–4.5 mm apart; veins to 16 pairs, not very thick, variably prominent on lower surface, grooved or flat on upper, 1 pair anastomosing, 3–4 pairs passing to sides of sinus-membrane; *lower surface* of costae, costules, sinus-membranes and edges bearing ± abundant erect slender acicular hairs, sometimes also capitate hairs (which may be abundant on sterile pinnae) on costules and veins. *Sori* exindusiate, close to costules except basal basiscopic one, not elongate; sporangia of Java specimens lacking glands, small red glands present on some specimens from Moluccas and Philippines.

Distr. *Malesia*: Java, Lesser Sunda Islands, Borneo, Celebes, Philippines, Moluccas, New Guinea.

Ecol. Usually in secondary growth, on hill-slopes; 500–2000 m.

Notes. The specimen *n.* 2225 from Herb. Wallich among HOOKER's specimens at Kew is labelled Kamaon in HOOKER's hand, though ROXBURGH gave Amboina as its origin; another was figured by BEDDOME; both have small red glands on the sporangia like those from the Moluccas. No locality is indicated in Wallich's Catalogue. Philippine specimens seen are more shallowly lobed than those from Java.

5. Chingia imponens (CES.) HOLTTUM, Kalikasan 3 (1974) 21. — *Polypodium imponens* CES. Rendic. Acad. Napoli 16 (1877) 27, 29. — *Dryopteris imponens* (CES.) C. CHR. Ind. Fil. (1905) 271; Dansk Bot. Ark. 9, 3 (1937) 50, pl. V, f. 5. — *Phegopteris imponens* (CES.) v.A.v.R. Handb. (1908) 506. — *Cyclosorus imponens* (CES.) COPEL. Gen. Fil. (1947) 142; Philip. J. Sci. 78 (1951) 437. — *Thelypteris imponens* (CES.) REED, Phytologia 17 (1968) 284. — Type: BECCARI, Arfak Mts, W. New

Guinea (FI, Herb. Becc. 12668).

Dryopteris armata ROSENST. Hedwigia 56 (1915) 351. — *Phegopteris armata* (ROSENST.) v.A.v.R. Handb. Suppl. (1917) 318. — Type: BAMLER 111, Sattelberg, N.E. New Guinea (B; UC).

Dryopteris muricata var. marginata BRAUSE, Bot. Jahrb. 56 (1920) 107. — Type: LEDERMANN 11937, Sepik Distr., New Guinea (B).

D. muricata var. obscura BRAUSE, *l.c.* 108. — Type: LEDERMANN 12022, same locality.

Stipe 100 cm or more long; basal scales 15–20 × 1.5 mm, medium dull brown, rest of stipe and rachis bearing many slender terete dark scales to 10 mm long, often broken and reduced to short spines which bear a few stiff hairs. *Lamina* 150 cm or more long; pinnae close, many pairs; lowest pinnae gradually narrowed in basal 8–10 cm, with stalks 2 mm long. *Largest pinnae* commonly 45 × 3.5–4.0 cm; base subtruncate; apex gradually attenuate; edges lobed 2/5–3/5 towards costa, lobes falcate distally; costules 6–6.5 mm apart; veins 12–15 pairs, slender, dark beneath and slightly prominent, grooved on upper surface when dry, 1 pair anastomosing, 2–3 pairs passing to sinus-membrane; *lower surface* of costae, costules, veins and sinus-membranes bearing sparse short pale acicular hairs; *upper surface* of costae bearing slender pale to brownish hairs 0.5 mm or more long, few hairs on costules. *Sori* near costules except basal 2 pairs which are divergent and slightly elongate; no indusia; no glands on sporangia.

Distr. *Malesia*: Eastern New Guinea, at altitudes to 1800 m, many collections.

Note. This species is very near *C. ferox* but has less rigid and more deeply-lobed pinnae and stiff hairs on the stumps of broken terete scales on the rachis.

6. Chingia pricei HOLTTUM, Kalikasan 3 (1974) 22. — Type: M. G. PRICE 512, Mt Santo Tomas, Benguet Prov. Luzon, exposed place near summit (PNH; K). — **Fig. 8f–g.**

Caudex 10 cm diameter (collector); stipe 45–60 cm long, basal half covered with glossy light brown scales to 10 × 1 mm, thin but firm, thickened at base, bearing sparse stiff hairs; distal part of stipe, and rachis, bearing only smaller scales (which are not terete) on edges of groove of adaxial surface, abaxial surface smooth. *Lamina* to 60 cm long; pinnae more than 20 pairs; lowest pinnae hardly narrowed near base, basal acroscopic lobe elongate; texture firm. *Largest fertile pinnae* 13 cm long, 2.1 cm wide above base (sterile to 18 × 2.3 cm); base truncate, usually dilated both sides to a total width of 3 cm; apex acuminate; edges lobed half-way to costa or a little more deeply, lobes slightly falcate; costules 4–4.5 mm apart; veins 10 pairs, basal pair very oblique, not joining but passing to sides of the sinus-membrane which is decurrent between them, next 1½–2 pairs also passing to sides of the membrane; *lower surface* of rachis, costae, costules, veins and between veins bearing copious short capitate hairs, acicular hairs present on sinus-membranes and edges; *upper surface* of costae covered with many thick brownish hairs less than 0.5 mm long, sparse acicular hairs on costules, scattered short capitate hairs on and between veins. Distal *sori* close to costules, lower ones a little divergent; indusia fairly large, thin, shrivelling, with capitate and acicular hairs; capitate hairs on sporangia.

Distr. *Malesia*: Philippines (Luzon), known from type only.

7. Chingia sakayensis (ZEILLER) HOLTTUM, *comb. nov.* — *Nephrodium sakayense* ZEILLER, Bull. Soc. Bot. France 32 (1885) 75; BEDD. Handb. Suppl. (1892) 78. — *Thelypteris sakayensis* (ZEILLER) REED, Phytologia 17 (1968) 311. — *Sphaerostephanos sakayensis* (ZEILLER) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 209. — Type: DE MORGAN *s.n.* 6 Aug. 1884, near Gunong Riam, Perak, 750 m (P; K).

C. pseudoferox HOLTTUM, Kalikasan 3 (1974) 24. — Type: MATTHEW *s.n.* 6 Feb. 1908, G. Hijau, Perak (K).

Cyclosorus ferox sensu HOLTTUM, Rev. Fl. Malaya 2 (1955) 265, f. 151, *quoad pl. Malay. tantum.* — **Fig. 8c–e.**

Stipe to 200 cm long, densely scaly throughout; scales to 20 × 1.5 mm, rigid, flat with thickened persistent bases, dark brown, bearing short stiff marginal and superficial setae; abaxial surface of basal part of rachis bearing very narrow and shorter similar scales. *Lamina* to 200 cm long; pinnae many pairs, texture thinner than in *C. ferox*, drying light greenish; basal pinnae gradually much narrowed towards their bases which may be only 5 mm wide. *Largest pinnae* to 40 × 3 cm (type of *C. pseudoferox*) but in young plants sometimes fertile at 19 × 1.6 cm (type of *N. sakayense*); apex rather evenly narrow-attenuate; edges lobed about half-way to costa, lobes distally falcate and narrowed to an obtuse tip; costules 5 mm apart; veins 10–15 pairs, slender and slightly prominent on lower surface, 1–2 pairs anastomosing, next 2–3 pairs to sides of sinus-membrane; *lower surface* of costae, costules, veins and surface between veins bearing ± abundant small sessile yellowish glands, short acicular hairs also sometimes present; *upper surface* hairy on costae and costules only, no glands. *Sori* close to costules except basal ones which are often a little elongate; indusia very small, bearing a few small glands; sporangia with small glands.

Distr. Peninsular Thailand, in *Malesia*: Malaya, Sumatra, Sarawak, W. Java.

Ecol. In forest, often near streams, at 150–1200 m.

Note. The type of *N. sakayense* at Paris consists of the apical part of a frond; at Kew are 2

detached pinnae. The aspect of these specimens is so different from that of fully grown plants that formerly I failed to recognize their identity, which is confirmed by recent gatherings of other small fertile plants. The single specimen from W. Java is from G. Pulosari at 600 m (ADELBERT 492).

8. Chingia clavipilosa HOLTTUM, Kalikasan 3 (1974) 23. — Type: HOLTTUM 44, Mt Kinabalu 2300 m, Sabah (K).

a. *var.* **clavipilosa**

Stipe densely scaly throughout, scales all flat, basal ones 15 × 1 mm; scales on abaxial surface of *rachis* more sparse but present throughout, very narrow but distinctly flat, not terete, at their bases. *Basal pinnae* narrowed towards base which is 1.5 cm wide. *Largest pinnae* 28 × 2.5 cm, very firm, lobed 1/3 towards costa; costules 4.5 mm apart; veins to 12 pairs, slender and slightly prominent on lower surface, not on upper, 1–1½ pairs anastomosing, 2–3 pairs passing to sides of sinus-membrane; *lower surface* of costae (at least distally) and costules bearing ± abundant slender spreading hairs to 1.5 mm long; on costae, costules and veins abundant small capitate hairs, on surface between veins short capitate hairs and very small sessile glands; *upper surface* of costae bearing thick brownish hairs 0.7 mm long, rest glabrous. *Sori* close to costules except on basal veins; no indusia; sporangia bearing capitate hairs.

Distr. *Malesia*: N. Borneo (Kinabalu) and Philippines (Luzon, Mountain Province).

Note. The description is prepared from Kinabalu specimens; those from N. Luzon are much smaller (pinnae to 10 × 1 cm) with more copious acicular hairs on lower surface.

b. *var.* **javanica** HOLTTUM, *var. nov., ab var. clavipilosa differt: costis costulis venisque subtus glandulis sessilibus vel subsessilibus praeditis, glandulis inter venas nullis; sporangiis immaturis glandulis pallidis minutis praeditis.* — Type: 1221 Herb. Bog., Tjibeureum, G. Gedeh, Java (BO). — **Fig. 8i.**

Distr. *Malesia*: West Java, many specimens, 1800–2000 m; Sarawak, G. Mulu.

Note. These specimens were formerly included in *C. ferox* but differ in the distinctly flat scales on the abaxial surface of the rachis and in the small glands on young sporangia.

9. Chingia bewaniensis HOLTTUM, *sp. nov.*

Stipes basin versus tantum paleatus, paleis omnibus applanatis; pagina adaxialis rhachidis paleis teretibus praedita, pagina abaxialis minute verrucosa; cetera C. feroci similis. — Type: JERMY 8170, Bewani Mts, N.E. New Guinea, 300 m (BM).

Stipe 70 cm long, densely scaly at base only, above base minutely verrucose; scales 15 mm long, 0.5–1.0 mm wide, thin, medium brown, bearing sparse setae. *Lamina* firm, drying light olivaceous, 120 cm long; several pairs lower pinnae gradually narrowed towards their bases which are 1.1 cm wide with auricle to 9 mm long on acroscopic side, stalk 2 mm. *Largest pinnae* 45 × 2.5 cm; apex narrowly acuminate; edges lobed 1/3 towards costa, lobes falcate subacute; costules 5 mm apart; veins to 12 pairs on acroscopic side, 14 on basiscopic, 1 pair anastomosing, 2–3 pairs passing to sides of sinus-membrane; *lower surface* of rachis pale, glabrous, with minute warts as upper part of stipe, of costae glabrous; *upper surface* of rachis, within the groove, bearing many slender terete scales, costae copiously antrorse-hairy, rest glabrous. *Sori* near costules, basal ones only slightly divergent, exindusiate; sporangia bearing small red glands.

Distr. *Malesia*: Papua New Guinea; only known from the type.

10. Chingia lorzingii HOLTTUM, *sp. nov.*

Stipes basin versus tantum paleatus; pagina abaxialis rhachidis pilis acicularibus patentibus 0.7–0.8 mm longis dense vestita; pinnae tenues, maximae 20 × 1.8 cm, vix 1/4 costam versus lobatae, subtus omnino pilis acicularibus erectis vestitae; sori exindusiati; sporangia glandulis non praedita. — Type: LÖRZING 16188, Karoplateau, Dolok-baros, Sumatra, 1750–1950 m (BO).

Stipe 80 cm long; basal scales few, flat; upper part of stipe bearing short pale acicular hairs and very few scales; abaxial surface of rachis, especially distally, densely covered with pale erect acicular hairs 0.7–0.8 mm long. *Lamina* 80 cm long; pinnae *c.* 30 pairs, texture thin but firm; basal pinnae narrowed very gradually towards their bases. *Largest pinnae* 20 × 1.8 cm; base broadly cuneate; apex narrowly acuminate; edges lobed to a depth of 2 mm (hardly 1/4 towards costa); costules 4–5 mm apart, at less than 60°; veins 8–9 pairs; slender, hardly prominent either side, 1–1½ pairs anastomosing, 3 pairs to sides of sinus-membrane; all parts of *lower surface* bearing erect slender acicular hairs *c.* 0.7 mm long, most densely on costae, very short capitate hairs also present on and between veins; *upper surface* of costae bearing thicker hairs, shorter ones also on costules and veins. *Sori* all close to costules, not elongate, exindusiate; no glands on sporangia.

Distr. *Malesia*: N.E. Sumatra; known from the type and SURBECK 814, from Sibuatan.

11. Chingia sambasensis HOLTTUM, Kalikasan 3 (1974) 24. — *Dryopteris penangiana var. calvescens sensu* COPEL. Philip. J. Sci. 5 (1910) Bot. 283 *quoad pl. Brooks. tantum.* — Type: C. J. BROOKS *s.n.* Sept. 1908, Sambas, W. Kalimantan, 900 m (BM; K, L, MICH).

Stipe of type lacking (see also below); *rachis* red-brown, quite smooth on abaxial surface. *Lar-*

gest pinnae 43 × 3.3 cm, thin, drying light olivaceous; apex narrowly attenuate; edges crenate to a depth of 2–2.5 mm; costules 5 mm apart; veins slender, slightly prominent on upper surface, not on lower, 10–11 pairs, 1–1½ pairs anastomosing, 4 pairs to sides of sinus-membrane; *lower surface* of pinnae quite glabrous; *upper surface* glabrous except for a few hairs near base of costae. *Sori* close to costules except basal basiscopic one, all slightly elongate, exindusiate; no glands on sporangia.

Distr. *Malesia*: Borneo. Besides the type, an unlocalized Bornean specimen of KORTHALS.

Note. The Korthals specimens (3 sheets at B, 2 at L) include a stipe of 125 cm, rather sparsely scaly near base, scales flat, narrow, long-acuminate, on rest of stipe scattered small black warts and a few narrow dark flat scales. One sheet bears the apex of a frond which is not fully expanded; it shows some short capitate hairs on both surfaces and on sporangia. The largest pinna is 24 × 2.1 cm, in shape and venation like the type.

12. Chingia christii (COPEL.) HOLTTUM, Kalikasan 3 (1974) 25. — *Dryopteris ferox var. calvescens* CHRIST, Philip. J. Sci. 2 (1907) Bot. 193. — *Cyclosorus christii* COPEL. Fern Fl. Philip. (1960) 362 *excl.* ESCRITOR BS 20707. — *Thelypteris zamboangana* REED, Phytologia 17 (1968) 325, *nom. nov.* (not *T. christii* (C. CHR.) REED). — Type: COPELAND 1721, San Ramon, Mindanao, 800 m (MICH; B, NSW). — **Fig. 8h.**

Stipe to 200 cm long (ELMER), castaneous, scaly at base only; scales 15 × 0.5 mm, thick, dull brown; upper part of stipe, and rachis, smooth on abaxial surface. *Lamina* 100 cm or more long; basal pinnae narrowed at asymmetric base, with stalks 2 mm long. *Largest pinnae* of type 25–35 cm long, 2.0–2.7 cm wide (but see note below), very firm, drying red-brown; apex long-attenuate with subentire cauda 3 cm long; edges crenately lobed to a depth of 2–3 mm, lobes falcate, acute; costules 4.5–5.5 mm apart; veins to 10 pairs, prominent on lower surface, 1½ pairs anastomosing, 3 pairs to sides of sinus-membrane; *lower surface* of type quite glabrous, of ELMER 10182 bearing a few small capitate hairs and sessile glands on costules and veins; *upper surface* hairy on costa only. Lower *sori* gradually divergent from costule, several pairs somewhat elongate; no indusia; sporangia bearing small glands.

Distr. *Malesia*: Philippines (Mindanao, Negros, Mindoro).

Note. With ELMER 10182 (from Negros) in UC is a note by the collector that the frond was 4 m long, with largest pinnae 52 × 3.3 cm.

13. Chingia paucipaleata HOLTTUM, Kalikasan 3 (1974) 26. — Type: M. G. PRICE 781, Tignoan, Infanta, Quezon Prov., Luzon (PNH; K).

Stipe to 150 cm long, basal 15 cm covered with scales, rest glossy, castaneous, sparsely verrucose; scales to 20 mm long, little more than 0.5 mm wide, thin, contorted when dry, bearing few setae. *Lamina* to 100 cm long; pinnae to at least 30 pairs, subopposite, 3.5 cm apart; several lower pairs slightly narrowed at their bases, sessile. *Largest pinnae* 24 × 1.5 cm; base subtruncate; apex narrowly attenuate; edges lobed 2/5 towards costa (to a depth of 3 mm), lobes falcate at tips; costules 3.5 mm apart; veins to 9 pairs, slender, distinct but hardly prominent on lower surface, 1–1½ pairs anastomosing, 1 pair to sides of sinus-membrane; *lower surface* of costae and costules glabrescent (some acicular hairs distally on young fronds), on veins and surface between them rather abundant small sessile glands; on *upper surface* of rachis sparse warts representing bases of scales, hairs on costae pale, 0.8 mm long. *Sori* all near costules, not elongate; indusia small, with a few small glands or short hairs.

Distr. *Malesia*: Philippines (Luzon).

Note. ESCRITOR BS 20707, from Tayabas Province, Luzon, (in Herb. Kew.) agrees with the above description but has pinnae to 32 × 2 cm and smaller indusia.

14. Chingia horridipes (v.A.v.R.) HOLTTUM, Kalikasan 3 (1974) 26. — *Dryopteris horridipes* v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 23. — *Thelypteris horridipes* (v.A.v.R.) REED, Phytologia 17 (1968) 283. — Type: BÜNNEMEIJER 9684, Mt Talamau, Sumatra (BO).

Scales at base of stipe to at least 10 × 1.5 mm, short-hairy throughout; above base of stipe scattered small warts (bases of former scales), uppermost part of stipe, and rachis, with sparse warts on adaxial surface only. *Lamina* 100 cm or more long, texture subcoriaceous; lowest pinnae narrowed towards their bases. *Largest pinnae* 35 × 2.2 cm; base truncate; apex acuminate; edges lobed almost half-way to costa; costules to 5 mm apart; veins to 15 pairs, grooved on upper surface, 1–1½ pairs anastomosing, 1½–2 pairs passing to sides of sinus-membrane; *lower surface* of costae and costules densely covered throughout with acicular hairs to nearly 1 mm long, fewer hairs on and between veins; *upper surface* hairy on costae and costules only. *Sori* near costules; indusia minute, short-hairy; sporangia lacking glands.

Distr. *Malesia*: Central West Sumatra (Mts Talamau and Kerintji), at 2200–2750 m.

15. Chingia perrigida (v.A.v.R.) HOLTTUM, Kalikasan 3 (1974) 27. — *Phegopteris perrigida* v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 27; Handb. Suppl. (1917) 317. — Type: MATTHEW 513, Mt Merapi, Sumatra (BO).

Dryopteris ferox var. calvescens sensu v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 150, *quoad Koorders* 43567 *tantum.*

Stipe to 100 cm long, densely scaly near base

only; basal scales to at least 15 × 1.5 mm, stiff, flat at base, apex very slender; no scales on abaxial surface of rachis. *Lamina* to 120 cm long; pinnae to at least 28 pairs; basal pinnae narrowed in basal 3 cm, basal lobes somewhat elongate. *Largest pinnae* 30 × 2.3 cm; base truncate or broadly cuneate; apex evenly attenuate; edges lobed 1/3 towards costa or a little more deeply; costules 4.5–5 mm apart; veins 8–12 pairs, grooved on upper surface and prominent on lower, basal pair meeting at base of sinus-membrane, next 2 pairs to sides of the membrane; *lower surface* bearing short capitate hairs on all parts and a varied number of acicular hairs (sometimes none) on costules and veins. *Sori* near costules, basal ones not divergent; indusia very small, bearing short capitate hairs; many short capitate hairs on sporangia.

Distr. *Malesia*: Central Sumatra, central Malaya, East Java, Lesser Sunda Is. (Flores).

Ecol. In open places at 1500–2000 m.

Notes. Found in Malaya for the first time at Genting Highlands in 1977, beside a recently-made road at 1500 m. Specimens from the Tengger and Ijang mountains in East Java have fewer capitate hairs on the lower surface; they were wrongly named *Dryopteris ferox var. calvescens* by v.A.v.R. and one has the MS name *D. ferox var. mitis* ROSENST. KOORDERS 37503 (Tengger Mts) has a seta on a few sporangia, capitate hairs on others.

16. Chingia supraspinigera (ROSENST.) HOLTTUM, Kalikasan 3 (1974) 27. — *Dryopteris supraspinigera* ROSENST. Hedwigia 56 (1915) 353. — *Cyclosorus supraspinigerus* (ROSENST.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 447. — *Thelypteris supraspinigera* (ROSENST.) REED, Phytologia 17 (1968) 318. — Type: BAMLER 91, Sattelberg, N.E. New Guinea (S-PA; B, UC).

Stipe more than 40 cm long, scaly at base only; adaxial side of stipe above base, and of rachis, bearing scattered small scales (or their wart-like bases), abaxial side smooth. *Lamina* 75 cm or more long, rather thin; basal pinnae slightly narrowed close to their bases. *Largest* pinnae 17 × 1.8 cm; base truncate; apex short-acuminate; edges lobed *c.* 1/3 towards costa; costules 4 mm apart; veins 8 pairs, very slender and hardly prominent either side, basal pair anastomosing to form a slender excurrent vein which is joined by the second acroscopic vein before entering the base of the sinus-membrane, next 2 pairs to sides of the membrane; *lower surface* of rachis and pinnae covered throughout with short thick hairs with variously thickened and sometimes wax-encrusted tips; *upper surface* of costae also bearing short papillae with a few acicular hairs. *Sori* all near costules; indusia small, glandular; sporangia bearing small glands.

Distr. *Malesia*: Papua New Guinea (Morobe Distr., 2 coll.).

Note. The second collection, from 300 m at foot of the Oomsis Range, is smaller than the type, with fertile pinnae 12.5 × 1.4 cm, rather less deeply lobed.

17. Chingia urens HOLTTUM, Kalikasan 3 (1974) 28. — Type: M. G. PRICE 2367, Mt Makiling, Batangas Prov. Luzon (PNH; K).

Caudex to 40 cm tall; stipe 75 cm long, basal 12 cm densely scaly, rest with sparse warts; basal scales to 15 × 1.5 mm, rather thin, contorted when dry, dull brown, not hairy; *rachis* lacking warts on abaxial side which is densely covered with short capitate hairs. *Lamina* to 75 cm long, firm but rather thin; pinnae 25 pairs; basal pinnae gradually narrowed in basal 7 cm to a quite narrow base which is auricled, next 4 pairs of pinnae progressively wider at base. *Largest pinnae* 29 × 2.5 cm; base broadly cuneate; apex narrowly attenuate; edges lobed almost half-way to costa, lobes falcate distally, acute, fringed with acicular hairs; costules 4–6 mm apart; veins 10–13 pairs, slender, not prominent either side, basal pair meeting, or not quite meeting, just below base of sinus-membrane, 2–3 pairs passing to sides of the membrane; *lower surface* bearing ± abundant short capitate hairs throughout, a few acicular hairs on distal parts of costae only; *upper surface* of costae densely covered with thick acicular hairs to 1 mm long, sparse shorter acicular hairs on costules and veins, a few short acicular and capitate hairs between veins. *Sori* close to costules except basal ones, not elongate; indusia small but always distinct, thin, with short capitate and sometimes 1–2 acicular hairs; sporangia with capitate hairs.

Distr. *Malesia*: Philippines (Luzon), only known from type.

Ecol. On steep slope inside crater at 960 m.

Note. PRICE reports: "malodorous; skin contact with living fronds produces a mild burning sensation".

18. Chingia tenerior HOLTTUM, *sp. nov.*

Pinnae usque 30 × 1.9 *cm, usque* 2/3 *costam versus lobatae, textura tenues; venae graciles, non prominentes, infimae vel ad basin membranae sinus junctae vel ibi conniventes non junctae, vena acroscopica secunda vel ad latus membranae vel ad marginem terminata; sori exindusiati; sporangia pilis capitatis praedita.* — Type: RAMOS BS 33066, near Baguio, Ilocos Norte Prov. Luzon (P; US).

Stipe scaly at base only; scales thin, to 10 mm long, hardly 1 mm wide at base. *Pinnae* to 30 × 1.9 cm, thin; apex gradually attenuate; edges lobed more than half-way (to 2/3) towards costa; costules 4 mm apart; veins to 15 pairs, very fine and not prominent either side, basal pair either meeting just below the sinus-membrane or touching the sides of the base of the membrane without meeting (base of membrane not decurrent be-

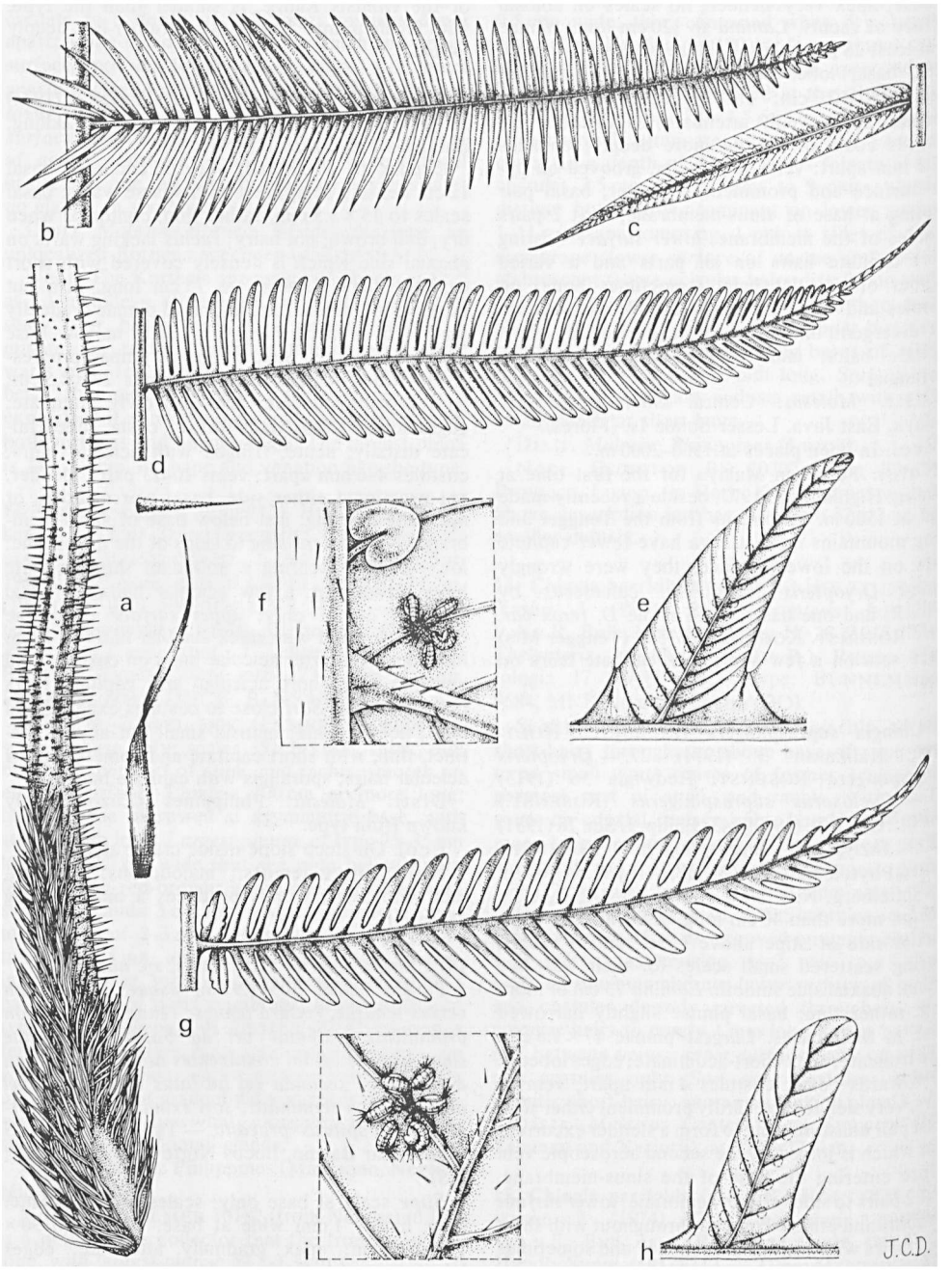

Fig. 9. *Plesioneuron marattioides* (ALSTON) HOLTTUM. *a.* Base of stipe, ×⅔, with scale and spine, ×2; *b.* lower pinna, ×⅓; *c.* one pinna-lobe, ×1. — *P. tuberculatum* (CESATI) HOLTTUM. *d.* Lower pinna, ×½; *e.* one pinna-lobe, ×3; *f.* sori (one with indusium removed), ×16. — *P. savaiense* (BAK.) HOLTTUM. *g.* Basal pinna, ×1; *h.* one pinna-lobe, ×3; *i.* sorus, ×16 (*a–c* MILLAR & HOLTTUM 15996, *d* FLOYD 5595, *e–f* BRASS 27112, *g–i* PRICE 2605).

tween them), second acroscopic vein ending at side of membrane or at margin just above base of sinus; *lower surface* throughout bearing scattered slender acicular hairs *c.* 0.4 mm long, short capitate hairs also present on veins and surface between them; *upper surface* of costae bearing rather sparse acicular hairs more than 0.5 mm long, very few hairs on costules, no others. *Sori* near costules, exindusiate, not elongate; short capitate hairs on sporangia.

Distr. *Malesia*: Philippines (Luzon), only known from the type which was distributed as *Dryopteris extensa*.

13. PLESIONEURON

HOLTTUM, Blumea 22 (1975) 232; Allertonia 1 (1977) 186; L. R. ATKINSON, Phytomorphology 25 (1975) 45 (gametophyte). — *Mesophlebion subg. Plesioneuron* HOLTTUM, Blumea 19 (1971) 30. — **Fig. 1j, 9.**

Caudex erect or suberect, rarely prostrate. Stipe always scaly at base, sometimes throughout, bases of scales usually thickened, in some species spine-like and persistent; lowest pinnae not or little reduced, variously narrowed at their bases, sometimes with a free basal lobe (or more than one); pinnae of firm texture, deeply lobed, usually with somewhat swollen or elongate basal aerophores, lower surface often verrucose when dry; veins all free, tips of lowest from adjacent costules usually touching sides of a sinus-membrane which may be decurrent between them as a hairy ridge almost to the costa, in the most deeply lobed pinnae both basal veins passing to the margin above base of sinus; basal basiscopic vein arising from costa near its costule, or from base of the costule; unicellular acicular hairs on lower surface of costae and costules various, usually short and stiff, thick brown hairs also sometimes present, rarely short capitate hairs, reduced scales few on most species; short acicular or capitate hairs sometimes present between veins on upper surface. Sori usually medial or inframedial, in a few cases supramedial; indusium, when present, usually firm and dark; sporangia often bearing small red or yellow glands, or setae, near annulus; hairs on sporangium-stalk sometimes acicular, never bearing red glands; spores dark, spinulose, in most observed cases (winged in three species), in about 15 species not yet observed.

Type species: *Plesioneuron tuberculatum* (CESATI) HOLTTUM.

Distr. *Malesia* & Pacific: Borneo (2 *spp.*); Moluccas (Tidore, Batjan, Buru, Amboina, 2 *spp.*); Mindanao (1 *sp.*); New Guinea & Bismarck Archipelago (32 *spp.*); islands of the Pacific, to Tahiti (12 *spp.*).

Ecol. In lowland and mid-mountain forest (and in a few cases to 2700 m) often by streams, sometimes pendulous from rock-crevices.

Cytol. Chromosome number 36 (*P. fulgens* only).

Taxon. The name *Plesioneuron* refers to the basal basiscopic veins in each pinna-lobe which always arise close to their costules, never far from them as in *Mesophlebion*. Plants of many species are similar in general aspect, and to some extent in venation, to *Mesophlebion*, to which genus they were assigned as a subgenus in 1971, but they differ from *Mesophlebion* in sporangia and spores, also, in a majority of species, in scales, and (in the only case investigated) in gametophytes. They appear to be related to *Chingia* and not very closely to any other genus. COPELAND included them in *Lastrea*, and published a key to the species of that genus in New Guinea (Philip. J. Sci. vol. 78, 1951) but he did not characterize them clearly nor distinguish them as a group. There are undoubtedly many species in New Guinea, but specimens of some are few or imperfect, so that more information about them is needed, and the present account probably needs some modification. Some type specimens may represent immature plants (an example is *P. ophiura*) and more local collecting is needed to establish this; in other cases small plants probably do represent the mature form of a species. Recent collections certainly include plants of previously undescribed species, and probably more remain to be discovered.

Several species show some degree of difference between lobes on acroscopic and basiscopic sides of a pinna, but there is no sharp distinction between these and those with no clear difference. However, in a few cases the difference is very marked and can be used in the key to the identification of species.

The sinus-membrane in *Plesioneuron* is in all cases distinctly decurrent from the base of the sinus as a more or less hairy ridge on the lower surface, sometimes almost reaching the costa. This condition is closely similar to that of *Dryopteris subg. Steiropteris* C. CHR. (Monogr. Dryopt. I, 1913, 161), a group of species in the American tropics. These species differ from *Plesioneuron* as follows: rhizome wide-creeping; septate hairs on lower surface of rachis and costae; neither glands nor setae on sporangia; spores with translucent wing and a few cross-wings (this type of spore occurs in a few species of *Plesioneuron*). Two aberrant species included with doubt by CHRISTENSEN in *subg. Steiropteris* are more similar to *Mesophlebion* and are mentioned under that genus.

I believe that characters of scales are often of diagnostic significance, but in many specimens they are not well represented; more information about them may help to clarify specific distinctions.

KEY TO THE SPECIES

1. Stipe and rachis bearing ± copious dark spines (bases of former scales); sori in most cases exindusiate.
2. Pinnae not over 4.5 cm wide; costules not over 5 mm apart.
3. Pinnae to 4.5 cm long; pinna-lobes concave beneath; stipe-scales to 4 mm long . . **1. P. pullei**
3. Pinnae larger; pinna-lobes not concave beneath; stipe-scales 8 mm or more long.
4. Sori exindusiate.
5. Sporangia bearing several long setae . . . . . **2. P. fuchsii**
5. Sporangia lacking setae.
6. Pinnae to 9 × 1.2 cm; basal veins both passing to margin above base of sinus **3. P. medusella**
6. Pinnae of well-grown plants much larger; basal veins both ending beside sinus-membrane.
7. Stipe-scales terete at base and apex, less than 0.5 mm wide in middle; pinnae to 4.5 cm wide . . . . . **4. P. woodlarkense**
7. Stipe-scales flat except at base, largest at least 1 mm wide; pinnae rarely more than 3 cm wide . . . . . **5. P. dryopteroideum**
4. Sori indusiate . . . . . **6. P. varievestitum**
2. Largest pinnae 7–12 cm wide with costules 10–12 mm apart.
6a. All pinna-lobes or pinnules auricled at base on basiscopic side; veins forked or pinnate in the auricles . . . . . **7. P. notabile**
6a. Pinna-lobes not thus auricled.
7a. Pinnae lobed almost to costae; lobes not separately adnate . . . . . **8. P. septempedale**
7a. Pinna-lobes in basal half of pinnae separately adnate to costa . . . . . **9. P. marattioides**
1. Stipe (except base) and rachis smooth; scales, if present, not spine-like; sori in almost all species indusiate.
8. Pinnae 1–5 pairs; apical lamina pinna-like; costules 5–7 mm apart . . . . . **10. P. fulgens**
8. Pinnae commonly to at least 10 pairs, or if fewer costules 3–4 mm apart.
9. No indusia; no setae on sporangia.
10. Aerophores elongate; sori near costules . . . . . **11. P. belense**
10. Aerophores not elongate; sori medial . . . . . **12. P. wariense**
9. Indusia present, or if absent all sporangia setiferous.
11. Sporangia all setiferous; no glands present.
12. Sori supramedial; sporangia with 1–3 short setae . . . . . **13. P. royenii**
12. Sori medial or inframedial; sporangia bearing several long setae.
13. Veins 10–12 pairs; largest pinnae not over 12 × 2.5 cm, almost sessile . . **14. P. savaiense**
13. Veins 14–16 pairs; largest pinnae 21 × 3.3 cm, with stalks 3–4 mm long . . . . **15. P. altum**
11. Sporangia usually with glands; setae, if present, short and not on all sporangia, sometimes alternating with glands.
14. Sori supramedial.
15. Pinnae to 20 × 3 cm; veins 15–18 pairs.
16. Indusia overlapping margin; basal acroscopic lobe of lower pinnae elongate with forked veins . . . . . **16. P. cystodioides**
16. Indusia not overlapping margin; basal acroscopic lobe of lower pinnae not enlarged **17. P. subterminale**
15. Pinnae smaller; veins not over 12 pairs.
17. Both basal lobes on basal pinnae free and short-stalked . . . . . **18. P. bipinnatum**

17. Basal lobes of basal pinnae not free . . . . . **19. P. quadriquetrum**
14. Sori medial or inframedial.
18. Pinna-lobes on both sides of costa conspicuously falcate.
19. Upper surface glabrous between veins; pinnae 8 pairs . . . . . **20. P. falcatipinnulum**
19. Upper surface bearing hairs between veins; pinnae 20 pairs.
20. Hairs on lower surface of rachis and costae 1 mm long, on upper surface between veins appressed . . . . . **21. P. kostermansii**
20. Hairs on lower surface of rachis and costae 0.3 mm long, on upper surface between veins short-erect . . . . . **22. P. angiensis**
18. Pinna-lobes not conspicuously falcate on both sides of costa.
21. Basal 10–12 pairs of pinna-lobes separately adnate to costa . . . . . **23. P. sandsii**
21. At most 1 free pinna-lobe separately adnate.
22. Pinnae to 25 × 5 cm, all except distal ones stalked; lower pinnae with stalks 3–6 mm; indusia small, caducous . . . . . **24. P. tuberculatum**
22. Pinnae smaller; most pinnae almost sessile, basal ones with stalks at most 2–3 mm long; indusia firm, persistent.
23. Veins 20 pairs or more.
24. Basiscopic lobes of all pinnae strongly falcate and shorter than acroscopic lobes; basal scales to 20 mm long, very narrow . . . . . **25. P. attenuatum**
24. Basiscopic lobes, if falcate, not or little shorter than acroscopic; basal scales much shorter, usually wider.
25. Basal acroscopic lobe of basal pinnae free, wider than the rest, with some forked veins . . . . . **26. P. platylobum**
25. Basal acroscopic lobe of basal pinnae otherwise.
26. Lower surface quite glabrous.
27. Pinnae *c.* 11 × 2 cm; basal acroscopic lobe of basal pinnae reduced . **27. P. crassum**
27. Pinnae *c.* 22 × 3 cm; basal acroscopic lobe of basal pinnae elongate . **28. P. stenura**
26. Lower surface of costules at least bearing acicular hairs.
28. Pinnae lobed to 0.5 mm from costa . . . . . **29. P. ophiura**
28. Pinnae lobed to 1–2 mm from costa . . . . . **30. P. costulisorum**
23. Veins 10–15 pairs.
29. Basal pinnae with stalks 2 mm or more long.
30. Pinnae lobed to 1.5–2 mm from costa . . . . . **31. P. doctersii**
30. Pinnae lobed to less than 1 mm from costa.
31. Basal scales thick, narrow; sori a little inframedial . . . . . **32. P. rigidilobum**
31. Basal scales *c.* 5 × 1.5 mm; sori near costules . . . . . **29. P. ophiura**
29. Basal pinnae sessile or nearly so.
32. Pinnae to 6 cm long; lobes on basiscopic side strongly falcate, on acroscopic side almost straight . . . . . **33. P. wantotense**
32. Pinnae longer; lobes on basiscopic side not greatly different from those on acroscopic side.
33. Aerophores small, dark; sori medial or a little inframedial.
34. Some sporangia bearing setae . . . . . **34. P. kundipense**
34. Sporangia lacking setae, glands usually present . . . . . **35. P. dryas**
33. Aerophores pale, slender, 1 mm long; sori near costules . . . . . **36. P. croftii**

1. **Plesioneuron pullei** HOLTTUM, Blumea 22 (1975) 236.—Type: PULLE 905, W. New Guinea, Mt Hellwig, 2600 m (L; BM).

Caudex short, massive, erect or suberect. *Stipe* of fertile fronds 25–30 cm long (shorter on sterile), red-brown, glossy, bearing many black spine-like scales 4 mm long, scale-bases persistent. *Lamina* to 30 cm long, texture coriacous; pinnae 30 pairs or more (but see below); basal 2–3 pairs of pinnae variably somewhat reduced, lowest on a large frond 2.2 cm long, basal acroscopic lobe free and elongate. *Largest pinnae* 4.5 × 0.9—1.0 cm, sessile; aerophores not enlarged; base truncate; apex obtuse; edges lobed to 1 mm from costa or more deeply; lobes strongly concave on lower surface, their edges much reflexed, entire, tips rounded; costules 2.5 mm apart; veins 4–5 pairs, thick and prominent beneath, invisible on upper surface, basal acroscopic vein passing to side of sinus-membrane, basal basiscopic vein arising from costa; *lower surface* of rachis bearing scattered glossy spine-like scales 1.5 mm long and stiff spreading hairs 0.7 mm long, costae and costules hairy as rachis, slender erect hairs present on surface between veins, copious hairs on and near margins of lobes; *upper surface* of costa deeply grooved with short hairs, capitate hairs present on rest of surface (often abraded on old specimens). *Sori* medial, exindusiate; sporangia lacking glands or setae.

Distr. *Malesia*: New Guinea; known from the type and PULLEN 5117 (see below).

Note. PULLEN 5117, from Western Highlands in Papua New Guinea, Kubor Range, at 3450 m, differs as follows: pinnae 18–20 pairs on a frond 30 cm long; costules 3–4 mm apart; veins 6–7 pairs; a very small hairy indusium present. The plant was on a steep bank near a rock-face in moss-forest, the fronds pendulous.

2. Plesioneuron fuchsii HOLTTUM, Blumea 22 (1975) 236. —Type: H. P. FUCHS 21477, Sabah, Mt Kinabalu, North Face, Goking's valley, 2715 m (L; K, US).

Caudex not seen; *stipe* 60 cm long, densely covered throughout with erect black spines, mostly broken, all except basal ones terete with sparse setae; basal scales rigid, dark brown, 10–15 mm long, 0.5 mm wide, with sparse setae. *Lamina* to at least 75 cm long; pinnae 35 pairs or more, rigid when dry; basal pinnae a little narrowed at their bases. *Largest pinnae* 21 × 1.8 cm; base truncate; apex caudate-acuminate; edges lobed to 2.5–3 mm from costa; lobes slightly falcate, entire, ciliate; costules 4–4.5 mm apart; veins 10–11 pairs, prominent beneath, slightly impressed above, basal veins both touching sides of sinus-membrane; *lower surface* of rachis bearing black spines as stipe, also some intact scales which are 4 mm long distally to 7–8 mm at base of stipe, similar scales 4 mm long on costae; costae, costules, veins and surface between veins bearing rather sparse slender erect acicular hairs and a few capitate hairs; *upper surface* bearing terete scales on edges of the rachis-groove, on costae copious brown acicular hairs with a few on costules also. *Sori* about medial, small, exindusiate; sporangia bearing long setae.

Distr. *Malesia*: Sabah (Mt Kinabalu), 2 collections (the second is CLEMENS 33719).

Ecol. At 2300–2700 m, overhanging river in moss-forest.

3. Plesioneuron medusella HOLTTUM, *sp. nov.*

Caudex erectus, tenuis; *stipes usque 25 cm longus, cum rachi omnino paleis angustis usque 8 mm longis vestitus*; *pinnae usque 9 × 1.2 cm, profunde lobatae*; *venae 6–7-jugatae, infimae ambae ad marginem terminatae*; *costae subtus pilis usque 1 mm longis vestitae*; *sori parvi, prope costulas, exindusati*; *sporangia non setifera.* — Type: A. C. JERMY 14133, Sarawak, Gunong Mulu National Park, G. Api, 1500 m (BM).

Caudex erect, 10 mm diameter; *stipe* 12–25 cm long, densely scaly at base, more sparsely upwards and on rachis, largest scales *c.* 8 mm long, terete or flattened at the thickened base, above base to 0.4 mm wide, apex filiform; also on stipe slender acicular hairs and many short blunt or capitate hairs. *Lamina* to 35 cm long; pinnae *c.* 30 pairs, slightly overlapping; basal pinnae slightly reduced and narrowed towards their bases, with elongate crenate basal acroscopic lobe. *Largest pinnae* 6.5–9 cm long, 1.2 cm wide above base; base truncate with both basal lobes a little longer than the next pair; apex evenly attenuate to tip; sides lobed to 1 mm from costa or more deeply, lobes not or slightly falcate; costules 2.5–3 mm apart, at more than 60° to costa; veins 6–7 pairs, prominent on lower surface, not on upper, basal veins both passing to margin above base of sinus; *lower surface* of rachis bearing scales 3–4 mm long, dark and very narrow, also sparse acicular hairs less than 1 mm long and more abundant short blunt or ± capitate hairs, hairs on costae similar but sometimes a little shorter, sparse acicular and more abundant short capitate hairs present on surface between veins; *upper surface* of rachis and costae with more abundant acicular hairs, few on costules and veins, between veins many short capitate hairs and a few acicular ones (often abraded from old fronds). *Sori* small, near costules except basal ones, exindusiate; sporangia sometimes bearing a shrivelled capitate hair; spores black, spinulose.

Distr. *Malesia*: Borneo (Sarawak: Mt Mulu, 1500 m), only known from the type.

Ecol. "In *Pandanus* zone over limestone pinnacles; in crevices of limestone getting considerable light".

Note. The specific epithet refers to the dense spreading slender scales which cover the uncoiling young fronds in a medusa-like manner.

4. Plesioneuron woodlarkense (COPEL.) HOLTTUM, Blumea 22 (1975) 236. — *Cyathea woodlarkensis* COPEL. Philip. J. Sci. 9 (1914) Bot. 1; HOLTTUM, Fl. Males. II, 1, pt 2 (1963) 158. — Type: C. KING 384, Woodlark Island, d'Entrecasteaux Is. (MICH; NSW).

Caudex erect, 22 cm tall (FLOYD); *stipe* to 100 cm long, bearing very short acicular hairs and short black spines throughout, scales (fully persistent at base of stipe) *c.* 12 mm long, dull brown, terete at base, flat but less than 0.5 mm wide above base, terete distally, bearing short acicular hairs; *rachis* also bearing scattered short blac spines on lower surface, on upper surface som complete bristle-like scales. *Lamina* to 150 cm long, texture firm-herbaceous; pinnae many pairs; basal pinnae with stalks 3 mm long, gradually narrowed in basal 4–5 cm, basal lobes 5–7 mm long. *Largest pinnae* 42 × 4.5 cm; base truncate; apex caudate-acuminate; edges lobed to 1–2 mm from costa, lobes slightly falcate on both sides of the costa; costules 5 mm apart, almost at right angles to costa; veins to more than 30 pairs, slender, basal ones touching sides of sinus-membrane; *lower surface* of rachis and costae bearing rather sparse pale hairs 1 mm long, shorter hairs on costules and veins, and a few on surface veins; *upper surface* of costae bearing dense rec

dish hairs 1 mm long, shorter hairs scattered on veins and surface between them. *Sori* near costules, exindusiate; sporangia not setiferous; spores dark.

Distr. *Malesia*: Papua New Guinea (Woodlark Island, New Britain, New Ireland) at 700–900 m.

Notes. In 1914 COPELAND wrongly cited the number 284 for the type; he again cited the type wrongly, as 383, in Philip. J. Sci. 77 (1947) 124. Of other specimens, CROFT 322 from southern New Ireland, exactly matches the type; FLOYD 6529, from New Britain, agrees in details of indument and sori but has pinnae to 33 × 3 cm. It should be noted that the number 384 occurs also on some specimens which do not belong here; at L, a specimen of *Amphineuron ceramicum*, at P a specimen of *A. immersum*.

5. **Plesioneuron dryopteroideum** (BRAUSE) HOLTTUM, Blumea 22 (1975) 237. —*Alsophila dryopteroidea* BRAUSE, Bot. Jahrb. 56 (1920) 70. —*Cyathea atrispora* DOMIN, Acta Bot. Bohem. 9 (1930) 95, *nom. nov.* — *Dryopteris atrispora* (DOMIN) C. CHR. Brittonia 2 (1937) 296.— *Thelypteris dryopteroidea* (BRAUSE) REED, Phytologia 17 (1968) 273.—Type: LEDERMANN 11897, N.E. New Guinea, Sepik Distr. 2070 m (B).

KEY TO THE VARIETIES

1. Stipe-scales 10 mm long; acicular hairs on lower surface of costae to 0.5 mm long.
2. Acicular hairs present on lower surface of rachis and costae . **a.** *var.* **dryopteroideum**
2. Hairs on lower surface of rachis and costae not acicular . . . . . **b.** *var.* **buruense**
1. Stipe-scales to 18 mm long; acicular hairs on lower surface of costae 1 mm long **c.** *var.* **pilosum**

a. *var.* **dryopteroideum**

Caudex erect, to at least 30 cm tall; *stipe* 60–120 cm long, basal part densely covered with dark brown rigid glossy scales *c.* 10 mm long, at least 1 mm wide with attenuate apex, distal part of stipe and both surfaces of rachis bearing less abundant similar but shorter scales or their spine-like bases. *Lamina* to 100 cm or more long, texture firm; lower pinnae narrowed towards their bases, with stalks 2 mm long. *Largest pinnae* commonly 20 × 2 cm, largest on type 35 × 2.7 cm; apex acuminate with cauda to 3 cm long; edges lobed to *c.* 2 mm from costa; lobes falcate, entire or slightly crenate, ciliate; costules 3.5–4.5 mm apart, at more than 60° to costa; veins commonly 12–15 pairs, basal veins both passing to sides of sinus-membrane; *lower surface* of rachis and costae bearing narrow dark scales and short acicular hairs, a few short acicular hairs present on costules with a variable number of small sessile or subsessile glands which in some specimens are much swollen and yellow (apparently infected by a fungus), between veins rather sparse short erect hairs; on *upper surface* acicular hairs confined to rachis and costae, or with a few short ones on costules. *Sori* near costules, exindusiate; sporangia bearing neither setae nor glands; spores dark, spinulose.

Distr. *Malesia*: Eastern New Guinea, at 2000–2700 m.

b. *var.* **buruense** HOLTTUM, *var. nov.*

A typo speciei differt: rachi costisque subtus pilis brevibus capitatis solum vestitis. — Type: STRESEMANN 387, N.W. Buru, G. Fogha, 1900 m (L).

Known only from the type collection which consists of part of a frond with pinnae to 20 × 2 cm.

Distr. *Malesia*: Moluccas (Buru I.).

c. *var.* **pilosum** HOLTTUM, *var. nov.*

A typo speciei differt: paleis stipitis usque 18 mm longis; costis costulisque subtus pilis 1 mm longis copiose vestitis. — Type: J. R. CROFT LAE 68379, New Ireland, Hans Meyer Range, 1700 m "landslip community" (L).

Known only from the type collection; stipe 50 cm long, lamina 150 cm long; largest pinnae 25 × 2.2 cm; veins 18 pairs.

Distr. *Malesia*: E. New Guinea (New Ireland).

6. Plesioneuron varievestitum (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris atrispora var. varievestita* C. CHR. Brittonia 2 (1937) 296. — *Lastrea varievestita* (C. CHR.) COPEL. Gen. Fil. (1947) 140; Philip. J. Sci. 78 (1951) 429. — *Thelypteris varievestita* (C. CHR.) REED, Phytologia 17 (1968) 323. — Type: BRASS 4996, E. New Guinea, Mt Tafa, 2400 m (BM; BO, BRI).

KEY TO THE VARIETIES

1. Rachis and costae bearing acicular hairs on lower surface . . . . . **a.** *var.* **varievestitum**
1. Rachis and costae bearing only short, blunt or capitate, hairs on lower surface **b.** *var.* **obtusipilum**

a. *var.* **varievestitum**

Caudex to 100 cm tall; *stipe* 47–70 cm long, stramineous above base, base densely covered with glossy castaneous scales to 10 × 2 mm, scattered smaller scales or their broken spine-like bases present on distal part of stipe and on rachis and costae. *Lamina* 40–75 cm long, texture rigid; pinnae to more than 30 pairs; basal pinnae somewhat narrowed towards their bases, with stalks 1 mm long. *Largest pinnae* of type 15 × 1.5 cm (of other specimens ranging from 7.5 × 1.2 to 21 × 2.3 cm); apex acuminate, with or without a short cauda; edges lobed to less than 1 mm from costa; lobes slightly falcate, entire; costules 3–4.5 mm apart; veins of type 9–10 pairs (on another speci-

men to 15 pairs), basal acroscopic vein ending beside sinus-membrane or near it, basiscopic vein at margin above base of sinus; *lower surface* of rachis bearing acicular hairs to 0.7 mm long, of costae and costules shorter acicular hairs and small colourless or yellow sessile or subsessile glands, between veins a variable number of short erect acicular hairs and a few glands; *upper surface* of rachis and costae bearing acicular hairs, between veins a variable number of small sessile glands. *Sori* near costules; indusia small, thin, pale, with a few glands or very short acicular hairs; sporangia sometimes bearing short capitate hairs or a short seta (not seen on type); spores dark, spinulose.

Distr. *Malesia*: Eastern New Guinea, at 1800–2800 m.

Notes. CHRISTENSEN and COPELAND failed to see the indusia, which are partly obscured by the developing sporangia. As in *P dryopteroideum*, tha small glands on pinnae are sometimes swollen and yellow, perhaps through infection by a fungus.

b. *var.* obtusipilum HOLTTUM, *var. nov.*

A typo speciei differt: rachi costisque subtus pilis 0.1 mm longis vel capitatis vel obtusis praedita; pagina inferiore pinnarum inter venas pilis acicularibus brevibus pilis brevioribus capitatis intermixtis vestita. — Type: NAKAIKE 80, N.E. New Guinea, Morobe Distr., Wau Subdistr., 1300–1600 m (K).

Scales on stipe much fewer than on *var. varievestitum*, and thinner; lower surface of rachis and costae lacking acicular hairs but bearing many blunt or capitate hairs *c.* 0.1 mm long; between veins on lower surface of pinnae very copious erect acicular hairs and shorter capitate hairs (not sessile glands); indusia lacking acicular hairs; sporangia apparently lacking capitate hairs or setae.

Distr. *Malesia*: Papua New Guinea; known from type and STREIMANN & KAIRO NGF 44469, also from Wau Subdistrict, at 1500 m, in abandoned garden site (K).

Note. The short blunt hairs on these plants resemble those on *Chingia supraspinigera*. They appear to develop a waxing covering of their tips when old.

7. Plesioneuron notabile (BRAUSE) HOLTTUM, Blumea 22 (1975) 237. — *Dryopteris notabilis* BRAUSE, Bot. Jahrb. 56 (1920) 91. — *Lastrea notabilis* (BRAUSE) COPEL. Gen. Fil. (1947) 139; Philip. J. Sci. 78 (1951) 429. — *Thelypteris notabilis* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 253. — Type: LEDERMANN 11663, N.E. New Guinea, Sepik Distr., Schraderberg, 2070 m (B).

Caudex not known. Stipe and frond together 3–4 m long; *stipe* seen 75 cm long, densely covered with erect black hair-pointed spines to 2 cm long, bearing short acicular hairs. *Lamina* very firm; basal pinnae somewhat reduced, with basal acroscopic lobe 7 × 1.4 cm and pinnatifid (*teste* BRAUSE); suprabasal pinnae opposite, 4–10 cm apart. *Largest pinnae* 38 × 11.5 cm, lobes in basal half or more separately adnate to costa and distinctly auricled on their basiscopic bases, the basal vein forked or pinnate in the auricle, lobes of distal part of pinna connected by a very narrow wing along the costa; costules to 1.7 cm apart (11 mm on smaller pinnae); veins to more than 30 pairs, slender and prominent both sides; *lower surface* glabrous except for hairs on margins of lobes and sometimes a few on costules; *upper surface* glabrous except for hairs on costae and costules. *Sori* large, near costules, exindusiate; sporangia not setiferous; spores very dark, minutely verrucose.

Distr. *Malesia*: Papua New Guinea. Known only from type and another collection from same locality (LEDERMANN 11991).

8. Plesioneuron septempedale (ALSTON) HOLTTUM, Blumea 22 (1975) 238. — *Dryopteris septempedalis* ALSTON, J. Bot. 78 (1940) 227; Nova Guinea n.s. 4 (1940) 111, t, 8, f. 11. — Type: L. E. CHEESMAN 1383, W. New Guinea, Japen I. (BM; LAE).

Caudex not known; frond with stipe 215 cm long (collector); base of *stipe* bearing many dark spine-like bases of scales which bear short rigid hairs; pinnae almost opposite, widely spaced, lower ones slightly reduced, texture rigid. *Largest pinnae* 40 × 12 cm; base somewhat narrowed, basal lobes ± deflexed; apex short-acuminate; edges lobed to within 1 mm from costa; lobes at right angles to costa, acuminate, entire; costules to 12 mm apart; veins to more than 50 pairs, immersed and only just visible on surface; *lower surface* quite glabrous; *upper surface* of costae and costules bearing sparse short hairs. *Sori* near costules, basal ones divergent, exindusiate; neither setae nor glands on sporangia; spores dark.

Distr. *Malesia*: New Guinea (Japen I.), only known from the type.

9. Plesioneuron marattioides (ALSTON) HOLTTUM, Blumea 22 (1975) 238. — *Dryopteris marattioides* ALSTON, J. Bot. 78 (1940) 227; Nova Guinea n.s. 4 (1940) 110, pl. 7, f. 7, 8. — Type: CLEMENS 4809, N.E. New Guinea, Morobe Distr., Sambanga (BM). — **Fig. 9a–c.**

Caudex to 30 cm tall (HOOGLAND & PULLEN); *stipe* 100 cm or more long, pale, minutely hairy, densely covered near base with erect dark spines, less densely upwards and on rachis, spines to 8 mm long, terete to their tips and bearing short hairs throughout; scales at base of stipe to at least 20 mm long, medium brown, glossy, 2 mm wide near base, apex filiform, bearing short stiff hairs especially on margins. *Lamina* to 200 cm or more long, thick; pinnae 25 pairs or more, all subopposite, several pairs of lower pinnae gradually

reduced, lowest 20 cm long. *Largest pinnae* 40 cm long, 8–11 cm wide, lobes separately adnate to costa in basal half of pinna, largest lobes 5.8 × 0.9 cm, acuminate, those near base deflexed and somewhat reduced; distal half of pinna lobed almost to costa; costules to 10 mm apart near base of pinna; veins 35–40 pairs or more, thick and slightly prominent, basal acroscopic vein in larger lobes sometimes forked; *lower surface* quite glabrous apart from short hairs on margins of lobes; *upper surface* of costa densely covered with thick dark brown hairs, a few shorter hairs also on costules. *Sori* near costules except basal ones, exindusiate; no hairs nor glands on sporangia; spores dark with many small wings of irregular shape.

Distr. *Malesia*: N.E. New Guinea, at 1800–2300 m, several collections from widely separated localities, in *Nothofagus* forest.

Note. Young plants were grown from spores at Kew but died after attaining a height of 30 cm. They had rather abundant short orange capitate hairs on the lower surface of costules and veins, also a few between veins; such hairs are probably abraded from fronds of mature plants.

10. Plesioneuron fulgens (BRAUSE) HOLTTUM, Blumea 22 (1975) 238. — *Dryopteris fulgens* BRAUSE, Bot. Jahrb. 56 (1920) 89. — *Thelypteris fulgens* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 251. — Type: LEDERMANN 11004, N.E. New Guinea, Sepik Distr. 1300 m (B).

Dryopteris hunsteiniana BRAUSE, Bot. Jahrb. 56 (1920) 79. — *Thelypteris hunsteiniana* (BRAUSE) REED, Phytologia 17 (1968) 284. — Type: LEDERMANN 11058, loc. as *D. fulgens* (B).

Mesoneuron wantotense sensu HOLTTUM, Blumea 13 (1965) 134. — **Fig. 1j.**

Caudex creeping, 4–5 mm diameter; *stipe* 25–60 cm long, smooth except base, basal scales 11 × 1.5 mm, stiff, hairy. *Lamina* 30–45 cm long, very firm; pinnae 4–5 pairs, lowest pinnae a little narrowed towards their bases; apex of lamina pinnalike. *Largest pinnae* 16–20 cm long, 3.5–4.2 cm wide; apex acuminate with subentire cauda 2–3 cm long; edges lobed to 2–3 mm from costa; lobes equal and slightly falcate on the two sides of costae; costules 7 mm apart, at a wide angle to costa; veins 16–20 pairs, basal acroscopic vein touching side of sinus-membrane which is decurrent as a ridge on the lower surface almost to the costa, basal basiscopic vein arising from the costa; *lower surface* sparsely hairy on sinus-membranes and margins of lobes, sometimes a few hairs also on costules; *upper surface* with coarse dark brown hairs on costa. *Sori* near but not touching costules; indusia firm, dark, with a few short hairs; slender acicular hairs present on receptacle with sporangia; sporangia with either a seta or a gland; spores dark with rather well-spaced short spines.

Distr. *Malesia*: Eastern New Guinea.

Ecol. At 1300–2000 m, on steep banks of streams, sometimes among rocks, in forest.

11. Plesioneuron belense (COPEL.) HOLTTUM, Blumea 22 (1975) 239. — *Dryopteris belensis* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Lastrea belensis* COPEL. Gen. Fil. (1947) 138; Philip. J. Sci. 78 (1951) 433, pl. 21. — *Thelypteris belensis* (COPEL.) REED, Phytologia 17 (1968) 263. — Type: BRASS 11509, W. New Guinea, Bele River (MICH; L).

Caudex stout, suberect; *stipe* 40 cm long, dark-hairy in groove only, bearing small (not spine-like) scales almost throughout, basal scales 4 × 1.5 mm, not thick. *Lamina* 45 cm long; pinnae 12–15 pairs, not opposite; texture very firm. *Largest pinnae* 15 × 3 cm; base broadly cuneate to rounded, with one pair of lobes somewhat reduced; apex caudate-acuminate; edges lobed to 2 mm from costa, lobes on acroscopic side falcate near their tips only, those on basiscopic side distinctly falcate from their bases but not shorter; costules 5 mm apart; veins to 18 pairs, basal pair passing to sides of the sinus-membrane which is decurrent between them; *lower surface* of rachis and costae bearing scattered stiff brown hairs and also narrow scales with marginal setae, costules similar but scales very small; *upper surface* of costae brown-hairy near their bases only, rest of pinna glabrous. *Sori* near costules, exindusiate; some acicular hairs present on receptacle with the sporangia; sporangia not setiferous, no glands seen on them; spores dark, large, closely and minutely papillose.

Distr. *Malesia*: West New Guinea (Bele R.). Known only from the type and another specimen (BRASS 11327) from the same place.

Ecol. On limestone cliff in forest at 2200 m.

Note. COPELAND stated that small deciduous setulose indusia were present; my observation of the type is that the only hairs are on the receptacle, as in several other species of this genus.

12. Plesioneuron wariense (COPEL.) HOLTTUM, Blumea 22 (1975) 239. — *Dryopteris wariensis* COPEL. Philip. J. Sci. 6 (1911) Bot. 73. — *Lastrea wariensis* COPEL. Gen. Fil. (1947) 146. — *Thelypteris wariensis* (COPEL.) REED, Phytologia 17 (1968) 324. — Type: C. KING 101, *p.p.*, N.E. New Guinea, Waria River (MICH; NSW).

Caudex not seen, nor base of stipe. *Lamina* 60 cm long; pinnae 8 pairs; basal pinnae with stalks 4 mm long, basal 4 pairs of lobes gradually reduced, successive pinnae with shorter stalks and fewer reduced basal lobes; apex of frond pinnalike. *Largest pinnae* 18–30 cm long, to 3.5 cm wide; aerophores not swollen; apex acuminate; edges lobed to 0.5 mm from costa, lobes slightly falcate, about equal on the two sides of the costa; costules to 5 mm apart; veins 17–20 pairs, concolorous and very prominent on lower surface, less so on upper, both basal veins passing to margin above base of sinus, sinus-membrane very

short but distinct; *lower surface* of rachis distally bearing many thick light brown hairs, rest of rachis and costae with sparse short hairs, no scales seen; *upper surface* of costae covered with very short hairs and scattered hairs 1 mm long, rest glabrous. *Sori* medial, rather large, exindusiate; no hairs seen on receptacle; sporangia bearing yellow glands, often 2; spores not seen.

Distr. *Malesia*: Papua New Guinea. Known from two collections by C. KING (second is n. 430).

Notes. A specimen of KING 101 at Bogor is *P. tuberculatum*. The latter differs from *P. wariense* in having sori near costules and small caducous indusia. The sori of the type of *P. wariense* are not quite mature.

13. Plesioneuron royenii HOLTTUM, Blumea 22 (1975) 240. — Type: VAN ROYEN 5469, W. New Guinea, Waigeu Island (L).

Caudex short-creeping; *stipe* to 40 cm long, basal scales 6 × 1 mm, setose. *Lamina* 22–27 cm long; pinnae 6 pairs; basal pinnae with stalks 1.5–2 mm long, basal 2–3 pairs of lobes gradually reduced, basal acroscopic lobe free, entire, 5 mm long; apex of frond almost pinna-like but widened at its base with some transition to upper pinnae. *Largest pinnae* 9–10 cm long, sterile to 2.8 cm wide, fertile to 2.3 cm; base subtruncate; apex acuminate with cauda 10 mm long; edges lobed to 1.5 mm from costa; lobes on both sides of costa alike, oblique and slightly falcate; costules 3.5 mm apart (fertile) to 4.5 mm (sterile); veins 11–12 pairs, both basal veins passing to margin above base of sinus; *lower surface* of rachis and costae bearing abundant very short erect hairs, distally on costae also a few longer hairs, few minute hairs on costules, rest of surface glabrous and slightly pustular; *upper surface* short-hairy on costae only. *Sori* supramedial, exindusiate, without hairs on receptacle; sporangia with 1–3 short setae; spores not seen.

Distr. *Malesia*: West New Guinea (Waigeu I.), only known from the type.

Ecol. In forest at 3 m altitude.

14. Plesioneuron savaiense (BAK.) HOLTTUM, Blumea 22 (1975) 240. — *Nephrodium savaiense* BAK. Ann. Bot. 5 (1891) 318. — *Dryopteris savaiensis* (BAK.) C. CHR. Ind. Fil. (1905) 291; Bishop Mus. Bull. 177 (1943) 82. — *Thelypteris savaiensis* (BAK.) REED, Phytologia 17 (1968) 312. — Type: POWELL 183, Samoa (K).

Dryopteris quadriaurita CHRIST, Philip. J. Sci. 2 (1907) Bot. 209. — *Lastrea quadriaurita* (CHRIST) COPEL. Gen. Fil. (1947) 139; Fern Fl. Philip. (1960) 326. — *Thelypteris quadriaurita* (CHRIST) REED, Phytologia 17 (1968) 307. — Type: COPELAND 1714, Mindanao, San Ramon 850 m (US; B, P).

Dryopteris ensipinna BRAUSE, Bot. Jahrb. 56 (1920) 84. — *Thelypteris ensipinna* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 251. — Type: LEDERMANN 12773, N.E. New Guinea, Sepik Distr. 1400 m (B). — **Fig. 9g-i.**

Caudex short, creeping or suberect; *stipe* 20–50 cm long, ± short-hairy at least distally, basal scales to 12 × 1 mm, firm, densely covered with short hairs. *Lamina* 30–40 cm long; pinnae 12–15 pairs; basal pinnae sessile, basal 1–2 pairs of lobes ± reduced (more on basiscopic than on acroscopic side), basal acroscopic lobe free or nearly so, sometimes with a toothed margin. *Largest pinnae* 10–12 × 2.0–2.5 cm; apex acuminate, sometimes with a short cauda; edges lobed to 1 mm from costa or more deeply, lobes on acroscopic side of costa somewhat oblique, straight, those on basiscopic side slightly falcate; costules 3.5–5 mm apart; veins 10–12(–15) pairs, concolorous and slightly prominent, basal pair both ending above base of sinus; *lower surface* of rachis, costae and costules ± densely covered with short stiff hairs of varying length to 0.5 mm, some hairs also on veins and on surface between them; *upper surface* usually hairy on rachis and costae only. *Sori* medial; indusia variable but always small, with stiff marginal hairs, absent on some specimens from New Guinea and the Moluccas; sporangia bearing several rather long setae; spores dark, spinulose.

Distr. Samoa, New Hebrides, and *Malesia*: New Guinea, Philippines (Mindanao, Negros), Moluccas (Batjan, Amboina).

Ecol. In New Guinea at 850–1500 m, in primary or secondary forest.

Notes. One collection by NAKAIKE from 1500 m in New Guinea has the largest pinnae 4.5 × 1.0 cm and very narrow scales 10 mm long. A Philippine specimen has much less hairy scales than any from New Guinea.

15. Plesioneuron altum (BRAUSE) HOLTTUM, Blumea 22 (1975) 241. — *Dryopteris alta* BRAUSE, Bot. Jahrb. 56 (1920) 86. — *Lastrea alta* (BRAUSE) COPEL. Philip. J. Sci. 78 (1951) 429. — *Thelypteris alta* (BRAUSE) REED, Phytologia 17 (1968) 259. — Type: LEDERMANN 11497, N.E. New Guinea, Sepik Distr. 1300 m (B).

Caudex short-creeping, apical scales to 10 × 1.5 mm, rigid, bearing short hairs; *stipe* 70 cm long, glabrescent, scaly near base only. *Lamina* 70 cm long; pinnae 14 pairs; several pairs of lower pinnae with stalks 3–4 mm long, only distal ones sessile; basal acroscopic lobe of basal pinnae little reduced, basal basiscopic lobe 12 mm long, apex of frond not pinna-like. *Largest pinnae* 21 × 3.3 cm; aerophores dark and slightly swollen; apex caudate-acuminate, cauda to 2.5 cm; edges lobed to less than 1 mm from costa; lobes on acroscopic side of costa almost straight, those on basiscopic side rather strongly falcate but little shorter than acroscopic lobes; costules to 6.5 mm apart; veins

to 16 pairs, prominent both sides, basal ones not meeting the distinct short-hairy sinus-membrane; *lower surface* sparsely hairy on costae and costules, short hairs present on margins of lobes; *upper surface* of rachis and costae densely hairy, of costules sparsely, scattered short hairs present on surface between veins. *Sori* near costules; indusia very small, hairy; sporangia setiferous, with acicular hairs on their stalks; spores dark, finely spinulose.

Distr. *Malesia*: Papua New Guinea; only known from the type.

Note. BRAUSE stated that he saw no indusia, but I observed them on the type. In frond-form this is near *P. tuberculatum*, but the latter differs in less deeply lobed pinnae, more distinct (though caducous) indusia, and glandular sporangia.

16. Plesioneuron cystodioides HOLTTUM, *sp. nov.*

Pinnae usque 12 × 2.5 *cm, subsessiles, fere ad costam lobatae, lobis acroscopicis et basiscopicis aequaliter leviter falcatis, lobis infimis acroscopicis variabile elongatis; venae usque* 15-*jugatae; rachis costaeque subtus pilis* 0.1 *mm longis praedita; sori submarginales, indusia magna, marginem superantia; sporangia nec setifera nec glandulosa.* — Type: T. NAKAIKE 50, N.E. New Guinea, near Wau (K; TNS).

Caudex not known; *stipe* 45 cm long, glabrous except distally; basal scales to 9 × 1 mm, very thick at base, thinner distally and narrowly attenuate, sparsely hairy. *Lamina* to 62 cm long; pinnae 12–18 pairs, basal ones only subopposite; basal pinnae sessile or nearly so, basal basiscopic lobe a little reduced, basal acroscopic lobe elongate, lobed, with pinnate veins in the lobes, to 2.5 × 0.5 cm; basal acroscopic lobe of suprabasal pinnae sometimes ± elongate. *Largest pinnae* 12 × 2.5 cm; apex caudate-acuminate, cauda 2 cm long, 1 mm wide; edges lobed almost to costa; lobes about equal on the two sides of the costa, separated by rather wide sinuses, slightly falcate (basiscopic lobes little more so than acroscopic), edges cartilaginous and slightly sinuous; costules 4–5 mm apart; veins to 15 pairs, basal ones passing to margin above base of sinus, concolorous and prominent on both surfaces; *lower surface* of rachis bearing erect hairs 0.1 mm long with a few thicker brown ones, costal and costular hairs a little longer, sparse hairs present on veins and a few between veins; *upper surface* of rachis and costae covered with erect hairs 0.2 mm long, minute hairs also on costules. *Sori* almost at the ends of the veins; indusia large, firm, glabrous, overlapping margins of pinna-lobes; no glands seen on sporangia; spores minutely spinulose.

Distr. *Malesia*: Papua New Guinea, only known from the type.

Note. The form of the pinna-lobes, with their marginal sori, is very similar to that of pinna-lobes of *Cystodium sorbifolium*.

17. Plesioneuron subterminale HOLTTUM, Blumea 22 (1975) 241. — Type: BRASS 32049, N.E. New Guinea, Eastern Highlands, 1400 m (K).

Caudex suberect; scales to 10 × 1 mm, thick at base, narrowed and thinner distally, bearing short hairs; *stipe* to 70 cm long, glabrescent except in groove. *Lamina* to 80 cm long, very firm; pinnae to *c.* 25 pairs; basal pinnae of type with stalks 2–3 mm long, of other specimens subsessile, basal 1–2 pairs of lobes somewhat reduced; aerophores slightly elongate. *Largest pinnae* 20 × 3 cm; apex acuminate, sometimes caudate; edges lobed to 1–1.5 mm from costae, lobes on acroscopic side slightly falcate distally, those on basiscopic side falcate from their bases; costules to 5 mm apart; veins to 20 on basiscopic side of costules, to 18 on acroscopic side, prominent both sides, basal acroscopic veins usually ending near sinus-membrane; *lower surface* of rachis densely covered with erect hairs 0.3 mm or more long, a variable number being rather thick and brown, costal hairs as rachis but antrorse distally, costular hairs more sparse, sparse and variable on and between veins; *upper surface* hairy about as lower, in some cases more and longer brown hairs present on rachis. *Sori* supramedial but not marginal; indusia firm, with many short hairs; acicular hairs rare on receptacle; sporangia sometimes with a small gland; spores dark, minutely spinulose.

Distr. *Malesia*: Papua New Guinea (Eastern Highlands and near Wau), in forest at 1200–2200 m.

18. Plesioneuron bipinnatum (COPEL.) HOLTTUM, Blumea 22 (1975) 242. — *Dryopteris bipinnata* COPEL. Philip. J. Sci. 9 (1911) Bot. 2. — *Lastrea bipinnata* COPEL. Philip. J. Sci. 78 (1951) 422. — *Thelypteris bipinnata* (COPEL.) REED, Phytologia 17 (1968) 264. — Type: C. KING 407, E. New Guinea, Loane (MICH).

Caudex not known; *stipe* 32 cm long, closely and minutely hairy; basal scales 5 mm long, narrow, hairy. *Lamina* 28 cm long, texture rather thin; pinnae 10–11 pairs. *Basal pinnae* largest, with stalk 1 mm long; basal pair of lobes free, short-stalked, 3–4 mm long, next pair of lobes almost free and longer, rest of pinna lobed almost to costa; apex acuminate with sinuous cauda 1.5 cm long; lobes slightly falcate, about equal on the two sides of the costa; costules to 3 mm apart; veins to 11 pairs, concolorous and prominent both sides, basal veins both passing to margin above base of sinus except near apex of pinnae; *lower surface* of rachis and costae bearing very short and scattered longer erect hairs, hairs on costules similar, few on veins; hairs on *upper surface* of costae as lower but antrorse. *Sori* supramedial, impressed (prominent on the upper surface); indusia small with many short hairs; no glands or setae seen on sporangia.

Distr. *Malesia*: Papua New Guinea. Known

only from the type and KING 221, from the extreme east of New Guinea, opposite Samarai island.

Note. These lowland coastal plants may represent the same species as the larger ones from mountains described here as *P. subterminale.*

19. Plesioneuron quadriquetrum (v.A.v.R.) HOLTTUM, Blumea 22 (1975) 242. — *Dryopteris quadriquetra* v.A.v.R. Nova Guinea 14 (1924) 16. — *Thelypteris quadriquetra* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 254. — Type: LAM 542, W. New Guinea, Mamberamo River, 10 m (L).

Caudex suberect; *stipe* 20–40 cm long, glabrous except for hairs in the groove, basal scales 6 mm long, narrow, hairy. *Fronds* subdimorphous, sterile to 25 cm long with 7–8 pairs of pinnae, fertile with 10 pairs; basal pinnae with 2–3 pairs of basal lobes reduced; apex of frond not pinna-like. *Sterile pinnae* to 10 × 2.0 cm; apex acuminate with cauda 1.5 cm long; edges lobed to 1 mm from costa; lobes slightly oblique, hardly falcate, about equal on the two sides of the costa; costules 4 mm apart; veins 10–12 pairs, basal veins usually both passing to margin above base of sinus; *lower surface* of costa bearing rather sparse erect hairs nearly 1 mm long and more abundant shorter ones, short hairs also on costules; *upper surface* of costae hairy as lower. *Fertile pinnae* to 8 × 1.2 cm; costules 3–3.5 mm apart; lobes well separated; sori supramedial; indusia firm, persistent, with short brown hairs; sporangia sometimes bearing a small colourless gland; spores with a translucent wing and cross-wings.

Distr. *Malesia*: West New Guinea; only known from the type.

Ecol. LAM's label records the type as growing epiphytically; confirmation of this unusual habitat is desirable.

Note. The spores resemble those of *P. archboldiae* (COPEL.) HOLTTUM from Fiji and *P. phanerophlebium* (BAK.) HOLTTUM from the Solomon Islands.

20. Plesioneuron falcatipinnulum (COPEL.) HOLTTUM, Blumea 22 (1975) 244. — *Dryopteris falcatipinnula* COPEL. Philip. J. Sci. 6 (1911) Bot. 74. — *Lastrea falcatipinnula* (COPEL.) COPEL. Gen. Fil. (1947) 138; Philip. J. Sci. 78 (1951) 433. — *Thelypteris falcatipinnula* (COPEL.) REED, Phytologia 17 (1968) 276. — Type: C. KING 114, Eastern New Guinea, in lowlands (MICH; BO).

Caudex not known; *stipe* 30 cm long, glabrous; basal scales 4 mm long, very narrow, rather thin. *Lamina* 30 cm long, very firm; pinnae 8 pairs, opposite, well-spaced, apical pair much reduced and unequal. *Largest pinnae* 12 × 1.5 cm; aerophores swollen but not elongate; basal 1–2 pairs of lobes reduced (except on distal pinnae); apex acuminate with a cauda 10–15 mm long; edges lobed to less than 0.5 mm from costa; lobes on both sides of costa oblique and much falcate; costules 3.5 mm apart; veins to 12 pairs, slender, concolorous, prominent, both basal veins passing to margin above base of sinus; *lower surface* of rachis and costae bearing copious short stiff pale hairs, similar hairs more sparse on costules; *upper surface* of pinnae hairy only on costae. *Sori* inframedial; indusia firm, short-hairy; sporangia bearing orange glands; spores not seen.

Distr. *Malesia*: Papua New Guinea, only known from the type.

21. Plesioneuron kostermansii HOLTTUM, *sp. nov.*

Stipes 45–50 cm longus, omnino pilis erectis usque 1 mm longis vestitus; lamina c. 50 cm longa; pinnae 25-jugatae, usque 12 × 1.8 cm, lobis utrinque falcatis; venae 10-jugatae; rachis costaeque subtus pilis erectis variis usque 1 mm longis dense vestitae, venae subtus paginaque inter venas pilis multis tenuibus erectis praeditae; pagina superior pinnarum pilis adpressis 0.3 mm longis vestita; sori mediales, indusia parva, setosa; sporangia non setifera. — Type: KOSTERMANS & SOEGENG 142, W. New Guinea, above Jayapura (L; BO).

Caudex short, erect, massive; *stipe* 45–50 cm long, covered with slender spreading hairs to 1 mm long, basal scales *c.* 7 × 0.5 mm, firm, glossy, not thick. *Lamina c.* 50 cm long, rigid; pinnae *c.* 25 pairs; basal pair of lobes of basal pinnae reduced and free. *Largest pinnae* 12 × 1.8 cm, sessile; aerophores not elongate; apex acuminate; edges lobed to 1.5 mm from costa, lobes equally falcate on the two sides of the costa; costules 3 mm apart; veins 10 pairs, basal pair both passing to margin above base of sinus; *lower surface* of rachis and costae densely covered with erect pale hairs of varying length, to 1 mm long, veins and surface between them bearing erect slender hairs 0.5 mm long; *upper surface* of costa bearing pale hairs 1 mm long, whole surface of pinna covered with appressed hairs 0.3 mm long. *Sori* medial or a little inframedial; indusia rather small, firm, dark, with stiff hairs 0.2 mm long; sporangia not setose, no glands seen on them.

Distr. *Malesia*: West New Guinea, only known from the type.

Ecol. At 300 m, "on slope of limestone hill, very wet".

22. Plesioneuron angiensis HOLTTUM, *sp. nov.*

Stipes 45 cm longus; lamina 55 cm longa; pinnae 24-jugatae, usque 12 × 2.1 cm, sessiles; venae 12–13-jugatae; rachis costaeque subtus pilis 0.3 mm longis erectis vestitae; pagina superior inter venas pilis brevibus erectis praedita; sori inframediales; indusia margine pilis brevibus fimbriata; sporangia nec setis nec glandulis praedita. — Type: KANEHIRA & HATUSIMA 13741, W. New Guinea, Arfak Mts, 1900 m (BO).

Caudex "60 cm high, 1.5 cm diameter" (collec-

tors' label); *stipe* 45 cm long, glabrous apart from brown hairs in the groove, basal scales not seen. *Lamina* 55 cm long, thin but firm; pinnae 24 pairs; lowest pinnae not well preserved; apex of frond pinna-like but larger than pinnae. *Largest pinnae* 12 × 2.1 cm, sessile; aerophores dark and slightly swollen; base of pinna truncate; apex short-acuminate; edges lobed to 1 mm from costa or more deeply; lobes falcate, about equally so on each side of costa, basal lobes not or little reduced; costules 4–4.5 mm apart, almost at right angles to costa; veins 12–13 pairs, slender and prominent both sides, basal acroscopic vein sometimes touching side of the short sinus-membrane; *lower surface* of costae densely covered with erect brown hairs 0.3 mm long with scattered longer ones, costal and costular hairs similar but less dense and mostly pale, no other hairs; *upper surface* of costae hairy as lower, rest of upper surface bearing scattered very short suberect hairs. *Sori* a little inframedial; a few acicular hairs present on receptacle; indusia rather small, dark, firm, fringed with stiff hairs 0.2 mm long; sporangia not setiferous, no glands seen on them; spores not seen.

Distr. *Malesia*: West New Guinea (Arfak Mts), only known from type.

Ecol. "Terrestrial in the poorly drained forest" near the "male" lake, 1900 m alt.

23. Plesioneuron sandsii HOLTTUM, *sp. nov.*

Stipes 45 cm longus, basi paleis 5 × 1 mm praeditus; lamina 50 cm longa; pinnae 25-jugatae, inferiores 2-jugatae redactae; pinnae maximae 13.5 × 2.0 cm, lobis inferioribus 10–12-jugatis singulatim ad costam adnatis; rachis costaeque subtus pilis brunneis erectis vestitae, costae etiam paleis angustis praeditae; sori inframediales; indusia firma, glabra; sporangia glandulis minutis praedita. — Type: M. J. S. SANDS 2380 A, New Ireland, 2150 m (K).

Caudex short-creeping with stipes tufted at its apex; *stipe* 45 cm long, covered throughout with stiff erect hairs 0.2–0.3 mm long, basal scales *c.* 5 × 1 mm, thick at base only, short-hairy, scales above base of stipe thin and translucent. *Lamina* 50 cm long, very firm; pinnae 25 pairs, basal 2–3 pairs irregularly reduced, lowest on one frond 3 × 1.2 cm, on another 7–8 cm long, basal acroscopic lobes of lower pinnae 7 mm long, basiscopic 3 mm; apex of frond not pinna-like. *Largest pinnae* 13.5 × 2.0 cm; apex acuminate, sometimes with cauda 2 cm long; edges lobed almost to costa in distal part of pinna, basal 10–12 pairs of lobes separately adnate to costa; lobes on acroscopic side almost all straight, to 12 mm long, on basiscopic side strongly falcate, to 10 mm long; costules to 5 mm apart; veins to 10 pairs, concolorous and prominent on upper surface, pale and less prominent on lower; *lower surface* of rachis densely covered with brown erect hairs 0.3 mm long, costae with shorter and less dense hairs, very small brown scales also present on costae and costules, rest of surface glabrous; *upper surface* of costae covered with short brown hairs, rest glabrous. *Sori* inframedial; indusia dark, firm, glabrous; sporangia bearing very small elongate glands (much shrivelled); spores black, closely and minutely spinulose.

Distr. *Malesia*: Papua New Guinea (New Ireland), only known from the type.

24. Plesioneuron tuberculatum (CESATI) HOLTTUM, Blumea 22 (1975) 246. — *Nephrodium tuberculatum* CESATI, Rendic. R. Acad. Napoli 16, fasc. 2 (1877) 26, 29. — *Dryopteris tuberculata* (CESATI) C. CHR. Ind. Fil. (1905) 299; Dansk Bot. Ark. 9, 3 (1937) 48, pl. V, f. 6. — *Thelypteris tuberculata* (CESATI) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 255. — Type: BECCARI, W. New Guinea, Arfak Mts (FI; K).

Dryopteris schlechteri BRAUSE, Bot. Jahrb. 49 (1912) 16, f. 1E, *incl. var. djammuense.* — Type: SCHLECHTER 16188, N.E. New Guinea, near Ketel, 200 m (B; K, L).

Dryopteris schizophylla v.A.v.R. Nova Guinea 14 (1924) 19. — Type: LAM 772, W. New Guinea (BO; L). — **Fig. 9d–f.**

Caudex massive, erect; *stipe* to at least 75 cm long, glabrescent, basal scales to at least 7 mm long, narrow, thick. *Lamina* to 100 cm long; pinnae 20 pairs, all stalked except distal ones; basal pinnae with stalks 3–5 mm long, basal basiscopic lobe much reduced, acroscopic lobe not. *Largest pinnae* 25 × 5 cm; aerophores ± elongate; apex caudate-acuminate, cauda 2.5–5 cm long; edges lobed to 1–1.5 mm from costa; lobes on acroscopic side almost straight, on basiscopic side somewhat falcate and sometimes shorter; costules 5–7 mm apart, a small swelling at the base of each, at least near bases of pinnae; veins to 23 pairs, slender, concolorous, prominent both sides, basal acroscopic vein usually passing to side of sinus-membrane; *lower surface* of rachis glabrous, of costae and costules bearing sparse brown hairs (often persistent only on costules and appressed), surface between veins often strongly pustular; *upper surface* bearing short dark hairs on groove of rachis and on costae only. *Sori* near costules; indusia small, glabrous, soon caducous; sporangia bearing small red glands on body and a short acicular hair on stalk; spores dark, minutely spinulose.

Distr. *Malesia*: New Guinea and Moluccas (Batjan: ALSTON 16977).

Ecol. In forest, low country to 1200 m in New Guinea, at 2000 m in Batjan.

Note. The Batjan specimen differs in more deeply lobed pinnae, basal acroscopic lobe of basal pinnae free, sori not so near costules, with many acicular hairs on the receptacle.

25. Plesioneuron attenuatum (BRACK.) HOLT-

TUM, Blumea 22 (1975) 245; Allertonia 1 (1977) 191, f. 4, k-m, *q.v.* for synonymy in the Pacific. — *Lastrea attenuata* BRACK. in Wilkes, U.S. Expl. Exp. 16 (1854) 193, t. 26, f. 2. — *Aspidium brackenridgei* METT. Ann. Sci. Nat. Bot. IV, 15 (1861) 75, *nom. nov.* (not *A. attenuatum* SW.). — *Thelypteris brackenridgei* (METT.) REED, Phytologia 17 (1968) 265. — Type: U.S. Expl. Exped. Tahiti (US).

Caudex erect or suberect; *stipe* to 80 cm long, glabrous, basal scales to 20 mm long, very narrow, rather thick and not glossy, with few hairs. *Lamina* to 120 cm long, very firm; pinnae 24 pairs or more, lower ones with stalks 2–3 mm long, all with basiscopic lobes strongly falcate and shorter than the almost straight acroscopic ones; basal acroscopic lobe on basal pinnae ± reduced and separately adnate to costa; aerophores elongate, slender. *Largest pinnae* 25 × 3.2 cm; apex gradually attenuate; edges lobed to 1 mm from costa or more deeply; acroscopic lobes to 2.2 cm long, narrowed to an acute tip, lobes on basiscopic side to 1.6 cm long; costules 4–5 mm apart; veins on acroscopic lobes to 22 pairs, slender and prominent both sides, basal acroscopic vein touching side of sinus-membrane which is pellucid and decurrent almost to the costa; *lower surface* of rachis sparsely short-hairy, glabrescent, of costae ± densely hairy at base, sparsely distally, with hairs 0.3–0.5 mm long, narrow scales sometimes also present; *upper surface* hairy in groove of rachis and on costae, hairs pale, 0.5 mm long. *Sori* near costules; acicular hairs present with sporangia on receptacle; indusia firm, persistent, glabrous or variably short-hairy; sporangia bearing 2–3 small red glands; spores dark, minutely verrucose.

Distr. Pacific, from Tahiti westwards to *East Malesia*: New Guinea (New Ireland, New Britain).

Ecol. In New Ireland and New Britain, in forest at 1100–1300 m, at lower altitudes in the Solomon Islands.

26. Plesioneuron platylobum HOLTTUM, Blumea 22 (1975) 246. — Type: JERMY 3610, N.E. New Guinea, Morobe Distr. (BM).

P. ctenolobum HOLTTUM, *ibid.* 247. — Type: JERMY 3604, same locality (BM).

Caudex creeping, 1 cm diameter, bearing fronds to 2 cm apart; *stipe* 40–50 cm long, basal scales to 6 × 1.5 mm, thick, hairy. *Lamina* 60–80 cm long, very firm; pinnae 20–30 pairs; basal pinnae with stalks 1 mm or less, their basal acroscopic lobes free, 2 cm long, 7–15 mm wide, with edges variably crenate or lobed and veins forked in the lobes, basal basiscopic lobes ± reduced, sometimes free but not wider than the next lobes. *Largest pinnae* 18–21 × 3.5–4.0 cm; basal lobes slightly reduced or not; apex acuminate and ± caudate; edges lobed to 1 mm from costa or more deeply; lobes on acroscopic side almost straight, on basiscopic side falcate but not shorter than acroscopic lobes; costules 4–6 mm apart; veins 18–22 pairs, basal acroscopic vein sometimes touching sinus-membrane; *lower surface* of rachis and costae variably short-hairy, few other hairs present; *upper surface* hairy on rachis and costae, some short hairs present on and between veins distally on lobes. *Sori* medial; indusia firm, large, with few to many short hairs; no acicular hairs on receptacle; sporangia bearing glands or setae; spores dark, minutely spinulose.

Distr. *Malesia*: Papua New Guinea, only known from the types.

Ecol. In *Castanopsis* forest at 1050 m.

27. Plesioneuron crassum (COPEL.) HOLTTUM, Blumea 22 (1975) 243. — *Dryopteris crassa* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Lastrea crassa* COPEL. Gen. Fil. (1947) 138; Philip. J. Sci. 78 (1951) 435, pl. 23. — *Thelypteris crassa* (COPEL.) REED, Phytologia 17 (1968) 269. — Type: BRASS 10878, W. New Guinea, Lake Habbema, 2650 m (MICH; L).

Caudex creeping, 1 cm diameter; *stipe* 60 cm long, glabrous above base, basal scales to 5 × 1.5 mm, thin except at base. *Lamina* to 28 cm long, texture rigid; pinnae 9 pairs, 2 basal pairs opposite, 1 pair basal lobes somewhat reduced on basal pinnae only. *Largest pinnae* 11 × 2 cm; aerophores elongate to 1 mm; apex acuminate with short cauda; edges lobed to 0.5 mm from costa; lobes on acroscopic side hardly falcate, on basiscopic side distinctly but not strongly so, margins (reflexed on drying) with a wide cartilaginous band; costules 4–4.5 mm apart; veins thick, 12 pairs, both basal veins passing to margin above base of sinus; *lower surface* wholly glabrous except for a few dark hairs on margins of lobes; *upper surface* of rachis and costae bearing stiff dark hairs. *Sori* near costules; indusia small, dark, thick, glabrous; sporangia not setiferous, no glands seen on them; spores of type not seen.

Distr. *Malesia*: West New Guinea. Known with certainty from 2 collections from the type locality (the second is BRASS 10934, from 2800 m); a specimen collected by C. B. KLOSS on the Carstensz Mts at 2135 m may also represent this species.

28. Plesioneuron stenura HOLTTUM, *sp. nov.*

P. crasso affinis, differt: pinnis 18-jugatis, usque 23 × 3 cm metientibus, lobis omnibus acutis, lobis basiscopicis valde falcatis, lobo infimo acroscopico pinnarum mediarum usque 2.5 cm elongato, lobis inferioribus utroque latere pinnarum superiorum redactis; sporangiis glanduliferis, receptaculo sori pilis acicularibus multis praedito. — Type: L. E. CHEESMAN 152, S.E. New Guinea, Mafulu, 1220 m (K).

Caudex not known; *stipe* glabrous, incomplete, probably 40 cm long, basal scales not seen.

Lamina c. 70 cm long; pinnae 18 pairs, very firm; apex of frond widened at base and grading to upper pinnae; basal pinnae almost sessile with basal acroscopic lobe elongate and basiscopic lobe a little reduced, both lobes reduced on upper pinnae; aerophores slender, 1 mm long. *Suprabasal pinnae* to 23 cm long, 3 cm wide above the base, basal acroscopic lobe elongate (maximum 2.5 cm) and parallel to rachis, basal basiscopic lobe strongly falcate, 1.2 cm long; apex acuminate with narrow cauda 4–5 cm long; edges lobed to 1.5 mm from costa; acroscopic lobes straight, to 1.8 cm long, basiscopic lobes all strongly falcate and shorter; costules 4.5–5 mm apart; veins to 23 pairs on acroscopic lobes, slender, concolorous and slightly prominent both sides, basal acroscopic vein ending beside or near the sinus-membrane; *lower surface* quite glabrous; *upper surface* of rachis almost glabrous, of costae copiously hairy on edges of groove, hairs 0.2 mm long. *Sori* close to costules; abundant acicular hairs present on receptacle with sporangia; indusia firm, dark, glabrous; sporangia bearing several red-orange glands.

Distr. *Malesia*: Papua New Guinea. Known only from the type collection and a small sterile frond from the same locality.

Note. This species is also close to *P. attenuatum* but has sessile basal pinnae and quite glabrous lower surface; scales are needed for a good comparison, those of *P. attenuatum* being very distinctive.

29. Plesioneuron ophiura (COPEL.) HOLTTUM, Blumea 22 (1975) 248. — *Dryopteris ophiura* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Lastrea ophiura* COPEL. Gen. Fil. (1947) 139; Philip. J. Sci. 78 (1951) 434, pl. 22. — *Thelypteris ophiura* (COPEL.) REED, Phytologia 17 (1968) 298. — Type: BRASS 12471, W. New Guinea, Idenburg River, 2050 m, on open rock-slide (MICH; BO, L).

Description of the type: *Caudex* erect, apical scales 5 × 1.5 mm, acute, rigid, copiously short-hairy; *stipe* 16 cm long, minutely hairy. *Lamina* 20 cm long, very firm; pinnae 7–9 pairs; basal pinnae with stalks 2 mm long, basal lobes 1–2 mm long; basal lobes of all other pinnae reduced; apex of frond not pinna-like. *Largest pinna* 8 × 1.4 cm; aerophores slightly swollen; apex acuminate with a cauda 1.5–2.0 cm long; edges lobed to less than 1 mm from costa; lobes slightly falcate on both sides of the costa; costules 3.5–4 mm apart; veins to 10 pairs, immersed (slightly prominent on the lower surface), basal ones both passing to margin above base of sinus; *lower surface* of rachis bearing copious short pale stiff hairs, similar hairs less copious on costae, also narrow scales, sparse hairs on costules and veins; *upper surface* glabrous apart from costa. *Sori* near costules; indusia thick, dark, glabrous; sporangia not setiferous, no glands seen on them; spores dark, minutely papillose.

Distr. *Malesia*: West New Guinea, at 2050 m.

Notes. BRASS 12465, from the same locality as the type but "in young forest at foot of rock-slide, a clump of fern with fronds to 180 cm long" (specimen at L) was named *Lastrea costulisora* by COPELAND, and so accepted by me in 1975, but agrees with the type of *P. ophiura* in deeply lobed pinnae, and probably represents the fully developed form of the same species; its description follows. *Stipe* 100 cm long; basal scales 10 × 1.5 mm. *Lamina* 100 cm long; pinnae 22 pairs, lower ones 7 cm apart; basal pinnae with stalks 3 mm long and 3–4 pairs of basal lobes gradually reduced and separately adnate to costa; all upper pinnae with much-reduced basal lobes; aerophores black, firm, more than 0.5 mm long. *Largest pinnae* 24 × 2.5–3.0 cm, at base lobed almost to costa, distally to 1 mm from costa, apex with cauda 3 cm long; lobes on acroscopic side of pinna straight, on basiscopic side somewhat falcate; costules 6 mm apart; veins to 20 pairs; sporangia sometimes with a small shrivelled gland, rarely a short seta. If this is included in *P. costulisorum*, I think that the type of *P. ophiura* should also be so included.

30. Plesioneuron costulisorum (COPEL.) HOLTTUM, Blumea 22 (1975) 246. — *Dryopteris basisora* COPEL. Philip. J. Sci. 6 (1911) Bot. 73, *non* CHRIST 1909. — *Lastrea costulisora* COPEL. Gen. Fil. (1947) 138, *nom. nov.* — *Thelypteris costulisora* (COPEL.) REED, Phytologia 17 (1968) 269. — Type: C. KING 304, E. New Guinea (MICH, BO, BRI, NSW).

Caudex lacking on type; stipe incomplete, glabrescent. *Lamina* 60 cm or more long; pinnae 15–20 pairs; basal pinnae with stalks to 2 mm long, basal 2 pairs of lobes gradually reduced; aerophores not elongate. *Largest pinnae* 22 × 3 cm; apex acuminate; edges lobed to 1–1.5 mm from costa; lobes on acroscopic side of costa straight, on basiscopic side somewhat falcate; costules 5 mm apart; veins commonly 18–20 pairs, basal acroscopic vein ending beside or near sinus-membrane; *lower surface* of rachis and costae bearing coarse erect brown hairs, hairs on costules similar but shorter, very short hairs present on and between veins, a few narrow fringed scales present on costae; *upper surface* of costae densely brown-hairy throughout, rest of surface glabrous. *Sori* near costules; indusia dark, firm, with a few short hairs; acicular hairs present on receptacle of sorus with the sporangia; sporangia bearing an orange gland; spores of type not seen.

Distr. *Malesia*: Eastern New Guinea, in forest, at altitudes to 1000 m.

Note. Other specimens which agree in frond-form and sori have differences in pubescence. PULLEN 8417 from 250 m in Milne Bay District differs in sparse shorter hairs on the lower surface

of rachis and costae and lacks hairs between veins. CROFT & LELEAN 68533, from a low altitude near the coast 93 km S.E. of Lae, has slender pale hairs 1 mm long on the lower surface of costules and many short hairs between veins. See also note above on *P. ophiura*.

31. Plesioneuron doctersii HOLTTUM, Blumea 22 (1975) 246. — Type: DOCTERS VAN LEEUWEN 10357, W. New Guinea, Rouffaer River, 300 m (BO; L).

Caudex short-creeping, 1.5 cm diameter; *stipe* 25–40 cm long, glabrescent, basal scales rather thin, apparently *c.* 3 × 1 mm. *Lamina* 40–50 cm long, thick and rigid when dry; pinnae 15–18 pairs; basal pinnae with stalks 3 mm long, only 1 pair of basal lobes reduced; successive pinnae with shorter stalks, only distal ones sessile; apex of frond not pinna-like. *Largest pinnae* 9–11 cm long, 2.2–2.6 cm wide; apex short-acuminate; edges lobed to 1.5–2.5 mm from costa; lobes separated by narrow sinuses, basiscopic lobes more falcate and shorter than acroscopic lobes; costules 4.5–5 mm apart; veins to 15 pairs, little prominent on either side, basal pair both passing to sides of the sinus-membrane; *lower surface* of rachis bearing rather dense stiff erect hairs 0.1–0.2 mm long, sparse longer hairs present on costae, costules, sinus-membranes and margins; *upper surface* of costae covered with thick antrorse hairs 0.2–0.3 mm long, minute hairs on costules. *Sori* near costules; indusia dark, thick, with a few hairs; sporangia sometimes bearing a small gland or a seta; spores not seen.

Distr. *Malesia*: W. New Guinea, type locality and Japen Island (L. E. CHEESMAN 1430).

Note. Specimens from Japen Island have some setiferous sporangia, those from type locality only glands.

32. Plesioneuron rigidilobum HOLTTUM, Blumea 22 (1975) 248. — Type: T. G. WALKER 7741, N.E. New Guinea, Edie Creek above Wau, on gold-mining rubble (BM).

Caudex suberect; *stipe* to 75 cm long, basal scales 5–6 mm long, narrow, thick. *Lamina* to 60 cm long, thick and rigid; pinnae 18 pairs; basal pinnae with stalks 2 mm long and free basal acroscopic lobes 8 mm long, basal basiscopic lobes shorter, several pairs of successive pinnae also stalked; basal lobes of middle and upper pinnae not reduced; apex of frond almost pinna-like. *Largest pinnae* of type 14 × 2.5 cm; apex acuminate, not or little caudate; edges lobed to 1 mm from costa or more deeply; lobes on acroscopic side straight and nearly at right angles to costa, on basiscopic side slightly falcate and a little shorter; costules 4.5–5 mm apart; veins to 15 pairs, basal veins both passing to margin above base of sinus; *lower surface* of rachis and costae bearing short pale hairs and thicker brown ones to 0.5 mm long, hairs on costules fewer, not brown, somewhat antrorse, a few very short hairs present on veins and on surface between them; *upper surface* of rachis and costae bearing many short hairs. *Sori* medial or somewhat inframedial, not touching costules; indusia large, firm, short-hairy; sporangia bearing small glands and rarely a seta; spores dark, minutely spinulose.

Distr. *Malesia*: Eastern New Guinea at 2000–2500 m.

Note. It is possible that this is connected by intermediates with *P. ophiura and P. costulisorum*.

33. Plesioneuron wantotense (COPEL.) HOLTTUM, Blumea 22 (1975) 245. — *Dryopteris wantotensis* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Lastrea wantotensis* COPEL. Gen. Fil. (1947) 140; Philip. J. Sci. 78 (1951) 436, pl. 24. — *Thelypteris wantotensis* (COPEL.) REED, Phytologia 17 (1968) 324. — Type: CLEMENS 11013 bis, N.E. New Guinea, Morobe Distr. 1200 m (MICH).

Caudex short, erect; *stipe* to 28 cm long, glabrous above base, basal scales small, acuminate, hairy. *Lamina* to at least 20 cm long; pinnae 10 pairs; basal pinnae sessile with 2 pairs of basal basiscopic lobes reduced, basal one very small; apex of frond pinna-like but broader than pinnae. *Largest complete pinna* 5.5 × 1.2 cm (one incomplete pinna 1.7 cm wide); apex acuminate with cauda 10 mm long; edges lobed to 1.5 mm from costa; lobes on acroscopic side almost straight, on basiscopic side shorter and falcate; costules 3–4 mm apart; veins 10–12 pairs, basal acroscopic one ending beside sinus-membrane; *lower surface* of rachis, costae, costules, sinus-membrane and margins of lobes bearing short stiff erect hairs; *upper surface* of rachis and costae short-hairy, rest glabrous. *Sori* near costules; indusia thick, dark, glabrous; sporangia bearing 2–3 red glands; spores not seen.

Distr. *Malesia*: Papua New Guinea, only known from the type.

Note. Apart from size, the type differs from *P. attenuatum* (which is similar in frond-form) in its much shorter basal stipe-scales.

34. Plesioneuron kundipense HOLTTUM, Blumea 22 (1975) 247. — Type: MILLAR & HOLTTUM NGF 18593, N.E. New Guinea, Western Highlands, 2150 m (LAE; BRI, K).

Caudex short, thick, creeping; *stipe* to 26 cm long, minutely hairy; basal scales thick at base, thin distally, to 5 × 1.5 mm. *Lamina* of type 29 cm long; pinnae 14 pairs; basal pinnae with stalks not over 1 mm long, aerophores slightly elongate, 1 pair basal lobes slightly reduced; apex of frond not pinna-like. *Largest pinnae* 8.5 × 2.0 cm; apex acuminate with short cauda; edges lobed to 1 mm from costa; lobes slightly falcate on both sides of costa; costules 3.5–4 mm apart; veins to 12 pairs,

prominent both sides, basal acroscopic one ending near sinus-membrane; *lower surface* of rachis and costae rather densely covered with stiff erect hairs 0.3–0.4 mm long, fewer hairs on costules, a few on veins, rarely between veins; *upper surface* of rachis and costae hairy as lower surface, scattered shorter hairs present on surface between veins. *Sori* medial or a little inframedial; indusia firm, dark, with a variable number of very short hairs; some sporangia bearing a short seta, glands not seen; short acicular hairs present on receptacle or on stalks of sporangia; spores not seen.

Distr. *Malesia*: Papua New Guinea (Western Highlands, 2150 m). Known only from the type.

35. Plesioneuron dryas HOLTTUM, Blumea 22 (1975) 247. — Type: BRASS 23447, Eastern New Guinea, Milne Bay Distr., Mt Dayman, in oak forest 800 m (BM; L, LAE).

Caudex short, horizontal (*teste* BRASS); *stipe* to 60 cm long, glabrescent, basal scales *c.* 10 × 1 mm, rigid, covered with short hairs, scales above base thinner. *Lamina* 50 cm long; pinnae 12 pairs, several lower pairs opposite; basal pinnae with stalks to 1 mm long, basal acroscopic lobe free and only slightly reduced, 3–4 pairs of basiscopic lobes gradually reduced; basal lobes not reduced on upper pinnae; apex of frond widened at base with transition to pinnae. *Largest pinnae* 12 × 2 cm on type (14 × 2.5 cm on BRASS 28451); aerophores slightly elongate; apex short-acuminate with entire cauda 10–15 mm long; edges lobed to 1–1.5 mm from costa; lobes slightly falcate, those on basiscopic side somewhat more oblique than those on acroscopic side; costules 3.5–4.5 mm apart; veins 10–12 pairs, slender and prominent both sides, basal acroscopic veins usually passing to margin just above base of sinus; *lower surface* of rachis and costae rather densely covered with short erect hairs, sometimes with scattered longer brown ones, sparse hairs on costules and veins and between veins; *upper surface* of costae densely short-hairy, sparse hairs on costules. *Sori* a little inframedial; indusia dark, firm, with a few short hairs; sporangia bearing red glands, sometimes several; spores not seen.

Distr. *Malesia*: Eastern New Guinea (2 collections) and Rossel Island.

36. Plesioneuron croftii HOLTTUM, *sp. nov.*

Stipes usque 36 cm longus, basi paleis brevibus vestitus; lamina 23 cm longa; pinnae 5-jugatae, subopppositae; pinnae infimae sessiles, aerophoris tenuibus pallidis 1 mm longis praeditae, lobis infimis vix redactis; pinnae maximae 12.5 × 2.5 *cm, lobis vix falcatis utroque latere fere aequalibus; venae 12–14-jugatae; sori prope costulas siti; indusia pilis 0.3 mm longis vestita; sporangia glandulis pallidis praedita.* — Type: J. R. CROFT 413, E. New Guinea, Natter Bay, 93 km S.E. of Lae, 50 m alt. (K; NSW).

Caudex short-creeping; *stipe* to 36 cm long, pale, sparsely short-hairy, basal scales not well preserved, short and relatively broad at base, thinner above base. *Lamina* 23 cm long; pinnae 5 pairs, subopposite; aerophores pale, slender, hairy, to 1 mm long; apex of frond pinna-like, 11 cm long; basal lobes of basal pinnae hardly reduced, acroscopic lobe not elongate; basal basiscopic lobes of distal pinnae reduced. *Largest pinnae* 12.5 × 2.5 cm (on another frond 10.5 × 1.5 cm); apex acuminate with cauda to 15 mm long; edges lobed to 1–1.5 mm from costa, lobes almost equal on the two sides of the costa, somewhat oblique, slightly falcate; costules 3–3.5 mm apart; veins 12–14 pairs, slightly prominent both sides, basal ones usually both passing to margin above base of sinus; *lower surface* of rachis bearing stiff erect hairs 0.2–0.5 mm long, similar hairs on costae to 0.8 mm, fewer hairs on costules, slender erect hairs on surface between veins; *upper surface* of rachis and costae hairy as lower surface but hairs thicker, no other hairs. *Sori* near costules; no acicular hairs on receptacle; indusia medium brown, firm, not very thick, with many hairs 0.3 mm long; sporangia not setiferous, sometimes bearing small inconspicuous pale glands; spores dark, minutely spinulose.

Distr. *Malesia*: Papua New Guinea; only known from the type.

Note. The type was growing near larger plants which are mentioned above under *P. costulisorum*. It seems probable that *P. croftii* produces only small plants; more information is needed. Apart from size, it differs from the larger plants in the presence of slender pale aerophores of a kind I have not seen on other plants of this genus.

14. CYCLOGRAMMA

TAGAWA, Acta Phytotax. Geobot. 7 (1938) 52; CHING, Acta Phytotax. Sinica 8 (1963) 316; HOLTTUM, Blumea 19 (1971) 28. — *Glaphyropteris sect. Cyclogramma* H. ITO in Nakai & Honda, Nov. Fl. Jap. *n.* 4 (1939) 148. — *Thelypteris subg. Cyclogramma* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 26. — **Fig. 10a–c.**

Caudex short to long-creeping; scales on stipe-base bearing acicular hairs, sometimes hooked; fronds drying dark-olivaceous, bearing short

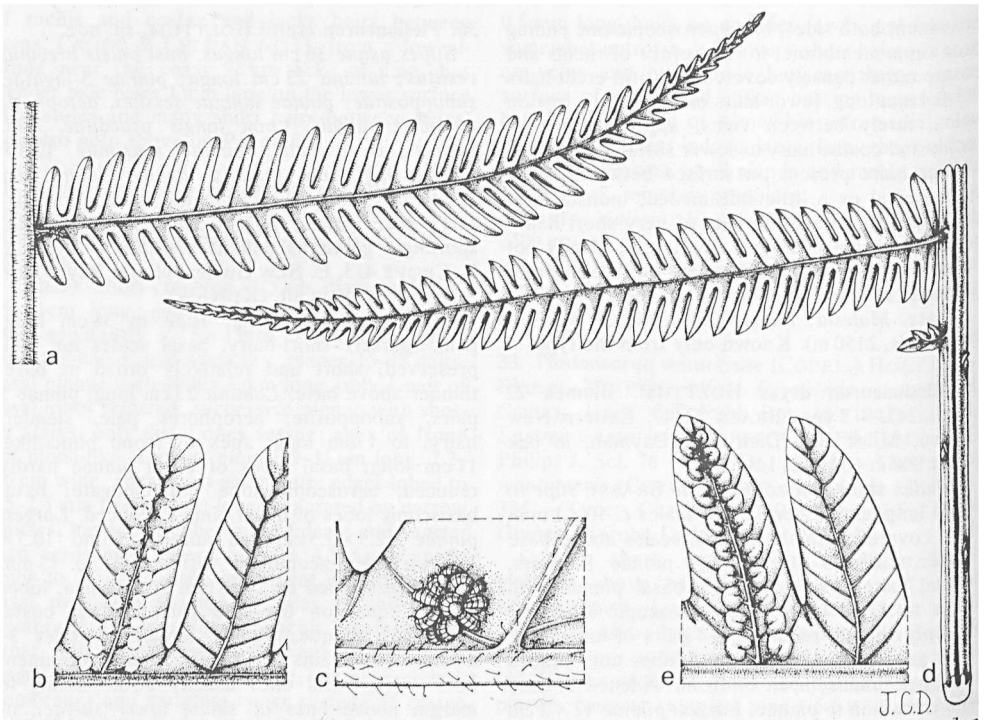

Fig. 10. *Cyclogramma auriculata* (J. SM.) CHING. *a.* Middle pinna, with an aerophore, × 1; *b.* venation, sinus-membrane and sori, × 3; *c.* sorus showing hooked hairs, × 9. — *Pseudocyclosorus tylodes* (KUNZE) CHING. *d.* Basal normal pinna and reduced pinnae, × 1; *e.* two pinna-lobes showing venation and sori, × 4 (*a–c* JACOBS 7299, *d–e* PRICE 387).

hooked hairs on lower surface of all axes and usually also on sporangia; lower pinnae reduced or not; aerophores at bases of pinnae swollen or elongate; pinnae deeply lobed; veins spreading at a wide angle to costule, basal ones from adjacent costules running to edge close to, or just above, sinus-membrane, never united; sori exindusiate; no glandular hairs on stalks of sporangia; spores pale with translucent anastomosing wings.

Type species: *Cyclogramma simulans* (CHING) TAGAWA.

Distr. About 8 *spp.*, Northern India to S. China, Taiwan; in *Malesia*: Philippines (Luzon).

Cytol. Base chromosome number probably 36: *C. auriculata* tetraploid; *C. omeiensis* octoploid (n = *c.* 136; KURITA, J. Jap. Bot. 41, 1966, 176).

Note. A very distinct genus which has no obvious near allies. The species *C. auriculata* is one of several ferns which are mainly distributed in Mainland Asia but have established themselves in Northern Luzon.

1. Cyclogramma auriculata (J. SM.) CHING, Acta Phytotax. Sinica 8 (1963) 317; HOLTTUM, Kalikasan 5 (1976) 110. — *Polypodium subvillosum* MOORE, Ind. Fil. (1861) 308, *nom nud.* — *Polypodium auriculatum* WALL. *ex* HOOK. Spec. Fil. 4 (1862) 237, *non* LINN., *nec* RADDI, *nec* PRESL; BEDD. Ferns Br. India (1866) t. 203; CLARKE, Trans. Linn. Soc. Bot. 1 (1880) 543. — *Phegopteris auriculata* J. SM. Hist. Fil. (1875) 233, *nom. nov.*; BEDD. Handb. (1883) 290, f. 149, *excl. syn. Polypodium appendiculatum* BEDD. — *Dryopteris auriculata* (J. SM.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 2 (1931) 196. — *Dryopteris himalayensis* C. CHR. Ind. Fil. Suppl. III (1934) 88, *nom. nov. superfl.* — *Thelypteris subvillosa* CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 279. — *C. himalayensis* TAGAWA, Acta Phytotax. Geobot. 7 (1938) 55. — *Thelypteris auriculata* (J. SM.) K.

IWATS. Acta Phytotax. Geobot. 19 (1961) 11; Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 42. — Type: WALLICH 314, Nepal (K).

Thelypteris simulans CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 280. — Type: FAURIE *s.n.* May 1914, Taiwan, Mt Arisan (S-PA).

Dryopteris squamaestipes sensu HAYATA, Icon. Fl. Formosa 4 (1914) 179, f. 117, not *Polypodium appendiculatum* BEDD. *var. squamaestipes* CLARKE. — **Fig. 10a–c.**

Caudex erect, to *c.* 10 cm tall. *Stipe* 5–10 cm long, densely covered with short pale hooked hairs, at base broad brown scales with some hooked hairs on them. *Lamina* to 100 cm long; pinnae more than 30 pairs, lower 10 pairs gradually reduced, a subabrupt transition between the upper of these and largest pinnae, lowest pinnae 3–4 mm long; aerophores at bases of pinnae 2 mm long. *Largest pinnae* seen on Philippine plants 10 × 2 cm (on Indian and Chinese plants to 20 × 2.5 cm), lobed to 1–1.5 mm from costa, base truncate, apex acuminate; lobes oblique, oblong with rounded tips, entire; costules 5–7 mm apart; veins to 11 pairs; hairs on lower surface of rachis 1 mm long, hooked, shorter hooked hairs on costae and costules, marginal hairs not hooked; hairs on upper surface of costae 1 mm long, not hooked; short suberect hairs between veins, a few of them hooked. *Sori* near costules; sporangia usually with 1 hooked hair.

Distr. N. India to S. China & Taiwan, in *Malesia*: Philippines (N. Luzon; Mt Pulog, M. JACOBS 7299 in L,K).

Ecol. Moist gully in mossy forest at 2600–2700 m altitude.

15. PSEUDOCYCLOSORUS

CHING, Acta Phytotax. Sinica 8 (1963) 322, *excl. P. ciliatus* (BENTH.) CHING and *P. caudipinna* CHING; HOLTTUM, J. S. Afr. Bot. 40 (1974) 137. — *Pneumatopteris sensu* HOLTTUM, Blumea 19 (1971) 42, *p.p.* — **Fig. 10d–e.**

Caudex erect or short-creeping; scales broad, thin, bearing when young marginal mucilage-secreting hairs; stipe scaly near base as caudex, scales appressed. Fronds bearing many deeply-lobed pinnae, at base an abrupt transition to much smaller ones; aerophores always swollen, in the sole Malesian species elongate; veins free, basal acroscopic vein to base or side of sinus-membrane, basal basiscopic vein to edge above base of sinus; short capitate hairs often present on lower surfaces or on indusia, spherical sessile glands lacking. Sori indusiate; no glands nor setae on sporangia; on sporangium-stalk a hair of 2–3 cells, terminal cell largest but not spherical; spores bearing many small subequal wings.

Type species: *Pseudocyclosorus tylodes* (KUNZE) CHING (by error as *xylodes*).

Distr. About 11 *spp.* Tropical Africa, Madagascar, Mascarene Islands, S. India & Ceylon, N. India to Japan; in *Malesia*: Philippines (Luzon).

Cytol. Chromosome numbers 35 and 36 both reported. *P. tylodes*, diploid (36, Ceylon and N. India); *P. esquirolii* and *P. repens*, both diploid (35, N. & S. India); *P. ochthodes*, diploid (35 and 36 both reported from India). There are erroneous records in LÖVE, LÖVE & PICHI SERMOLLI, Cytotaxonomical Atlas of Pteridophyta, p. 221.

Notes. This genus differs from *Pneumatopteris* in having veins always free, lamina never pustular when dry, sporangia lacking glands or setae on body. Because of the position of basal veins in relation to the sinus-membrane CHING (1963) thought *Dryopteris patens* (SW.) O. KTZE and *D. normalis* (SOD.) C. CHR. of Tropical America should probably be included in *Pseudocyclosorus*, but in my judgement these species, and some others allied to them in Africa, are better regarded as constituting a section of *Christella* (see HOLTTUM, J. S. Afr. Bot. 40, 1974, 144). CLARKE (1880) united all species of *Pseudocyclosorus* in N. India under the name *Nephrodium prolixum*, based on *Aspidium prolixum* WILLD., but WILLDENOW's type is a species of *Christella* from New Caledonia (HOLTTUM, Amer. Fern J. 63, 1973, 82).

1. **Pseudocyclosorus tylodes** (KUNZE) CHING, Acta Phytotax. Sinica 8 (1963) 324; HOLTTUM, Brit. Fern Gaz. 11 (1974) 55; HOLTTUM & GRIMES, Kew Bull. 34 (1979) 503. — *Aspidium tylodes* KUNZE, Linnaea 24 (1851) 244, 283 (*xylodes*, *err. typ.*, p. 281). — *Lastrea tylodes* (KUNZE) MOORE,

Ind. Fil. (1858) 107; BEDD. Ferns S. India (1863) t. 107; COPEL. Fern Fl. Philip. (1960) 330. — *Nephrodium ochthodes var. tylodes* BEDD. Handb. (1883) 240. — *Nephrodium tylodes* (KUNZE) HOPE, J. Bombay Nat. Hist. Soc. 14 (1903) 724. — *Dryopteris tylodes* (KUNZE) CHRIST, Notul. Syst. 1 (1909) 41; C. CHR. Contr. U. S. Nat. Herb. 26 (1931) 274. — *Thelypteris tylodes* (KUNZE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 296; HENNIPMAN, Blumea 16 (1968) 99, f. 1e. — Syntypes cited: SCHMID-KOCH 11, 63, 89, 115, Nilgiri Hills, S. India (none seen).

Dryopteris crassinervia C. CHR. Hedwigia 74 (1934) 229. — Type: G. STEIN 1179, Timor, Ramelau (B; BM).

Nephrodium prolixum sensu BAK. Syn. Fil. (1867) 268, *var. tylodes tantum.* — *Dryopteris luerssenii* (*non* HARR.) CHRIST, Philip. J. Sci. 2 (1907) Bot. 208. — **Fig. 10d–e.**

Caudex erect. *Stipe* short, glabrous, flushed red, covered at base with broad scales. *Reduced pinnae* many pairs, represented by aerophores only. *Lamina* 30–80 cm long, subcoriaceous, rigid when dry; basal pinnae narrowed towards their bases; aerophores elongate. *Largest pinnae* 12–20 × 1.2–2.0 cm; base subtruncate with basal acroscopic lobe ± elongate; apex caudate-acuminate; edges lobed to 1.5–2 mm from costa, lobes entire with falcate acute tips; costules 3.5–4.5 mm apart; veins 10–12 pairs, pale and prominent on both surfaces; lower surface entirely glabrous or some acicular hairs present on distal parts of costae and on sinus-membranes; upper surface hairy only on costa. *Sori* inframedial; indusia large, firm, glabrous; spores dark, finely spinulose.

Distr. India (except N.W.) and Ceylon, Burma to S.W. China and Hong Kong; in *Malesia*: Philippines (N. Luzon) and Lesser Sunda Is. (Timor). For a similar distribution, see VAN STEENIS, J. Linn. Soc. Bot. 79 (1979) 127.

Ecol. In Luzon at 1700–2500 m, usually on banks of streams.

Notes. It is evident from KUNZE's preliminary list of species (l.c. 1851, p. 244) that he intended the specific epithet to be *tylodes* (from the Greek *tylos*, meaning a hump or knob, referring to the aerophores); the name is also so written in the description of *Aspidium ochthodes* where the two species are compared. METTENIUS, HOOKER and BEDDOME all adopted this spelling. It seems to me certain that the spelling *xylodes* on p. 281 was an error; it has no meaning. The paper was published shortly after the death of KUNZE, who perhaps did not correct a proof. I regard the use of *xylodes* by later authors as an error, to be corrected.

16. PNEUMATOPTERIS

NAKAI, Bot. Mag. Tokyo 47 (1933) 179; HOLTTUM, Blumea 19 (1973) 42, *excl. Pseudocyclosorus* CHING; Allertonia 1 (1977) 226. — *Thelypteris subg. Pneumatopteris* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 33, *excl. sect. Macrocyclosorus.* — *Cyclosorus sensu* CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 230, *p.p.*; *sensu* HOLTTUM, Rev. Fl. Mal. 2 (1955) 255, *p.p.*; *Lastrea et Cyclosorus sensu* COPEL. Gen. Fil. (1947) 135, 140, *p.p.* — **Fig. 11.**

Caudex usually short, erect or decumbent, long-creeping in 2 *spp.*; stipe never conspicuously hairy, basal scales in almost all cases broad, thin, bearing few marginal acicular hairs, in some species also septate hairs bearing mucilage-cells; fronds usually large with many pinnae, and in almost all species a varied number of much-reduced basal pinnae, the transition to these gradual or abrupt; lamina of reduced pinnae in most species distinct, in the type and a few others greatly reduced; aerophores at bases of reduced and lower normal pinnae ± swollen, in a few cases much elongate and then small aerophores also present at bases of costules; pinnae always lobed, edges of lobes distinctly cartilaginous and in some species toothed at the ends of veins; veins free in a few species which have deeply lobed pinnae, in most species the basal veins at least anastomosing (in *P. costata* small plants with fertile fronds may have free veins, later and larger fronds having anastomosis); lamina between veins almost always ± pustular when dried (*P. costata* is an exception); lower surface of rachis, costae and

other parts never densely hairy, short capitate hairs present in some species, minute colourless glands in a few, conspicuous sessile spherical glands never present; sori usually covered with rather thin indusia; sporangia often bearing short club-shaped glandular hairs (rarely setae) near annulus and on the stalk a hair of 3–4 cells, the terminal cell enlarged but usually colourless; spores in most cases light brown, bearing many very small ± quadrate wings, in a few species a ± continuous longitudinal wing with cross-wings.

Type species: *Pneumatopteris callosa* (BL.) NAKAI.

Distr. Tropics of the Old World, in the Pacific southwards to New Zealand; in all ç. 80 *spp.*, the majority Malesian.

Ecol. Almost all species in forest, especially near streams, some in rocky stream-beds; a few species confined to limestone.

Cytol. Base chromosome number 36; 7 Malesian *spp.*, including *P. costata*, diploid (T. G. WALKER, unpublished); *P. truncata* tetraploid in Ceylon and diploid in N. India and Sarawak; *P. pennigera* (G. FORST.) HOLTTUM tetraploid in New Zealand.

Taxon. NAKAI confined the genus to one species, stating "there is no other fern with which it can offer any specific comparison", but there are three species closely allied to the type in Malesia and four more in the Pacific. The distinctive character of this group is the extreme reduction of basal rudimentary pinnae which consist of little more than swollen aerophores which project through the layer of mucilage which covers very young fronds (GOEBEL, Ann. Jard. Bot. Btzg 36, 1926, 84–96, with figures). TROLL described the mucilage-bearing scales of another species (probably *P. kerintjiensis*) which he mis-named *Dryopteris sumatrana* v.A.v.R. (Flora 128, 1933, 329–337); this species has shorter aerophores than *P. callosa* and quite large reduced basal pinnae. The number, shape and size of such pinnae provide important characters for distinguishing between species, and in some cases there is still not enough information about them.

Pneumatopteris is closely related to *Sphaerostephanos* but is distinct in the following characters: presence of colourless short capitate hairs in place of spherical sessile glands; limited development of acicular hairs apart from adaxial surface of rachis and costae; pustular appearance of lower surface between veins of dried fronds; broad thin stipe-scales. There are exceptions to some of these, the most notable in Malesia being *P. costata* and a few allies which do not have a pustular surface when dried. The species with free veins are nearly all in New Guinea. They do not look like a primitive group and may be derived from ancestors with anastomosing veins. *P. truncata* looks more like a prototype for the genus.

KEY TO THE SPECIES

1. Veins anastomosing.
2. Stipe and rachis bearing many dark spines 1 mm long irregularly arranged.
3. Indusia lacking.
4. Pinnae to 25 × 1.6–2.7 cm with cauda 3 cm long; spores with many small wings . . **1. P. glabra**
4. Pinnae to 12 × 2 cm with cauda 1.5 cm; spores with wing and cross-wings . . . **2. P. sibelana**
3. Indusia present.
5. Pinnae short-acuminate (Sumatra) . . . . . **3. P. dicranogramma**
5. Pinnae narrowly long-acuminate (Philippines) . . . . . **1. P. glabra**
2. Stipe and rachis lacking such spines.
6. Elongate aerophores present at bases of pinnae.
7. Reduced pinnae consisting of a prominent aerophore with a minute rim . . . . **4. P. callosa**
7. Reduced pinnae with a distinct lamina.
8. Pinnae crenate; veins 6–7 pairs . . . . . **5. P. subappendiculata**
8. Pinnae lobed 1/3 towards costa; veins 10–16 pairs . . . . . **6. P. superba**
6. Aerophores not elongate (in many cases slightly swollen).
9. Indusia lacking.
10. Pinnae commonly 12–15 × 1.5–2.0 cm, thin; lower surface of rachis with or without minute acicular hairs; sporangia with capitate hairs . . . . . **7. P. costata**
10. Pinnae to 7 × 1 cm, rigid when dry; lower surface of rachis densely covered with erect hairs 0.3 mm long; sporangia mostly bearing setae . . . . . **8. P. latisquamata**
9. Indusia present.

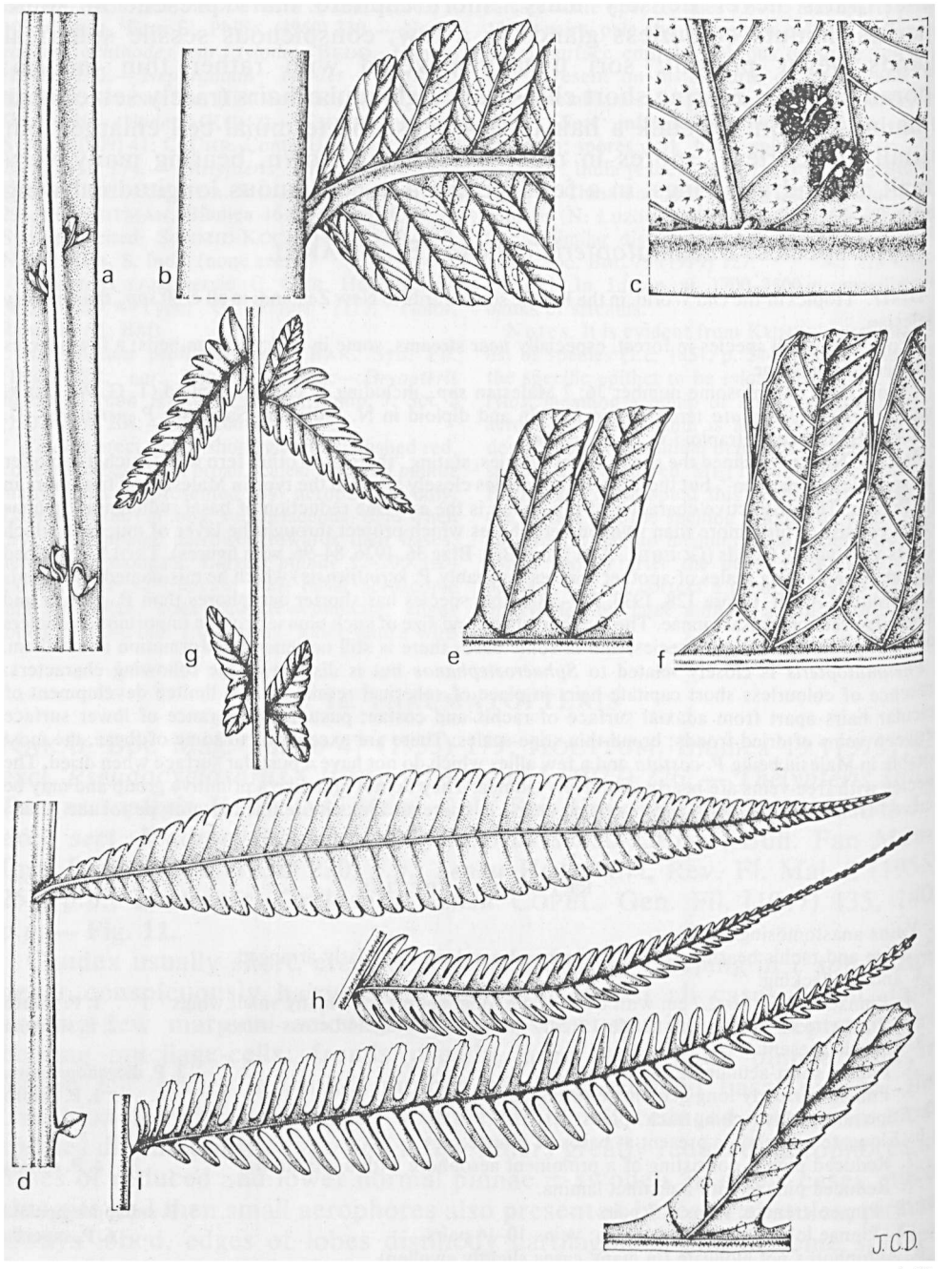

Fig. 11. *Pneumatopteris callosa* (BL.) NAKAI. *a.* Reduced basal pinnae, ×1; *b.* base of normal pinna ×2; *c.* part of a fertile pinna showing pustular lamina, aerophore at base of costule and sori, ×8. — *P. truncata* (POIR.) HOLTTUM. *d.* Basal normal pinna and a reduced pinna, ×⅔; *e.* part of pinna, ×2; *f* showing veins joined along margin in lobes, ×3. — *P. laevis* (METT.) HOLTTUM. *g.* Reduced basal pinnae, ×1.5; *h.* upper pinna, ×⅔. — *P. keysseriana* (ROSENST.) HOLTTUM. *i.* Basal pinna, ×⅔; *j.* one pinna-lobe, ×3 (*a–c* W. L. CHEW *et al.* 1373, *d–f* MATTHEW *s.n.*, *g–h* MATTHEW *s.n.*, *i–j* cult. Kew).

11. Veins in fertile pinnae 2–5 pairs; pinnae in most cases not over 12 cm long.
12. Lower pinnae gradually reduced; stipe 5–15 cm long.
13. Basal pinnae auricled on acroscopic base.
14. Basal large pinnae narrowly cuneate at base on basiscopic side . . . . **9. P. egenolfioides**
14. Basal pinnae truncate at base on basiscopic side.
15. Brown hairs on rachis both sides; pinnae to 8 cm long . . . . . **10. P. patentipinna**
15. Lower surface of rachis glabrous; pinnae 3–3.5 cm long.
16. Pinnae lobed 2/5–1/2 towards costa . . . . . **11. P. cheesmaniae**
16. Pinnae crenate . . . . . **12. P. lithophila**
13. Basal pinnae not auricled on acroscopic base.
17. Basal pinnae narrowly cuneate on basiscopic side; pinnae to 15 cm long including cauda 4–5 cm . . . . . **13. P. angusticaudata**
17. Basal pinnae not so; pinnae, if 15 cm long, with shorter cauda . . . . **14. P. microloncha**
12. Abrupt transition to reduced pinnae; stipe 20 to 50 cm long . . . . . **15. P. brooksii**
11. Veins in fertile pinnae 7–10 pairs or more; pinnae usually much longer.
18. Basal pinnae not or variably a little reduced.
19. Pinnae 4 cm or more wide, lobed less than 1/2 . . . . . **16. P. inclusa**
19. Pinnae to 2.5 cm wide, lobed more than 1/2 . . . . . **17. P. longipes**
18. At least 1 pair basal pinnae conspicuously reduced.
20. Middle and upper pinnae very oblique, their bases asymmetric; apices of pinnae long and very narrow.
21. Largest reduced pinnae and lower normal ones distinctly auricled at their bases **18. P. laevis**
21. Lower pinnae narrowed towards their bases and not auricled.
22. Pinnae lobed 1/2 way to costa; *c.* 12 pairs of reduced pinnae, largest 3 cm long **19. P. obliqua**
22. Pinnae lobed less deeply; reduced pinnae *c.* 6 pairs, largest 5 mm long **13. P. angusticaudata**
20. Middle pinnae not very oblique, their bases ± symmetrical.
23. One pair basal pinnae reduced.
24. Reduced pinnae 2 cm long; normal pinnae lobed more than 1/2 . . . **20. P. basicurtata**
24. Reduced pinnae 1 mm long; normal pinnae lobed less than 1/2 . **21. P. microauriculata**
23. At least 2 pairs of abruptly reduced pinnae or several pairs gradually reduced.
25. Reduced pinnae and lower normal pinnae with large serrate or lobed acroscopic auricles.
26. Reduced pinnae 2–4 pairs, subequal . . . . . **22. P. ecallosa**
26. Reduced pinnae to 8 pairs, decreasing downwards . . . . . **23. P. auctipinna**
25. Reduced pinnae and lower normal pinnae not thus auricled.
27. Hairs on upper surface of rachis thick, brown; some similar hairs usually present on lower surface of rachis and costae.
28. Pinnae lobed less than 1/2; 1½ pairs of veins anastomosing . . . . . **24. P. jermyi**
28. Pinnae lobed 1/2–2/3; basal veins meeting at base of sinus-membrane . **25. P. papuana**
27. Hairs on rachis and costae not thick and brown.
29. Lower pinnae gradually decrescent, at least on fertile fronds.
30. Indusia very small; lower surface bearing minute glands between veins . **7. P. costata**
30. Indusia conspicuous; lower surface lacking such glands . . . . **26. P. rodigasiana**
29. Transition from normal to reduced pinnae abrupt.
31. Pinnae lobed 2/3 or more deeply.
32. Pinnae lobed to 1.5 mm from costa, not pustular between veins when dried **27. P. japenensis**
32. Pinnae lobed less deeply, pustular between veins.
33. Pinna-lobes dentate at ends of veins . . . . . **28. P. tobaica**
33. Pinna-lobes entire.
34. Pinnae lobed to 2.5 mm from costa; hairs present on all parts of lower surface **29. P. incisa**
34. Pinnae lobed to 4 mm from costa; lower surfaces quite glabrous **30. P. psilophylla**
31. Pinnae lobed at most 3/5 towards costa.
35. Lowest pinnae considerably narrowed towards their bases, gradually or rather abruptly.
36. Pinnae of well-grown plants lobed more than 1/2.
37. Stipe-scales narrow, spreading . . . . . **31. P. pergamacea**
37. Stipe-scales thin, appressed.
38. Pinnae commonly 2.5–3 cm wide; sporangia lacking glands . . **32. P. sogerensis**

38. Pinnae not over 2 cm wide; sporangia bearing glands . . . **33. P. micropaleata**
36. Pinnae of well-grown plants lobed less than 1/2.
39. Pinnae commonly 20 × 2.5 cm, usually with some hairs on lower surface of costae, often also between veins . . . . . **34. P. truncata**
39. Pinnae not more than 2 cm wide; lower surface quite glabrous.
40. Pinna-lobes almost at right angles to costa; sporangia bearing glands **35. P. lawakii**
40. Pinna-lobes oblique; no glands on sporangia . . . . . **36. P. michaelis**
35. Lowest pinnae not or little narrowed towards their bases.
41. Upper reduced pinnae longer than wide, with dilated bases and lobed distally; lower surface slightly pustular . . . . . **37. P. nitidula**
41. Upper reduced pinnae as long as wide, not dilated at base nor lobed above base, strongly pustular between veins . . . . . **38. P. kerintjiensis**

1. Veins free.
42. Largest pinnae less than 2 cm long, entire or slightly crenate; many pairs of lower pinnae gradually decrescent . . . . . **39. P. nephrolepioides**
42. Largest pinnae in most cases larger; lower pinnae otherwise.
43. Both surfaces of pinnae bearing short erect hairs throughout.
44. Lower 1–3 pairs of pinnae progressively smaller, lowest commonly 1 cm long . **40. P. ligulata**
44. Lower 5–6 pairs of pinnae less than 2 mm long . . . . . **41. P. finisterrae**
43. No hairs between veins on upper surface, few or none on lower.
45. Four or more pairs of lower pinnae gradually reduced; pinnae lobed *c.* half-way to costa **7. P. costata**
45. Not this combination of characters.
46. Pinnae 2–3 cm long.
47. Basal pinnae shorter than the next pair . . . . . **42. P. versteeghii**
47. Six pairs of lower pinnae ± gradually reduced.
48. Basal 3–4 pairs of pinna-lobes separately adnate to costa . . . . . **43. P. sumbawensis**
48. Pinnae lobed half-way to costa . . . . . **53. P. petrophila**
46. Pinnae much longer.
49. Much-reduced basal pinnae 0–3 pairs.
50. Sori supramedial; pinnae lobed to 1–2 mm from costa; basal veins from adjacent costules often meeting, or nearly so, at the sinus.
51. Pinnae to 23 × 4 cm; basal acroscopic lobe of middle pinnae not almost free **44. P. keysseriana**
51. Pinnae *c.* 8 × 1.5 cm; basal acroscopic lobe of middle pinnae almost free . **45. P. caudata**
50. Sori medial; pinnae lobed to less than 1 mm from costa; basal veins from adjacent costules ending far apart at the margin.
52. Basal basiscopic lobes of middle pinnae equal to acroscopic lobes . . . **46. P. deficiens**
52. Basal basiscopic lobes of middle pinnae shorter than acroscopic.
53. Basal acroscopic lobes of largest reduced pinnae and lowest normal pinnae elongate.
54. Much-reduced basal pinnae 2 pairs; hairs present on lower surface of rachis and costae **47. P. mingendensis**
54. Much-reduced pinnae lacking; lower surfaces quite glabrous . . . . **48. P. eburnea**
53. Basal acroscopic lobes of such pinnae reduced . . . . . **49. P. excisa**
49. Much-reduced basal pinnae at least 6 pairs.
55. Pinnae to 15 cm or more long.
56. Reduced pinnae 6 pairs, lowest 1 cm long.
57. Pinnae lobed to 1 mm from costa.
58. Sori inframedial; dark brown hairs present on upper surface of costa . . **50. P. regis**
58. Sori supramedial; no dark brown hairs . . . . . **44. P. keysseriana**
57. Pinnae lobed to 3.5–4 mm from costa . . . . . **51. P. boridensis**
56. Reduced pinnae many pairs, lower ones smaller . . . . . **52. P. imbricata**
55. Pinnae not or little more than 10 cm long.
59. Pinnae lobed half-way to costa . . . . . **53. P. petrophila**
59. Pinnae lobed almost to costa . . . . . **54. P. walkeri**

1. Pneumatopteris glabra (COPEL.) HOLTTUM, Blumea 21 (1973) 301. — *Cyclosorus glaber* COPEL. Philip. J. Sci. 81 (1952) 34; Fern Fl. Philip. (1960) 363. — *Thelypteris sevillana* REED, Phytologia 17 (1968) 313. — Type: RAMOS BS 42976, Sevilla River, Bohol (UC; BM).

Cyclosorus viridis COPEL. Philip. J. Sci. 81 (1952) 35, pl. 24; Fern Fl. Philip. (1960) 364. — *Thelypteris viridis* (COPEL.) REED, Phytologia 17 (1968) 324. — Type: RAMOS & EDAÑO BS 37490, Mt Masigit, Luzon (MICH; US, BO).

Caudex short, creeping. *Stipe* 5 cm long, basal

scales small, thin, soon disappearing; base of stipe to first large pinna 25–100 cm; stipe and rachis bearing many dark spines, erect or curved, 1 mm long. *Reduced pinnae* many pairs, c. 3 cm apart, each consisting of an aerophore 1–2 mm long, upper ones with a lamina 2–3 mm long almost encircling the aerophore; transition to normal pinnae abrupt or subabrupt; *lamina* excluding reduced pinnae to 120 cm long (sometimes fertile at a length of 30 cm), basal pinnae narrowed near their bases. *Largest pinnae* to 25 cm long, 1.6–2.2 cm wide; base broadly cuneate to full width (asymmetric on upper pinnae); apex caudate-acuminate (cauda to 3 cm long, finely toothed throughout); edges lobed 1/3 towards costa or a little more deeply, lobes entire with acute falcate tips; costules 4–6 mm apart with a small aerophore at the base of each; veins 8–10 pairs, basal pair anastomosing, next 2 pairs passing to sides of a long sinus-membrane; *lower surface* of rachis glabrous, of costae and costules bearing a few small capitate hairs, surface between veins rather strongly pustular; *upper surface* of rachis bearing ± abundant thick brown hairs 0.5–1 mm long, similar hairs near bases of costae, rest of upper surface glabrous. *Sori* medial on distal veins, variably supramedial on lower ones; small firm indusia sometimes present; sporangia bearing rather large colourless club-shaped glands.

Distr. *Malesia*: Philippines (Luzon, Samar, Bohol, Mindanao).

Ecol. Usually on rocky stream-banks, to 400–1000 m, also found in ridge forest.

Note. COPELAND distinguished *Cyclosorus viridis* by the green (not dark) colour of dried fronds, narrower pinnae and the presence of small indusia. All these characters appear to be variable. Very young fronds of plants in cultivation at Kew develop a coat of mucilage, as in *P. callosa*. Small indusia, not as large as a mature sporangium, are found in some sori of these plants. RAMOS & EDAÑO, BS 49586, from Mindanao (collected in 1927) was distributed as *Dryopteris todayensis* CHRIST?.

2. Pneumatopteris sibelana HOLTTUM, Blumea 21 (1973) 301. — Type: ALSTON 16942, Batjan, N. slope of Mt Sibela, 1500 m (BM).

Stipe less than 5 cm long; base of stipe to first large pinna 45 cm; stipe and rachis bearing slender spines 1 mm long. *Reduced pinnae* 10–12 pairs, each consisting of a semicircular lamina 2–3 mm wide and an aerophore 1 mm or more long; *lamina* exclusive of reduced pinnae 65–70 cm long; pinnae c. 28 pairs, basal ones slightly narrowed at their bases. *Largest pinnae* 12 cm long, 1.8–2.0 cm wide; base subtruncate; apex acuminate with a finely-toothed cauda 10–15 mm long; edges lobed c. 1/3 towards costa, lobes entire, falcate, subacute; costules 5–5.5 mm apart; veins 10 pairs, basal 1–1½ pairs anastomosing, next 2½ pairs to sides of a long sinus-membrane; on *lower surface* of rachis short curved brown hairs, sparse minute hairs on costae, rest of surface glabrous; *upper surface* glabrous apart from rachis and costae. *Sori* medial, lower ones not or little divergent, exindusiate; no glands seen on sporangia; spores light brown with a ± continuous translucent wing and cross-wings.

Distr. *Malesia*: Moluccas (Batjan), only known from the type.

3. Pneumatopteris dicranogramma (v.A.v.R.) HOLTTUM, Blumea 21 (1973) 301. — *Dryopteris dicranogramma* v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 202. — *Thelypteris dicranogramma* (v.A.v.R.) REED, Phytologia 17 (1968) 272. — Type: BÜNNEMEIJER 10454, Sumatra, G. Kerinci (BO; L).

Stipe very short; base of stipe to first large pinna 45–55 cm; stipe and lower part of rachis bearing short dark spines. *Reduced pinnae* c. 2.5–3 cm apart, each consisting of a narrow lamina almost encircling the base of an aerophore. *Lamina* excluding reduced pinnae 50–70 cm long, coriaceous; basal pinnae, several pairs, narrowed at their bases. *Largest pinnae* 17.5 × 1.8 cm; base truncate; apex short-acuminate, serrate to tip; edges lobed 1/3–1/2 towards costa, lobes falcate, acute; costules c. 4 mm apart, each with a small aerophore at its base; veins 10–12 pairs, thick, basal pair anastomosing, then several pairs ending beside a long sinus-membrane; *lower surface* of rachis bearing short stiff brown hairs, a few similar hairs sometimes on bases of costae, rest glabrous; *upper surface* of rachis covered with brown hairs, of costae glabrous. *Sori* in an inverted V (basal ones divergent); indusia soon broken, probably hairy when young.

Distr. *Malesia*: Sumatra (G. Kerinci, 2 collections at 2100–2400 m; G. Dempo).

Note. The specimen from Malaya named *Cyclosorus dicranogramma* in HOLTTUM, Rev. Fl. Mal. 2 (1955) 267 is *P. callosa*.

4. Pneumatopteris callosa (BL.) NAKAI, Bot. Mag. Tokyo 47 (1933) 179; HOLTTUM, Blumea 21 (1973) 302. — *Aspidium callosum* BL. En. Pl. Jav. (1828) 152. — *Nephrodium callosum* (BL.) KEYS. Pol. Cyath. Herb. Bung. (1873) 48; RACIB. Fl. Btzg 1 (1898) 192. — *Dryopteris callosa* (BL.) C. CHR. Ind. Fil. (1905) 256; v.A.v.R. Handb. (1908) 220; BACKER & POSTH. Varenfl. Java (1939) 62. — *Cyclosorus callosus* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 205. — *Thelypteris callosa* (BL.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 34. — Type: BLUME, Java (L, *n.* 908, 339–365).

Goniopteris lobbiana FÉE, Gen. Fil. (1852) 251. — Type: LOBB, Java (orig.?; isotypes BM, K).

Aspidium multijugum CHRIST, Ann. Jard. Bot.

Btzg 15 (1898) 135. — Lectotype (HOLTTUM 1973): SARASIN 1323, Celebes (BAS). — **Fig. 11a–c.**

Caudex stout, erect; apex and fronds in their early stages covered with mucilage. *Stipe* very short; base of stipe to first large pinna 60–100 cm. *Reduced pinnae* 2–4 cm apart, each consisting of a prominent aerophore with a narrow rim at its base; *lamina* excluding reduced pinnae 100–200 cm long, texture very firm; 2–3 pairs of lower pinnae narrowed near their bases. *Largest pinnae* commonly 15–25 cm long, 2.0–2.5 cm wide; base truncate to broadly cuneate; apex rather evenly attenuate; edges lobed 1/4–1/3 towards costa, lobes entire, falcate, subacute, with conspicuous pale cartilaginous edge; costules 3.5–4.5(–5) mm apart, at a wide angle to costa, a small aerophore at the base of each; veins *c.* 12 pairs, slender and prominent both sides, basal 1–1½ pairs anastomosing, 3–4 pairs passing to sides of the prominent sinus-membrane; *lower surface* of rachis and costae glabrous or with some pale acicular hairs, short hairs present on sinus-membrane and edges, lamina between veins finely and copiously pustular; *upper surface* of rachis (at least distally) bearing long curved brown hairs, a few such hairs near bases of costae, rest of surface glabrous. *Sori* in an inverted V; indusia firm, glabrous; sporangia bearing club-shaped glands, stalks of sporangia bearing hairs with an end-cell which (on young sporangia) is swollen and orange; spores with many small wings.

Distr. *Malesia*: West Malesia, Celebes, Lesser Sunda Is. (Flores) and Moluccas (Ceram).

Ecol. Near streams in forest, at 600–1750 m.

Notes. BLUME distinguished *var. B.* with more rigid fronds and sori confluent; I have not seen the type, and consider the distinctions not good. v.A.v.R. described *var. sumatrana* (Handb. 220) from a small plant with gradually reduced lower pinnae; it might represent another species (type not found). CHRIST gave a brief description of the SARASIN specimen from Celebes cited under *Aspidium multijugum*, referring to *Nephrodium multijugum* BAK. Syn. Fil. (1867) 291 and ascribing the name to WALLICH, but WALLICH included specimens of three different species under his *n.* 348 and it is not clear to which of them BAKER's description applies, though certainly not to *P. callosa*. I have not seen the WARBURG specimens also cited by CHRIST.

5. Pneumatopteris subappendiculata (COPEL.) HOLTTUM, Blumea 21 (1973) 303. — *Dryopteris subappendiculata* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Cyclosorus subappendiculatus* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 449, pl. 30. — *Thelypteris subappendiculata* (COPEL.) REED, Phytologia 17 (1968) 317. — Type: BRASS 12247, New Guinea, Idenburg River (MICH; L).

Stipe 10 cm long, covered with short brown hairs and when young thin scales; base of stipe to first large pinna 35 cm. *Reduced pinnae* to 7 pairs, lowest 5 mm long, uppermost 2 cm long, broadly triangular with auricled acroscopic base. *Lamina* excluding reduced pinnae to 90 cm long; pinnae *c.* 16 pairs, opposite, with conical aerophores at their bases; basal pinnae auricled on acroscopic side or ± dilated both sides at base; texture firm. *Largest pinnae* 18 × 3 cm (sterile), fertile to 2.5 cm wide; base truncate to subcordate; apex short-acuminate; edges crenately lobed, sterile to a depth of 2 mm, fertile to 3 mm; costules 5–6 mm apart; veins 6–7 pairs, slender, prominent both sides, basal 1½–2 pairs anastomosing, next 1–2 pairs to sides of sinus-membrane which is not prominent on lower surface; *lower surface* of rachis bearing rather sparse thick brown hairs, costae, costules and sinus-membrane sparse slender short hairs, surface between veins slightly pustular; *upper surface* of rachis covered with brown hairs, those on costae paler and more slender. *Sori* medial (distal ones inframedial); indusia thin, pale, with a few short hairs; sporangia lacking glands.

Distr. *Malesia*: Eastern New Guinea, at 1400–2200 m.

Note. It is not clear whether this is sharply distinct from *P. superba*.

6. Pneumatopteris superba (BRAUSE) HOLTTUM, Blumea 21 (1973) 303. — *Dryopteris superba* BRAUSE, Bot. Jahrb. 56 (1920) 105. — *Cyclosorus superbus* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 249; COPEL. Philip. J. Sci. 78 (1951) 447. — *Thelypteris superba* (BRAUSE) REED, Phytologia 17 (1968) 318. — Type: LEDERMANN 11733, N.E. New Guinea, Sepik Distr., Schraderberg 2070 m (B).

Dryopteris deltiptera COPEL. Univ. Cal. Publ. Bot. 18 (1942) 142. — *Cyclosorus deltipterus* COPEL. Gen. Fil. (1947) 142; Philip. J. Sci. 78 (1951) 449, pl. 29. — *Thelypteris deltiptera* (COPEL.) REED, Phytologia 17 (1968) 271. — Type: BRASS 11260, New Guinea, near Lake Habbema 2200 m (GH).

Differs from *P. subappendiculata*: caudex short, erect; stipes of largest fronds bearing a few spines less than 0.5 mm long; fronds larger; pinnae to 23 cm long, ± dilated at base which in largest fronds is 3–4 cm wide, asymmetric (wider throughout on basiscopic side of costa than on acroscopic side), edges lobed up to 1/3 towards costa, more deeply on basiscopic than on acroscopic side; lobes with broad undulate cartilaginous edges; costules 6–7 mm apart; veins 10–16 pairs; basal sori not much divergent.

Distr. *Malesia*: Eastern New Guinea, many collections; 2 doubtful from W. New Guinea.

Ecol. In forest at 1700–2700 m.

7. Pneumatopteris costata (BRACK.) HOLTTUM, Blumea 21 (1973) 305; Allertonia 1 (1977) 229, f.

9b. — *Goniopteris costata* BRACK. in Wilkes, U.S. Expl. Exp. (1854) 28. — *Dryopteris costata* (BRACK.) MAXON, Univ. Cal. Publ. Bot. 12 (1924) 26. — *Thelypteris costata* (BRACK.) REED, Phytologia 17 (1968) 269. — Type: U.S. Expl. Exped., Fiji (US).

Lastrea cavitensis COPEL. Philip. J. Sci. 81 (1952) 26; Fern Fl. Philip. (1960) 328. — *Thelypteris cavitensis* (COPEL.) REED, Phytologia 17 (1968) 267. — Type: MANGUBAT BS 1302, Luzon, Cavite (MICH).

Dryopteris pennigera (FORST. *f.*) C. CHR. subsp., C. CHR. Ind. Fil. (1905) 289. — *Dryopteris luzonica* CHRIST, Philip. J. Sci. 2 (1907) Bot. 196, *quoad Mangubat* 1302 *tantum*.

Caudex short, erect; *stipe* 5–10 cm long, basal scales broad, thin, imbricating. *Lamina* to 80 cm long; pinnae to more than 25 pairs, basal 4–8 pairs gradually decrescent, lowest 3–12 mm long; reduced pinnae not auricled nor narrowed at their bases; texture thin but firm. *Largest pinnae* to 14 × 1.5 cm (type of *L. cavitensis* 8 × 0.8 cm); base broadly cuneate to subtruncate; apex narrowly acuminate; edges lobed *c.* ½ way to costa; costules to 4 mm apart (2.5 mm in type of *L. cavitensis*); veins in well-grown plants 8–9 pairs, basal veins anastomosing, next acroscopic vein or pair to short sinus-membrane (in type of *L. cavitensis* 4–6 pairs of veins, basal ones meeting without joining at sinus-membrane); *lower surface* of rachis and costae bearing many minute acicular hairs, such hairs sparse on costules and veins, on and between veins minute sessile or subsessile glands which collapse on drying; *upper surface* of rachis and costae covered with pale hairs more than 0.5 mm long, between veins minute glands as lower surface. *Sori* inframedial, exindusiate or sometimes with very small indusia; sporangia bearing small capitate hairs; spores pale, with a ± continuous thin translucent wing and cross-wings. Chromosomes: n = 36 (T. G. WALKER).

Distr. Queensland, Solomon Islands, New Hebrides, New Caledonia, eastwards to Tahiti; *var. hispida* HOLTTUM in Cook Islands, Pitcairn, Easter Island (see HOLTTUM in Allertonia 1977), in *Malesia*: N.E. New Guinea, Philippines (S. Luzon), and Lesser Sunda Is. (Bali, Sumbawa).

Ecol. In Malesia at 250–1200 m, on sloping ground near streams, apparently not in deep shade.

Note. This species has been much misinterpreted; the first author after BRACKENRIDGE to characterize it clearly was MAXON (1924) but he did not see the characteristic minute glands. The fern so named by HOOKER (Spec. Fil. 5, 1864, 7) is *Chingia longissima* (BRACK.) HOLTTUM. DIELS and CHRISTENSEN confused *P. costata* P. *pennigera* (FORST. *f.*) HOLTTUM of New Zealand and S.E. Australia; some specimens from Samoa were named *Dryopteris transversaria* and *D. christopherseni* by CHRISTENSEN.

8. Pneumatopteris latisquamata HOLTTUM, Blumea 21 (1973) 305. — Type: MILLAR & HOLTTUM NGF 15777, N.E. New Guinea, Morobe Distr., Edie Creek, 2000 m (K; BO, LAE).

Caudex short; apex covered with imbricating firm, apparently hairless scales; *stipe* 4 cm long, minutely hairy, scales early caducous. *Lamina* 35 cm long; pinnae *c.* 24 pairs, lower 8 pairs gradually shorter, lowest 2 cm long, all with symmetric bases; texture firm, rigid when dried. *Largest pinnae* 3.5 × 0.8 cm; base broadly cuneate; apex short-acuminate; edges lobed *c.* ½ way to costa; lobes slightly falcate, their edges reflexed when dried; costules 2 mm apart; veins 4 pairs, lowest anastomosing, next pair to margin; *lower surface* of rachis densely covered with erect acicular hairs 0.3–0.4 mm long, more sparse and shorter similar hairs on costae, costules and veins and on surface between veins, minute sessile or subsessile glands on all parts; *upper surface* of rachis covered with pale hairs more than 0.5 mm long, shorter hairs on costae, rest of pinna bearing many suberect acicular hairs 0.2 mm long and many short capitate hairs or small glands. *Sori* probably medial, confluent at maturity and covering most of lower surface, exindusiate; sporangia bearing either a short seta or a short capitate hair; spores with extended sinuous wings which are joined together irregularly.

Distr. *Malesia*: Papua New Guinea, only known from the type.

Note. Allied to *P. costata* but very distinct.

9. Pneumatopteris egenolfioides HOLTTUM, Blumea 21 (1973) 306. — Type: BRASS 11497, New Guinea, near Lake Habbema, 2200 m, on limestone cliffs (L; BM, BO, MICH).

Caudex slender, procumbent, 8 cm long with a tuft of stipes at apex; *stipe* 10–17 cm long, pale, glabrous, base covered with dark ovate-acute glabrous scales 1.2 mm long. *Lamina* to 45 cm long; pinnae to 28 pairs, firm to rigid, 3–4 lower pairs gradually smaller and more widely spaced, lowest 5–7 mm long. *Largest pinnae* 2.4–3.2 cm long, 0.6–0.8 cm wide, base strongly auricled on acroscopic side, narrowly cuneate on basiscopic; apex narrowed, subtruncate with a small mucro; edges lobed *c.* 1/3 towards costa; lobes oblique, near bases of larger pinnae obliquely truncate with teeth at vein-ends; costules 3 mm apart, at little more than 45° to costa; veins mostly 2 pairs (3 pairs in basal auricle), 1 pair anastomosing with a short excurrent vein to the sinus-membrane, free in distal part of pinna, pale and prominent on lower surface; *lower surface* hairless, with residual very small scales on costae, costules and veins, surface between veins pustular; *upper surface* hairy on rachis and bases of costae only. *Sori* only on basal acroscopic vein of each group, near costule; indusium firm, glabrous; a short capitate hair present on some sporangia.

Distr. *Malesia*: W. New Guinea (Habbema).
Ecol. Limestone cliffs at 2200 m.

10. Pneumatopteris patentipinna HOLTTUM, Blumea 21 (1973) 307. — Type: T. G. WALKER 8477, N.E. New Guinea, trail from Moro to Sewi (BM).

Caudex short-creeping; *stipe* 5–15 cm long, pale, glabrescent or with a few brown hairs, basal scales thin, caducous. *Lamina* to 60 cm long (of type 35 cm); 5–10 pairs of lower pinnae gradually smaller, lowest less than 1 cm long; *reduced pinnae* either auricled on acroscopic base or dilated both sides, middle ones broadly triangular, opposite or not; all pinnae at right angles to rachis; texture firm. *Largest pinnae* of type 4.0 cm long, 1.1 cm wide above auricled base, of largest plants seen 8.5 × 1.8 cm; base truncate; apex short-acuminate, slightly upcurved; edges of pinnae of largest fronds lobed ½ way to costa, of smaller fronds less deeply, lobes truncate with acute falcate apex, ± toothed at ends of veins; costules 3–4 mm apart; veins 4–6 pairs, pale and prominent, 1 pair anastomosing, next vein to sinus-membrane or edge; *lower surface* of rachis and costae bearing a variable number of brown hairs, some short pale hairs also on costae, rather sparse large pustules on surface between veins; *upper surface* of rachis covered with thick brown hairs to 1 mm long, hairs on costae shorter, few, pale distally. *Sori* medial, indusia large, thin, bearing a variable number of short acicular hairs; no glandular hairs on sporangia. Chromosomes: n = 36 (T. G. WALKER).

Distr. *Malesia*: Eastern New Guinea, at 1650–2300 m.

Note. The type appeared to be very distinct, but later collections indicate a possible gradation to the condition of *P. jermyi*.

11. Pneumatopteris cheesmaniae HOLTTUM, Blumea 21 (1973) 307. — Type: L. E. CHEESMAN 1269, Japen Island, Aian Range, 300 m, in forest on old coral limestone (BM).

Stipe at least 14 cm long, pale, glabrous; *lamina* 26 cm long, pinnae c. 14 pairs, basal 3 pairs of pinnae gradually reduced, lowest 3–5 mm long. *Largest pinnae* 3.3 cm long, 1.1 cm wide above auricled base, basiscopic base truncate; apex short-pointed; edges lobed 2/5 or a little more deeply; lobes ± quadrate, apices subtruncate with slight projections at vein-ends, edge not conspicuously cartilaginous; costules 3–3.5 mm apart, almost at right angles to costa; veins 3 pairs except in basal auricle which has 4–5 pairs, slender, concolorous, basal ones meeting to form a very short excurrent vein below the sinus or in smaller pinnae meeting at the sinus-membrane; *lower surface* quite hairless, surface between veins slightly pustular; *upper surface* not seen. *Sori* inframedial, lowest not divergent, exindusiate; sporangia often with a pear-shaped small gland.

Distr. *Malesia*: New Guinea (Japen I.), only known from type.

Ecol. In forest on old coral limestone, 300 m altitude.

12. Pneumatopteris lithophila HOLTTUM, *sp. nov.*

Lamina 30 cm longa; pinnae 16–18-jugatae, inferiores 6–7-jugatae sensim decrescentes; pinnae maximae 3.0 × 1.0 cm, marginibus crenatis, apicibus rotundatis, pagina inferiore fere glabra; rachis supra pilis brunneis vestita, pinnae supra inter venas pilis erectis acicularibus minutis praeditae; sori mediales, indusia glabra. — Type: M. G. PRICE & B. F. HERNAEZ 779, Western Samar, on limestone cliff in forest, 700 m (K).

Caudex short; *stipe* 3–6 cm long, pale, hairy in groove, basal scales very small, broad, thin. *Lamina* 30 cm long; pinnae 16–18 pairs, 6–7 lower pairs gradually decrescent, lowest 3 × 3 mm; texture thin. *Largest sterile pinnae* 3.0 × 1.1 cm, fertile 2.5 × 1.0 cm; base truncate, a little auricled on acroscopic side; apex rounded; edges crenate to a depth of 1–1.5 mm; costules 2.5 mm apart; veins 3–4 pairs at base of largest pinnae, basal pair anastomosing to form an excurrent vein to the short sinus-membrane, next acroscopic vein to the membrane or the margin; *lower surface* of rachis glabrous, very sparse minute acicular hairs present on costae and costules, sometimes also between veins, a few short capitate hairs on costules, veins and on surface between veins which is slightly pustular; *upper surface* of rachis covered with slender brown hairs 1 mm long, hairs on costae pale and shorter, short erect acicular hairs rather sparse on surface between veins. *Sori* medial; indusia small, glabrous; neither glands nor setae on sporangia; spores pale, with many small wings.

Distr. *Malesia*: Philippines (W. Samar), 2 coll. from type locality.

Ecol. On limestone cliff in forest at 700 m altitude.

13. Pneumatopteris angusticaudata HOLTTUM, Blumea 21 (1973) 308. — Type: BRASS 24984, New Guinea, Goodenough Island, 800 m, on a rock-face beside a stream (BM; LAE).

Fronds pendent (collector); *stipe* short; base of stipe to first large pinna 50–55 cm; *reduced pinnae* 6 pairs, 3–5 mm long, then 2 pairs of intermediate length. *Lamina* excluding reduced pinnae 65 cm long; pinnae 25 pairs; several pairs of lower pinnae narrowed towards their bases, especially on basiscopic side; texture firm. *Largest pinnae* 15 × 1.2 cm; base broadly cuneate to full width on acroscopic side, narrowly cuneate on basiscopic; apex acuminate with subentire cauda 4–5 cm long and 1 mm wide; edges lobed to a depth of 2 mm; lobes very oblique, falcate, subacute, entire; costules 4 mm apart; veins 4–5 pairs, 1 pair anastomosing, next acroscopic vein to side of sinus-

membrane; *lower surface* quite glabrous; *upper surface* of rachis bearing a few short hairs, similar hairs on bases of costae, rest glabrous. *Sori* medial; indusia small, thin, with many short hairs; no glands nor setae on sporangia.

Distr. *Malesia*: Papua New Guinea (Goodenough I.), known from the type only.

Ecol. Rock-face beside a stream at 800 m altitude.

14. Pneumatopteris microloncha (CHRIST) HOLTTUM, Blumea 21 (1973) 308. — *Dryopteris microloncha* CHRIST, Philip. J. Sci. 2 (1907) Bot. 202. — *Cyclosorus microlonchus* (CHRIST) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 366. — *Thelypteris microloncha* (CHRIST) REED, Phytologia 7 (1968) 293. — Lectotype (HOLTTUM 1973): MANGUBAT BS 1304, Cavite, Luzon (P).

Dryopteris caudiculata v.A.v.R. Handb. (1908) 820 (based on *Nephrodium caudiculatum* J. SM. *nom. nud.*).

Caudex erect; *stipe* 4–10 cm long, pale, glabrous, scales broad, thin, not persistent. *Lamina* 25–45(–55) cm long; pinnae 15–25 pairs, texture thin; 3–6 pairs of lower pinnae gradually smaller, lowest 3–5 mm long. *Largest pinnae* 3–12 cm long, 0.6–1.5 cm wide; base subtruncate, a little dilated both sides or only on acroscopic side; apex acuminate, ± caudate on longest pinnae; edges lobed ½ way to costa; lobes obliquely quadrate, ± dentate at ends of veins; costules 2–4 mm apart; veins 3–4(–6) pairs, slender and prominent, 1 pair anastomosing, next pair to sinus-membrane on larger pinnae; *lower surface* bearing short slender erect hairs throughout; *upper surface* of rachis bearing slender pale hairs 0.5 mm long, similar hairs sparse on costae, no others. *Sori* medial; indusia short-hairy; sporangia with rather large pale or yellowish club-shaped hairs.

Distr. *Malesia*: Philippines (Luzon, Negros).

Ecol. At low altitudes on rocky stream-banks.

Note. CHRIST cited several specimens (the lectotype is the best in his herbarium), among them CUMING 317, which is one of several numbers cited by JOHN SMITH under "*Nephrodium caudiculatum* PRESL" (a non-existent name), the others representing *Sphaerostephanos productus*. v.A.v.R., adopting SMITH's name, copied CHRIST's description. Plants are fertile from a small size.

15. Pneumatopteris brooksii (COPEL.) HOLTTUM, Blumea 21 (1973) 308. — *Dryopteris brooksii* COPEL. Philip. J. Sci. 3 (1908) Bot. 345; v.A.v.R. Handb. Suppl. (1917) 185. — *Thelypteris brooksii* (COPEL.) REED, Phytologia 17 (1968) 265. — Type: C. J. BROOKS *s.n.* April 1908, Bidi, Sarawak (MICH; BM).

Caudex erect or suberect; *stipe* 20–50 cm long, pale, glabrescent, basal scales appressed; base of stipe to first large pinna 40–70 cm; *reduced pinnae* 3–4 pairs, 4–5 mm long. *Lamina* excluding reduced pinnae 75 cm long; pinnae more than 40 pairs, texture firm; several pairs of lower pinnae gradually narrowed towards their bases, not auricled. *Largest pinnae* 10–12.5 × 1.0–1.3 cm; base abruptly broad-cuneate; apex evenly and narrowly attenuate; edges lobed *c.* 1/3 towards costa, lobes slightly oblique with rounded apices; costules 3.5–4 mm apart; veins 4–5 pairs (to 7 pairs in largest sterile pinnae), slender, 1 pair anastomosing with a long excurrent vein, next veins to edge; *lower surface* quite glabrous, hardly pustular; a few short pale hairs in groove of *upper surface* of rachis, few or none on costae. *Sori* medial; indusia small, firm, glabrous; sporangia lacking glandular hairs.

Distr. *Malesia*: Borneo (Sarawak), several collections.

Ecol. On limestone.

16. Pneumatopteris inclusa (COPEL.) HOLTTUM, Blumea 21 (1973) 306. — *Dryopteris inclusa* COPEL. Univ. Cal. Publ. Bot. 14 (1929) 373, pl. 57. — *Thelypteris inclusa* (COPEL.) REED, Phytologia 17 (1968) 284. — Type: BARTLETT 8576, Sumatra, Karo Plateau (UC).

Dryopteris berastagiensis C. CHR. Dansk Bot. Ark. 9, 3 (1937) 59. — Type: RIDLEY *s.n.* 1921, Sumatra, Berastagi (K).

Caudex creeping, 10 mm diameter; *stipe* not seen. *Lamina* to at least 100 cm long; pinnae to 20 pairs, thin but firm; basal pinnae not or slightly reduced. *Largest* pinnae 28 × 5 cm; base of lower pinnae cuneate, of upper ones truncate; apex abruptly short-acuminate; edges lobed 1/4 towards costa or less deeply; lobes obliquely truncate with slight teeth at ends of veins; costules 6.5–7.5 mm apart, at a little more than 60° to costa; veins 10–12 pairs, slender, 2½ pairs anastomosing, 2½–3 pairs passing to sides of sinus-membrane; *lower surface* glabrous in type, with sparse slender hairs on costae and costules of another specimen; *upper surface* with short hairs on rachis and costae only. *Sori* medial; indusia thin with a few short hairs; hairs on stalks of sporangia with swollen orange end-cell; spores with many small wings.

Distr. *Malesia*: Central and north Sumatra, several collections.

Note. There is some variation among the specimens included here. One collected by C. G. MATTHEW at Padang Panjang has thinner pinnae than the type, with slender hairs on lower surface of costae and costules; it also has the basal pair of pinnae distinctly reduced (12 and 17 cm long) with much-narrowed bases. Other collections show different parts of fronds and are difficult to compare.

17. Pneumatopteris longipes (BL.) HOLTTUM, Blumea 21 (1973) 306. — *Aspidium longipes* BL. En. Pl. Jav. (1828) 155; MIQUEL, Ann. Mus. Bot.

Lugd.-Bat. 4 (1869) 158. — *Nephrodium longipes* (BL.) MOORE, Ind. Fil. (1868) 95; RACIB. Fl. Btzg 1 (1898) 182. — *Dryopteris longipes* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 211; BACKER & POSTH. Varenfl. Java (1939) 58. — *Thelypteris longipes* (BL.) REED, Phytologia 17 (1968) 289. — Type: BLUME, Java, Boerangrang (L, *n.* 908,335–1062).

Caudex long-creeping, to 10 mm diameter; *stipe* *c.* 100 cm long, pale, glabrous, basal scales *c.* 10 × 4 mm. *Lamina* *c.* 100 cm long; pinnae to 35 pairs; basal pair of pinnae not opposite, not auricled, variably unequal and reduced, in some cases 2.5 cm long, in others much longer, ± narrowed near their bases. *Largest pinnae* 17–22 × 2.2–3.0 cm; base truncate; apex narrowly acuminate; edges lobed *c.* 2/3 towards costa, lobes with rounded tips, at most slightly dentate at vein-ends; costules 4 mm apart; veins to 11 pairs, lowest only anastomosing, next pair to margin or to the short sinus-membrane; sparse erect hairs on *lower surface* of costules and distally on costae, on sinus-membranes and margin, surface between veins finely and not copiously pustular; *upper surface* hairy on rachis and costae only. *Sori* medial; indusia small, hairy; sporangia sometimes with a small capitate hair.

Distr. *Malesia*: Java, at 1400–1800 m.

18. Pneumatopteris laevis (METT.) HOLTTUM, Blumea 21 (1973) 308. — *Aspidium laeve* METT. Farngatt. IV (1858) 104. — *Dryopteris laevis* (METT.) C. CHR. Ind. Fil. (1905) 273; v.A.v.R. Handb. (1908) 220. — *Thelypteris laevis* (METT.) REED, Phytologia 17 (1968) 286. — Neotype (HOLTTUM 1973): JAGOR, Samar (B, *ex* Herb. Mett.).

Dryopteris luzonica CHRIST, Philip. J. Sci. 2 (1907) Bot. 196, *excl. var. puberula*; v.A.v.R. Handb. (1908) 821, *excl. var. puberula*. — Lectotype (HOLTTUM 1973): LOHER *s.n.* Jan. 1906, Mt Makiling, Luzon (P).

Cyclosorus nitidulus sensu COPEL. Fern Fl. Philip. (1960) 364, *p.p.* — *Cyclosorus microlonchus sensu* COPEL. *ibid.* 366, *p.p.* — **Fig. 11g–h.**

Caudex quite prostrate with closely seriate fronds; *stipe* 12–18 cm long, pale, glabrous; base of stipe to first large pinna *c.* 30 cm; *reduced pinnae* 3–5 pairs, transition to large ones gradual or subabrupt, lowest 5–10 mm long, all strongly auricled on acroscopic base. *Lamina* in all 50–80 cm long (sometimes fertile at a smaller size); pinnae to 25 pairs. *Largest pinnae* to 18 cm long, 1.4–2.0 cm wide; middle and upper pinnae oblique, with very asymmetric base, auricled on acroscopic side, narrower and rounded on basiscopic; apex caudate-acuminate (cauda 2–4 cm long); edges lobed *c.* 1/3 towards costa; lobes oblique, subtruncate with teeth at vein-ends; costules 4–4.5 mm apart; veins 5–8 pairs, slender, basal pair anastomosing, next acroscopic vein to sinus-membrane; *lower surface* quite glabrous, slightly pustular between veins; *upper surface* bearing short pale hairs on rachis and costae (in a few cases hairs on rachis red-brown). *Sori* medial, lower ones not divergent; indusia glabrous or with a few short acicular or capitate hairs on edges; sporangia usually lacking glands. *Chromosomes*: n = 36 (T. G. WALKER, plant cult. Kew).

Distr. *Malesia*: Philippines (Luzon, Negros, Samar, Leyte, Mindanao).

Ecol. On rocky banks of streams, with pendulous fronds; low altitudes.

Notes. Mettenius cited as type "Cuming 83 bis ex parte"; this is not represented in his herbarium at Berlin. The neotype is one named by him and agreeing with his description. Copeland's treatment is very confused. M. G. Price has sent to Kew several dried specimens and also living plants which have supplied information for the above description. One of his specimens has red-brown hairs on the rachis and a few capitate hairs on its sporangia.

19. Pneumatopteris obliqua HOLTTUM, Blumea 21 (1973) 309. — Type: P. & F. SARASIN 127, Masarang, N. Celebes (BAS).

Caudex short-creeping; *stipe* *c.* 40 cm long, pale, glabrous; base of stipe to first large pinna 90 cm or more; *reduced pinnae* to 12 pairs, all *c.* 3 × 3 mm or the uppermost a little larger, transition to large pinnae abrupt. *Lamina* excluding reduced pinnae to 65 cm long; pinnae 25 pairs, all except lower ones very oblique; several pairs of lower pinnae gradually narrowed towards their bases, not auricled. *Middle pinnae* to 16 × 1.6–1.9 cm; base very asymmetric, basal basiscopic lobe much reduced, basal acroscopic lobe not longer than next; apex acuminate with almost entire cauda 3–4 cm long; edges lobed *c.* 3/5 towards costa, lobes with falcate acute tips and slight teeth at vein-ends; costules to 5 mm apart, at *c.* 50° to costa; veins slender, 7–8 pairs, basal pair meeting at base of sinus-membrane, next acroscopic vein passing to side of membrane, rest to margin; *lower surface* of rachis rather densely covered with hairs 0.1–0.2 mm long, similar hairs more sparse on costae, surface between veins with rather sparse large pustules; *upper surface* of rachis and costae bearing pale hairs to 0.5 mm long. *Sori* medial; indusia thin, glabrous or with a few short hairs; sporangia sometimes with small capitate hairs.

Distr. *Malesia*: North Celebes, in forest at 1100–1200 m (5 collections).

20. Pneumatopteris basicurtata HOLTTUM, Blumea 21 (1973) 309. — Type: ROBINSON & KLOSS 148, G. Kerinci, Sumatra, 2250 m (BM).

Stipe 42 cm long, pale, minutely hairy; *lamina* 50 cm long, comprising 15 pairs normal pinnae and one basal pair 2 cm long, 1.2 cm wide at base which is strongly auricled on acroscopic side;

lowest normal pinnae more widely-spaced, deflexed, much narrowed at their bases on basiscopic side; texture thin but firm. *Largest pinnae* of type 12 × 2.4 cm, of BÜNNEMEIJER 10296 19 × 2.7 cm; base truncate, slightly dilated both sides; apex short-acuminate; edges lobed a little more than ½ way to costa; lobes falcate with ± acute tips, not toothed at vein-ends; costules 5–5.5 mm apart, at a wide angle; veins 9–10 pairs, basal pair anastomosing, next pair to sinus-membrane; *lower surface* quite glabrous except for a few slender hairs on costules and veins near tips of lobes, also on sinus-membrane and margin. *Sori* medial; indusia large, rather firm, with a few hairs; sporangia sometimes with capitate hairs.

Distr. *Malesia*: Sumatra: G. Kerinci (2 collections) and near Lake Toba.

Note. It is possible that these specimens are not distinct from *P. longipes* of Java; information about the caudex and constancy of basal pinnae is needed.

21. Pneumatopteris microauriculata HOLTTUM, Blumea 21 (1973) 311. — Type: CLEMENS 27137, Mt Kinabalu, Sabah, 850 m (BM).

Caudex short-creeping with closely seriate fronds; *stipe* 50–70 cm long, pale except near base, glabrous, basal scales *c.* 2.5 × 2.0 mm. *Lamina* 35–40 cm long, consisting of *c.* 18 pairs normal pinnae and 1 pair 1 mm long 6–8 cm below basal normal pair; basal pinnae narrowed gradually towards their bases which are 8 mm wide, not auricled; texture firm. *Largest pinnae* 12 × 1.6 cm; base somewhat asymmetric, truncate and slightly auricled on acroscopic side, narrow and rounded on basiscopic; apex upcurved, acuminate, serrate to tip; edges lobed *c.* 2/5 towards costa; lobes falcate, broadly pointed, not toothed; costules 3.5–4 mm apart, at a wide angle to costa; veins 8 pairs, concolorous, prominent both sides, 1 pair anastomosing, 1½–2 pairs passing to sides of sinus-membrane; *lower surface* of rachis glabrous, costae bearing very short pale hairs distally, a few hairs on sinus-membrane, surface between veins pustular; *upper surface* hairy on rachis and costae only. *Sori* a little inframedial, lower ones not divergent; indusia large, thin, glabrous, caducous; sporangia lacking glands.

Distr *Malesia*: Borneo (Sabah: Mt Kinabalu), collections.

22. Pneumatopteris ecallosa (HOLTTUM) HOLTTUM, Blumea 21 (1973) 310. — *Cyclosorus ecallosus* HOLTTUM, Gard. Bull. Sing. 11 (1947) 269; Rev. Fl. Mal. 2 (1955) 272, f. 156. — *Thelypteris ecallosa* (HOLTTUM) REED, Phytologia 17 (1968) 274. — Type: HOLTTUM 31294, Cameron Highlands, Malaya (SING; BO, K).

Caudex short-creeping; *stipe* to 100 cm long, pale except near base, glabrous, scales thin, adherent. *Lamina* to 100 cm long, consisting of *c.* 35 pairs normal pinnae and at the base 2–3(–4) pairs of subequal opposite pinnae *c.* 2.5 × 2.5 cm, deeply lobed, strongly auricled on the acroscopic side; several pairs of lower normal pinnae narrowed towards their bases with a lobed acroscopic auricle; texture thin. *Largest pinnae* commonly 20 × 2.2 cm, sterile pinnae to 28 × 3 cm; base truncate; apex narrowly attenuate; edges lobed *c.* ½ way to costa (sterile pinnae often more deeply); lobes not falcate, truncate with slight teeth at vein-ends; costules to 5 mm apart, at a wide angle to costa; veins 7–12 pairs, prominent both sides, lowest pair anastomosing, next pair to sinus-membrane; *lower surface* quite glabrous, minutely pustular between veins; *upper surface* of rachis and costae bearing short pale hairs. *Sori* inframedial, lower ones not divergent; indusia thin, glabrous; sporangia bearing many short club-shaped glands.

Distr. *Malesia*: Malaya (middle and north of Main Range).

Ecol. Near streams in forest; now abundant in secondary growth near streams where forest has been felled at Cameron Highlands, 1500 m.

23. Pneumatopteris auctipinna HOLTTUM, Blumea 21 (1973) 310; Reinwardtia 8 (1974) 499. — Type: P. & F. SARASIN 119, N. Celebes, Tomohon (BAS).

Aspidium truncatum var. celebicum? MIQUEL, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 160. — Type: DE VRIESE, Menado, N. Celebes (L).

Aspidium truncatum sensu CHRIST, Ann. Jard. Bot. Btzg 15 (1898) 133, as regards specimens cited from Celebes.

Caudex short, erect (ALSTON); *stipe* 20 cm long, pale, minutely hairy; base of stipe to first large pinna 75 cm; *reduced pinnae c.* 8 pairs, all with a broad asymmetric base which is enlarged to form a serrate auricle, uppermost 2.5–4.0 × 2–3 cm, lowest 1.5 × 1.5 cm. *Lamina* excluding reduced pinnae 80 cm or more long; pinnae *c.* 25 pairs, thin but firm, 2–3 lower pairs with ± auricled base as reduced pinnae. *Largest pinnae* 20 × 2.5 cm; base truncate (except sub-basal ones); apex caudate-acuminate (cauda 2.5 cm, sinuous or crenate); edges lobed 1/2–1/3 towards costa; lobes subtruncate to rounded with slight teeth at vein-ends; costules 4–4.5 mm apart, at a wide angle to costa; veins 8–10 pairs, slender, prominent both sides, often pale reddish on lower surface, basal 1–1½ pairs anastomosing, next 2–2½ pairs to the sinus-membrane; lower surface of rachis and costae rather densely covered with short erect pale hairs, sparse hairs on costules, veins and on surface between veins which is finely pustular; hairs on *upper surface* of costae pale, 0.5 mm long, rest of surface glabrous. *Sori* a little inframedial, basal ones not divergent; indusia small, short-hairy; sporangia bearing capitate hairs.

Distr. *Malesia*: North & Central Celebes, East Java, Lesser Sunda Is. (Flores) and Moluccas (Buru & Amboina), 900–2000 m.

Note. SARASIN 124 bears a note that young fronds are rose-coloured.

24. Pneumatopteris jermyi HOLTTUM, Blumea 21 (1973) 310. — Type: JERMY 3739, N.E. New Guinea, Butemu, Moro Trail (BM).

Caudex short, suberect; *stipe* 23 cm long, pale, hairs brown, sparse above base; base of stipe to first large pinna 50 cm; *reduced pinnae c.* 6 pairs, not opposite, uppermost 1.5–2.0 cm long, 0.8 cm wide at base which is truncate and slightly auricled on acroscopic side, lowest 2–3 mm long, ± orbicular. *Lamina* excluding reduced pinnae 60 cm long; pinnae 22 pairs, texture thin but firm; lowest pinnae slightly narrowed towards their bases, ± auricled on acroscopic side. *Largest pinnae* of type 13 × 1.8 cm (of another specimen 14 × 2.5 cm); base truncate; apex acuminate with narrow subentire cauda 2–3.5 cm long; edges lobed ½ way to costa or a little less deeply, lobes subtruncate with slight projections at vein-ends; costules 4 mm apart, at a wide angle to costa; veins to 9 pairs, concolorous, basal pair meeting at an obtuse angle to produce a slender excurrent vein which may be joined by another vein before entering base of sinus-membrane, next pair of veins to sides of the membrane; *lower surface* of rachis bearing stiff curved brown hairs more than 0.5 mm long, similar hairs near bases costae grading to pale hairs distally, rest of surface almost glabrous; *upper surface* of rachis and costae hairy as lower. *Sori* inframedial, lower ones not divergent; indusia short-hairy; sporangia lacking glands.

Distr. *Malesia*: Eastern New Guinea, 1150–2000 m.

25. Pneumatopteris papuana HOLTTUM, Blumea 21 (1973) 311. — Type: BRASS 22778, Mt Dayman, E. New Guinea, 2000 m (LAE; BM, L).

Differs from *P. jermyi* as follows: lamina excluding reduced pinnae to 150 cm long; largest pinnae 18 × 3.5 cm, lobed 1/2–2/3 towards costa; costules 5–6 mm apart; basal veins meeting at an acute angle at base of sinus-membrane, sometimes without true anastomosis; lower surface of costae and rachis glabrous or with few brown hairs; indusia glabrous.

Distr. *Malesia*: Eastern New Guinea, 1750–2000 m.

Note. A specimen from near Bulolo has pinnae to 24 × 3.5 cm, lobed rather more than 2/3, with copious brown hairs on lower surface of rachis and costae. Field study of this and *P. jermyi* is needed to confirm distinctions between them, or possibly to indicate that they should be united.

26. Pneumatopteris rodigasiana (T. MOORE) HOLTTUM, Blumea 21 (1973) 319; Allertonia 1 (1977) 233. — *Nephrodium rodigasianum* T. MOORE in Linden, Ill. Hort. 29 (1882) 27, pl. 442. — *Thelypteris rodigasiana* (T. MOORE) REED, Phytologia 17 (1968) 310. — *Dryopteris transversaria* (BRACK.) C. CHR. *var. rodigasiana* C. CHR. Bishop Mus. Bull. 177 (1943) 88. — Type: cult. LINDEN, *ex* Herb. T. Moore (K).

Cyclosorus rotumaensis ST. JOHN, Occ. Pap. Bish. Mus. 21 (1954) 180. — Type: ST. JOHN 19139, Rotuma I. (BISH; K).

Caudex erect; *stipe* 9–18 cm long, pale, minutely hairy. *Lamina* to 100 cm or more long; pinnae thin, lower 6–9 pairs gradually decrescent, lowest less than 1 cm long, none of them either narrowed or auricled at their bases. *Largest pinnae* 18 × 2 cm; base truncate; apex narrowly acuminate; edges lobed ½ way to costa; lobes slightly falcate with rounded tips, projections at vein-ends slight; costules 4–5.5 mm apart; veins slender, hardly prominent, concolorous, 6–9 pairs, 1 pair anastomosing, next acroscopic vein to sinus-membrane or to margin; *lower surface* of rachis and costae bearing very short erect pal hairs, a few such hairs on costules and veins an some on the surface between veins; *upper surface* of rachis bearing pale hairs 0.5 mm long, shorter hairs on costae, no others. *Sori* a little inframedial; indusia thin, glabrous or with a few hairs in the middle; sporangia bearing capitate hairs. *Chromosomes*: n = 36 (T. G. WALKER).

Distr. Polynesia (Samoa, Niue I.), Melanesia (Solomons, New Hebrides, Rotuma I.), and *E. Malesia*: Papua New Guinea (Admiralty Is., New Ireland).

27. Pneumatopteris japenensis HOLTTUM, *sp. nov.*

Pinnae basales redactae 12-jŭgatae, superiores 1.5 cm longae, auriculatae; lamina 100 cm longa; pinnae maximae 24 × 2 cm, profunde lobatae, tenues; venae infimae anastomosantes, vena communi excurrenti perbrevi; pagina inferior inter venas glandulas minutas ferens; indusia parva, glabra. — Type: AET & IDJAN 426, Japen Island, W. New Guinea (SING; K, L).

Caudex short, erect or suberect; *stipe c.* 12 cm long, pale, glabrescent, when young covered with scales 15 × 3 mm; base of stipe to first large pinnae 65 cm; *reduced pinnae* 12 pairs, upper ones auricled, uppermost 1.5 cm long with auricle 4 × 1 mm on acroscopic base, narrowed to basiscopic base, lower ones less than 5 mm long, an intermediate pinna *c.* 8 cm long sometimes present. *Lamina* excluding reduced pinnae more than 100 cm long; pinnae more than 30 pairs, thin, drying pale olivaceous; lower pinnae somewhat narrowed at their bases which are slightly auricled. *Largest pinnae* 24 × 2.0 cm; base truncate; apex with narrow entire cauda 2.5 × 0.3 cm; edges lobed to 1.5 mm from costa; lobes at right angles to costa, separated by broad sinuses, their tips rounded with slight teeth at vein-ends; costules 4–5 mm apart; veins 12–13 pairs, basal pair anastomosing to form a very short vein excurrent to the sinus;

lower surface of rachis, costae and costules bearing sparse pale hairs to 1 mm long, between veins sparse short erect acicular hairs and small colourless glands which collapse when dried, surface not pustular; *upper surface* of rachis bearing coarse pale hairs 1 mm long, hairs on costae shorter, minute acicular hairs and glands between veins. *Sori* a little inframedial, lower ones not divergent; indusia small, glabrous; sporangia apparently lacking glands; spores with a fairly broad erose wing and some anastomosing cross-wings.

Distr. *Malesia*: New Guinea (Japen I.), only known from type.

28. Pneumatopteris tobaica HOLTTUM, Blumea 21 (1973) 316. — Type: SURBECK 14, N. Sumatra, S side of Lake Toba, 1900 m (L; BO).

Stipe not seen; base of stipe to first large pinna more than 50 cm; *reduced pinnae* 5–6 cm apart, *c.* 7 × 7 mm, not auricled; *basal normal pinnae* much narrowed towards their bases, not auricled, base of fifth pinna less than 1 cm wide. *Largest pinnae* 24 × 2.8 cm; apex acuminate, serrate to tip; edges lobed to 4 mm from costa; lobes oblong, subtruncate with irregular short teeth at vein-ends; costules 5–5.5 mm apart; veins 11–12 pairs, basal pair anastomosing, rest all to margin; *lower surface* of rachis bearing sparse hairs, of pinnae glabrous apart from a few hairs on sinus-membranes and margin, surface slightly pustular; *upper surface* of costa bearing sparse hairs, rest glabrous. *Sori* inframedial; indusia firm, with a ew short hairs; sporangia bearing capitate hairs.

Distr. *Malesia*: N. Sumatra. Known only from type collection.

Note. The Bogor isotype includes a small plant with erect caudex, but it is not certain that this represents the same species as the large frond. The reduced pinnae are only shown by the Leiden specimen; apart from them, the fronds are very like those of *P. longipes*. More collections are needed.

29. Pneumatopteris incisa HOLTTUM Blumea 21 (1973) 317. — Type: ALSTON 16623, Ternate, G. Gamalama (BM).

Stipe 15 cm long; base of stipe to first large pinna 50 cm; *reduced pinnae* 7 pairs, subopposite, uppermost 1.5 × 1.0 cm, triangular, base symmetrically truncate, edges crenate, apex blunt, lowest 5–6 mm long and wide. *Lamina* excluding reduced pinnae 70 cm long; pinnae 30 pairs, texture firm; lower pinnae sub-opposite, gradually narrowed towards their bases, base of lowest 10 mm wide, not auricled; middle pinnae with basal 1–2 pairs of lobes somewhat reduced, basal basiscopic lobe usually longer than acroscopic; upper pinnae with cuneate bases. *Largest pinnae* 21 × 2.7 cm; apex acuminate with subentire cauda 2–2.5 cm long; edges lobed to 2.5 mm from costa; lobes slightly falcate, their tips rounded, entire; costules 5 mm apart, at a wide angle to costa; veins to 12 pairs, slender, pale and prominent both sides, basal pair anastomosing, next pair usually both to margin; *lower surface* of rachis sparsely hairy, of costae and costules with short slender pale erect hairs, somewhat longer hairs on veins and sparsely on surface between veins, longer ones on sinus-membrane and margin, surface between veins slightly pustular; *upper surface* of costae with hairs 1 mm long, rest of pinna glabrous. *Sori* inframedial, lower ones not divergent; indusia thin, with slender hairs; sporangia bearing capitate hairs.

Distr. *Malesia*: Moluccas (Ternate; Halmahera, PLEYTE 397).

Ecol. By stream in forest, at 600 m.

30. Pneumatopteris psilophylla HOLTTUM, *sp nov.*

Pinnae redactae 3-jugatae, usque 7 × 5 mm; pinnae normales steriles usque 17 × 2.8 cm, 2/3 costam versus lobatae, subtus perfecte glabrae; venae 12-jugatae, infimae vel anastomosantes vel ad basin membranae sinus conniventes, par sequens latera membranae tegentes; pinnae fertiles ignotae. — Type: JERMY 13741, Sarawak, Gunong Mulu (BM).

Caudex erect (collector); *stipe* 10 cm long, pale, basal scales thin, to 8 mm long, 1–2 mm wide at base, small residual ones adherent; base of stipe to first normal pinna 25–30 cm; *reduced pinnae* 3 pairs, uppermost 7 × 5 mm, deltoid with almost symmetrical base, lowest very small; aerophores not elongate on dried specimens but functional on very young fronds which are covered with mucilage (collector). *Lamina* (sterile) 65 cm long; pinnae *c.* 25 pairs, basal pinnae slightly reduced and narrowed towards their bases in basal 5 cm, base 7–8 mm wide, pinnae above base successively less narrowed, 6 pairs or more with basal 1–2 pairs of lobes reduced. *Largest pinnae* 17 × 2.8 cm; apex acuminate with entire cauda 1.5–2.0 cm long; edges lobed 2/3 towards costa or a little more deeply, lobes slightly falcate, slightly narrowed distally, edges entire, cartilaginous margins well-marked; costules 5 mm apart; veins 12 pairs, slender, slightly prominent both sides, basal pair anastomosing or meeting at the base of the sinus-membrane, second pair passing to the sides of the membrane; *lower surface* quite glabrous; upper surface with sparse short pale hairs on rachis and costae. *Fertile fronds* not known.

Distr. *Malesia*: Borneo (Sarawak: Mt Mulu), only known from type.

Ecol. In humus in limestone crevices at 150 m.

Note. This is related to *P. truncata* but its pinnae are much more deeply lobed; it is probably confined to limestone.

31. Pneumatopteris pergamacea HOLTTUM, Blu-

mea 21 (1973) 315. — Type: JERMY 7877, New Ireland, cult. Hort. Bot. Kew, 123/70, *n.* 1035 (K).

Caudex short-creeping; *stipe* 10 cm long, bearing many rather persistent ± spreading scales 6–10 × 1 mm with acicular hairs 0.3 mm long on their dorsal surface; base of stipe to first normal pinna 60 cm; *reduced pinnae* to 15 pairs, uppermost 3.0 × 1.7 cm, subtriangular, base broadly cuneate and almost symmetric, edges lobed, tip acute, lowest *c.* 6 × 4 mm with base auricled both sides. *Lamina* excluding reduced pinnae 75 cm long, rather thin; pinnae 28 pairs; lowest 3.5 cm wide in the middle, narrowed towards the base which is 1.8 cm wide, not auricled. *Largest pinnae c.* 27 × 3 cm; base broadly cuneate to full width; apex rather abruptly caudate-acuminate, cauda subentire, to 3 cm long; edges lobed 3/5 towards costa; lobes slightly falcate, tips bluntly pointed, margins entire or nearly so; costules 5–5.5 mm apart, at *c.* 60° to costa; veins 11–12 pairs, concolorous, hardly prominent, basal pair anastomosing to form a short excurrent vein to base of sinus-membrane, next 1–1½ pairs passing to sides of the membrane; *lower surface* of rachis and costae sparsely and minutely hairy (hairs more abundant distally in both cases), a few short hairs on sinus-membranes and margins of lobes, rest glabrous, old fronds distinctly pustular between veins; *upper surface* of rachis bearing pale hairs more than 0.5 mm long and shorter ones, hairs on costae similar, rest of surface of pinnae of large fronds glabrous but acicular hairs present between veins of the small fronds of young plants, also on reduced basal pinnae of mature plants. *Sori* a little inframedial on distal veins, further from costules on lower veins especially near apex of pinna; indusia very small, hidden by mature sporangia, bearing a few short hairs; sporangia lacking glands; spores medium brown, bearing many minute wings.

Distr. *Malesia*: Papua New Guinea (New Ireland), only known from the type.

Ecol. On mossy limestone boulder in forest at 630 m.

32. Pneumatopteris sogerensis (GEPP) HOLTTUM, Blumea 21 (1973) 315. — *Dryopteris sogerensis* GEPP, J. Bot. 61 (1923) Suppl. 61. — *Cyclosorus sogerensis* (GEPP) COPEL. Gen. Fil. (1947) 146; Philip. J. Sci. 78 (1951) 450. — *Thelypteris sogerensis* (GEPP) REED, Phytologia 17 (1968) 314. — Type: FORBES 446, Sogere, S.E. New Guinea (BM).

P. laticuneata HOLTTUM, Blumea 21 (1973) 312. — Type: JERMY 8044, N.E. New Guinea (BM).

Caudex erect; *stipe* 15–30 cm long, pale, glabrous, bearing residual appressed scales; base of stipe to first normal pinna 70 cm or more; *reduced pinnae c.* 6 pairs, gradually decrescent downwards, uppermost *c.* 4 cm long, 1.5 cm wide at base which is slightly auricled both sides, crenate or lobed above base, lowest 10 × 5 mm or smaller. *Lamina* to 150 cm long, rather thin; pinnae to more than 40 pairs; lower pinnae narrowed near their bases which are about ½ maximum width. *Largest pinnae* commonly 27 × 2.5–3 cm, on largest fronds 36 × 4.5 cm (fronds often fertile at a much smaller size); base subtruncate; apex acuminate but not narrowly caudate; edges lobed ½ way to costa (less deeply in small plants, up to 2/3 in largest); lobes slightly falcate with slight projections at vein-ends; costules 4–5.5 mm apart, pale and prominent on lower surface; veins to 14 pairs, slender, concolorous, slightly prominent, 1 pair anastomosing and 1 pair to sides of sinus-membrane; *lower surface* entirely glabrous; upper surface rather sparsely hairy on rachis and costae, hairs pale, to 1 mm long. *Sori* inframedial, basal ones not divergent; indusia usually glabrous, rarely with some acicular hairs; sporangia lacking glands; spores pale with many small wings. *Chromosomes*: n = 36 (T. G. WALKER).

Distr. Australia (Queensland and north of New South Wales), Melanesia (Solomon Is.) and *Malesia*: Papua New Guinea (Bismarck Arch.) and Moluccas.

Ecol. In lowland forest, especially near streams; a common species.

Note. *P. laticuneata* was based on a small plant with shallowly lobed pinnae.

33. Pneumatopteris micropaleata HOLTTUM, Blumea 21 (1973) 319. — Type: HOLTTUM 58, Mt Kinabalu, Sabah, on wet rocks near waterfall, 1800 m (K; SING).

Caudex erect; *stipe* 10 cm long, pale, bearing short pale acicular hairs and appressed scales; base of stipe to first large pinna 50 cm; *reduced pinnae* 4–5 pairs, uppermost 1 cm long, 0.9 mm wide at subtruncate base, almost semicircular with projections at vein-ends, lowest 5 mm long. *Lamina* to 100 cm long, texture firm; pinnae *c.* 30 pairs; 1–2 pairs basal pinnae gradually narrowed in basal 2 cm. *Largest pinnae* 17 × 1.8 cm; base truncate; apex acuminate with entire cauda to 2 cm long; edges lobed a little more than ½ way to costa (basal pinnae lobed 3/5); lobes slightly oblique, not falcate, their apices broadly rounded, projections at vein-ends slight; costules 3–3.5 mm apart on a fertile frond; veins to 11 pairs, slender, concolorous, 1 pair anastomosing or meeting at base of sinus-membrane, next pair to sides of membrane; *lower surface* of rachis bearing rather sparse slender pale hairs 0.2–0.4 mm long, hairs on costae very short, near base only, on costules slender appressed pale hairs 0.5 mm long, small scales (the smallest linear) at first abundant on costae and costules; *upper surface* of rachis covered with slender pale hairs *c.* 1 mm long, similar shorter hairs on costae and sparse on costules and veins. *Sori* a little inframedial, basal ones not divergent; indusia glabrous; sporangia

bearing small capitate hairs; spores not seen (sporangia immature).

Distr. *Malesia*: Sabah (Mt Kinabalu), known from type only.

Ecol. On wet rocks near waterfall at 1800 m.

34. Pneumatopteris truncata (POIR.) HOLTTUM, Blumea 21 (1973) 314. — *Polypodium truncatum* POIR. Encycl. Meth. 5 (1804) 534. — *Dryopteris truncata* (POIR.) C. CHR. Ind. Fil. (1905) 299, *excl. Polystichum truncatum* GAUD.; v.A.v.R. Handb. (1908) 227, *quoad pl. Males.*; BACKER & POSTH. Varenfl. Java (1939) 54. — *Cyclosorus truncatus* (POIR.) FARW. Amer. Midl. Nat. 12 (1931) 259; CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 216; HOLTTUM, Rev. Fl. Mal. 2 (1955) 266, f. 152; COPEL. Fern Fl. Philip. (1960) 367. — *Thelypteris truncata* (POIR.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 33. — Type: "Brézil", no collector cited (P).

Aspidium abortivum BL. En. Pl. Jav. (1828) 154, *incl. var. B (var. C?).* — *Dryopteris abortiva* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 217. — Type: BLUME, W. Java (L, *n.* 908, 337–855).

Aspidium abruptum BL. En. Pl. Jav. (1828) 154. — Type: KUHL & VAN HASSELT, W. Java (L, *n.* 908, 337–817).

Aspidium eusorum THW. Enum. Pl. Zeyl. (1864) 391. — *Nephrodium eusorum* (THW.) BEDD. Ferns Br. India (1866) pl. 130. — Type: THWAITES CP 3064, Ceylon (K).

Dryopteris batacorum var. winkleri ROSENST. Fedde Rep. 13 (1914) 217. — Type: J. WINKLER 158a, Sumatra, in terra Batacorum (S-PA).

Cyclosorus lepidopodus C. CHR. & TARD. Notul. Syst. 7 (1938) 73; Fl. Gén. I.-C. 7, 2 (1941) 392, f. 45. — *Thelypteris lepidopoda* (C. CHR. & TARD.) REED, Phytologia 17 (1968) 287. — Type: EBERHARDT 5252, Tonkin, Bac Kan (BM).

P. christelloides HOLTTUM, Blumea 21 (1973) 311. — Type: CLEMENS 27451, Sabah, Mt Kinabalu, 1000 m (K; BM).

Nephrodium truncatum sensu RACIB. Fl. Btzg 1 (1898) 190, *non* (Gaud.) PRESL. — **Fig. 11d–f.**

Caudex erect; *stipe* 10–30 cm long, pale, glabrous, bearing residual thin appressed scales; base of stipe to first normal pinna 60–85 cm; *reduced pinnae* 6–10 pairs, not opposite, 3–6 cm apart, uppermost *c.* 1 × 1 cm, not auricled, 1 or 2 intermediate pinnae sometimes present. *Lamina* to 120 cm long, thin but firm; pinnae to 30 pairs or more; several pairs of lower pinnae much narrowed near their bases which are less than 1 cm wide and unlobed for 1–2 cm, not auricled. *Largest pinnae* commonly 20 × 2.5 cm (to 32 × 3.5 cm); base broadly cuneate to truncate; apex acuminate, in broader pinnae rather abruptly; edges lobed *c.* 1/3 towards costa, less deeply in narrower pinnae; lobes almost at right angles to costa, truncate, always with some teeth at ends of veins; costules 4–5 mm apart; veins to 12 pairs, pale and prominent, 1½–2 pairs anastomosing, 2 pairs to sides of the sinus-membrane where they usually unite to form a distinct vein on each side of the distal part of the membrane, often continuing close to the margin of a pinna-lobe to join higher veins there; *lower surface* of rachis and costae bearing a variable number of short slender erect pale hairs (in Sarawak sometimes quite glabrous), sparse hairs also on costules and veins and sometimes a few between veins where the surface is always pustular; *upper surface* of rachis bearing longer pale hairs, short hairs sparse on costae, minute on costules, sometimes a few between veins near apices of pinna-lobes. *Sori* a little inframedial, lower ones not divergent; indusia thin, glabrous (hairy on two specimens from Mt Kinabalu); sporangia bearing elongate small glands (lacking in some Sarawak specimens); spores with many small wings.

Distr. Ceylon & S. India; N.E. India to S. China; *Western Malesia*, Lesser Sunda Islands and Philippines.

Ecol. Near streams in forest, at 100–1200 m.

Notes. The epithet *truncatum*, as used by 19th century authors, was based on *Polystichum truncatum* GAUD. CHRISTENSEN cited *Polypodium truncatum* POIR. as basionym in Ind. Fil. (1905), wrongly placing GAUDICHAUD's name as a synonym. CHING was the first to see and describe POIRET's type, and accepted its origin as Brazil, but there is no species at all like it in S. America, and the specimen closely matches those from Ceylon and Malaya. A plant examined by MANTON in Ceylon was tetraploid. Smaller plants in N. India are diploid and differ in pinna-lobes and larger glands on sporangia (see HOLTTUM 1973); plants from G. Mulu, Sarawak, lacking glands on sporangia, are diploid (T. G. WALKER).

The type of *Aspidium abortivum* BL. was a lowland plant and agrees well with specimens from Malaya. The type of *A. abruptum* BL. was a mountain plant, differing in entire pinna-lobes, but among other specimens from Java there is much variation in the shape of pinna-lobes and it does not seem possible to divide the specimens on this character. Existing specimens do not show any possible distinctions in characters of the reduced basal pinnae, or of lower normal pinnae. As with several other species of this family from Java, good new specimens are needed.

The type of *P. christelloides* at Kew lacks the basal pinnae, but these are present on the BM isotype and show that my description of 1973 was inaccurate. The type differs chiefly from typical *P. truncata* in the unusual abundance of short hairs between the veins of both surfaces (but not on all pinnae), also on indusia. Another plant from Mt Kinabalu, cultivated at Kew, is identical. The pubescence is very like that of *Christella*.

Allied species have been described from China,

and need to be critically compared with Malesian specimens.

35. Pneumatopteris lawakii HOLTTUM, *nom. nov.* — *Polystichum truncatum* GAUD. in Freyc. Voy. Bot. (1827) 332. — *Aspidium truncatum* GAUD. *ibid.* t. 10. — Type: GAUDICHAUD, Rawak (= Lawak) I., W. New Guinea (P; B, FI).

P. glaberrima sensu HOLTTUM, Blumea 21 (1973) 318, *p.p.*

Agreeing with *P. truncata* (POIR.) HOLTTUM in the peculiar venation (which is well figured by GAUDICHAUD), differing as follows: fronds much smaller, and thinner; largest pinnae 15 × 1.8 cm; veins 6–7 pairs; lower surface quite glabrous; upper reduced pinnae 2.0 × 0.9 cm, lowest 0.5 cm.

Distr. *Malesia*: West New Guinea.

Notes. Known from the type and MCKEE NGF 1940 from Biak Island, from which the details of the reduced pinnae are described (not figured by GAUDICHAUD). The fronds of the type of *P. glaberrima* (RICHARD) are of similar size but the pinna-lobes are different. More specimens are needed from West New Guinea.

36. Pneumatopteris michaelis HOLTTUM, Blumea 21 (1973) 313. — Type: M. G. PRICE 317, Mt Makiling, Luzon, 1050 m (K).

Caudex erect; *stipe* of type 17 cm long, minutely hairy; base of stipe to first normal pinna 50 cm; *reduced pinnae* 4–5 pairs, uppermost 1.2 cm long, 0.8 cm wide at truncate base which is symmetric or slightly wider on acroscopic side, margins crenate. *Lamina* excluding reduced pinnae 60 cm long; pinnae 20 pairs or more, rather close together, texture firm; basal pinnae narrowed towards their bases which are 8 mm wide, narrowed part very shallowly lobed. *Largest pinnae* 22 cm long, 1.5–1.9 cm wide; base broadly cuneate; apex evenly attenuate, apical 2–2.5 cm subentire; edges lobed *c.* 1/3 towards costa; lobes oblique, strongly truncate with broad teeth at vein-ends and an acute forward-pointing tip; costules 4–5 mm apart; veins 7–8 pairs, slender, concolorous, slightly prominent, 1½ pairs anastomosing, 1 pair to sides of sinus-membrane; lower surface quite glabrous including sinus-membranes and margin, surface between veins slightly pustular; *upper surface* of rachis and costae rather sparsely hairy, hairs pale, 0.5 mm long. *Sori* inframedial on distal veins, supramedial on basal ones, those on basal veins from adjacent costules sometimes confluent; indusia thin, glabrous; sporangia lacking glands; spores pale with a moderate number of distinctly flat small wings.

Distr. *Malesia*: Philippines (Luzon: Mt Makiling), 2 collections.

Note. Plants have been cultivated at Kew, and have remained very distinct from a plant of *P. truncata* from Mt Kinabalu both in size of plant and shape of pinnae, and also in requiring a cooler temperature for good growth.

37. Pneumatopteris nitidula (PRESL) HOLTTUM, Blumea 21 (1973) 318. — *Nephrodium nitidulum* PRESL, Epim. Bot. (1851) 46; HOLTTUM, Novit. Bot. Univ. Carol. Prag. 1968 (1969) 40. — *Cyclosorus nitidulus* (PRESL) COPEL. Fern Fl. Philip. (1960) 364, *p.p. excl. syn. omn.* — *Thelypteris nitidula* (PRESL) REED, Phytologia 17 (1968) 296. — Type: CUMING *s.n.*, Philippines (PRC).

Caudex short, erect; *stipe c.* 10 cm long, pale, bearing thin appressed scales; base of stipe to first large pinna 30–40 cm; *reduced pinnae* to 7 pairs, basal ones 7 × 7 mm, almost orbicular, uppermost 2.5–3.0 cm long, 1.5 cm or more wide, base truncate, auricled or dilated both sides, distal part lobed. *Lamina* excluding reduced pinnae to 100 cm long; pinnae to 30 pairs or more, thin, spreading at a wide angle to rachis; basal pinnae not or little narrowed at their bases. *Largest pinnae* of type 24 × 2.2 cm (largest seen 34 cm long); base truncate; apex almost evenly attenuate, narrow subentire distal part 2 cm or more long; edges lobed less than ½ way to costa on small fronds, more than ½ on type; lobes slightly oblique, their apices almost rounded on largest pinnae, subtruncate on smaller ones, projections at vein-ends slight or lacking, cartilaginous margins narrow; costules 4.5–5.5 mm apart; veins 8–10 pairs, slender, concolorous, basal pair anastomosing, next acroscopic vein to side of short sinus-membrane; *lower surface* of rachis and costae bearing minute erect hairs, similar hairs also ± abundant on other parts, surface between veins often not pustular; hairs on *upper surface* of rachis and costae sparse, pale, short. *Sori* inframedial, basal ones not divergent; indusia bearing few to many acicular hairs; sporangia with many rather large club-shaped glands; spores light brown with many very small wings.

Distr. *Malesia*: Philippines (Luzon to Mindanao).

Ecol. A common species at low altitudes, often near streams, sometimes in rather open places.

38. Pneumatopteris kerintjiensis HOLTTUM, Blumea 21 (1973) 312. — Type: ALSTON 14149, Sumatra, Sungei Kering, Kerintji (BM).

Dryopteris sumatrana sensu TROLL, Flora 128 (1933) 329–337.

Stipe 5 cm long; base of stipe to first large pinna 75 cm; *reduced pinnae* at least 10 pairs, uppermost to 3.5 × 3.5 cm, almost symmetrically triangular with shallowly lobed edges and blunt tip, lowest 2 × 2 cm. *Lamina* excluding reduced pinnae 120 cm long; pinnae 45–50 pairs; basal pinnae not or little narrowed towards their bases which are almost symmetrically dilated; texture firm. *Largest pinnae* 25 × 2.5 cm; base truncate; apex acuminate, not caudate; edges lobed 1/3–2/5 towards

costa; lobes not falcate, entire with rounded tips; costules 4.5 mm apart, at a wide angle to costa; veins to 12 pairs, hardly prominent either side, 2 pairs anastomosing, next $1\frac{1}{2}$ pairs to sides of sinus-membrane; minute hairs present on *lower surface* of costae, costules and veins, surface between veins strongly pustular; *upper surface* of costae bearing short hairs, rest of pinnae glabrous. *Sori* a little inframedial, lower ones not divergent; indusia thin, glabrous; sporangia bearing capitate hairs; spores light brown with many small wings.

Distr. *Malesia*: North-central Sumatra.

Ecol. In forest at 1150–1400 m; the type found in a tea estate.

Note. TROLL's photograph and his data about mucilage hairs on scales clearly indicate the present species. He refers to BEDDOME's description of the reduced basal pinnae of *Nephrodium molle var. major*, but that description refers to *Christella papilio, q.v.*

39. Pneumatopteris nephrolepioides (C. CHR.) HOLTTUM, Blumea 21 (1973) 320. — *Dryopteris nephrolepioides* C. CHR. Brittonia 2 (1937) 268, f. 1, c, d. — *Thelypteris nephrolepioides* (C. CHR.) REED, Phytologia 17 (1968) 295. — Type: BRASS 5354, Mafulu, Central div. Papua, on limestone 1700 m (BM; NY).

Caudex short; *stipe* 3–4 cm long, slender, glabrous, scales ovate, 1 mm long. *Lamina* to 40 cm long; pinnae *c.* 40 pairs; lower pinnae gradually reduced and more widely spaced, lowest 2 mm long; texture firm, drying light green. *Largest pinnae* 1.8 × 0.6 cm; base truncate to subcordate, slightly auricled on acroscopic and rounded on basiscopic side; apex rounded; edges slightly sinuous to almost crenate; small hydathodes each with a white scale near ends of veins, just within the margin; veins 7–8 pairs in each pinna, oblique, simple except the forked basal acroscopic one, free, slightly prominent on upper surface; *lower surface* of rachis bearing short acicular hairs, sparse minute capitate hairs present on costa and veins; *upper surface* of rachis copiously hairy, very short erect acicular hairs also present on whole upper surface of pinnae. *Sori* medial on veins, small, exindusiate; sporangia bearing very small capitate hairs (sometimes 3); spores light brown with many small wings.

Distr. *Malesia*: Papua New Guinea. Only known from type.

Ecol. On limestone, at 1700 m.

40. Pneumatopteris ligulata (PRESL) HOLTTUM, Blumea 21 (1973) 320. — *Lastrea ligulata* PRESL, Epim. Bot. (1851) 35; COPEL. Fern Fl. Philip. (1960) 327. — *Dryopteris ligulata* (PRESL) O. KUNTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 184. — *Thelypteris ligulata* (PRESL) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 252. — Type: CUMING 74, Luzon (PRC; E, K).

Lastrea philippina PRESL, Epim. Bot. (1851) 36. — Type: CUMING 343, Zebu (PRC).

Nephrodium luerssenii HARR. J. Linn. Soc. Bot. 16 (1877) 29. — *Dryopteris luerssenii* (HARR.) C. CHR. Ind. Fil. (1905) 276; v.A.v.R. Handb. (1908) 190. — Type: STEERE *s.n.* Bulukai Isl. (K).

Dryopteris immersa var. ligulata CHRIST, Philip. J. Sci. 2 (1907) Bot. 208. — Type: CUMING 343, Zebu (P).

Dryopteris foxii CHRIST, Philip. J. Sci. 2 (1907) Bot. 208; v.A.v.R. Handb. (1908) 814. — *Lastrea foxii* (CHRIST) COPEL. Fern Fl. Philip. (1960) 328. — *Thelypteris foxii* (CHRIST) REED, Phytologia 17 (1968) 277. — Lectotype (HOLTTUM 1973): COPELAND 940, Mindanao (US).

Caudex short-creeping; *stipe* pale or ± flushed reddish, to 40 cm long, scales near base to 5 × 1 mm bearing many short acicular hairs on outer surface. *Lamina* very variable, in largest plants 70 cm or more long with *c.* 20 pairs of well-spaced and oblique pinnae, basal pinnae of large fronds commonly about half length of largest, sometimes a smaller, more widely-spaced pair also; smaller plants have fertile fronds 25 cm long, three pairs lower pinnae gradually reduced and more widely spaced, lowest 1 cm long. *Pinnae of large fronds* to 23 × 3 cm; base unequally broadly cuneate with acroscopic lobe longer than basiscopic; apex caudate-acuminate; edges lobed to 0.5 mm from costa or more deeply; lobes 2.5–3 mm wide, oblique, sometimes slightly toothed at ends of veins, widened a little above the base, apices broadly pointed; sinuses between lobes broad with rounded base and very small sinus-membranes; costules 5 mm apart, at 45° to costa; veins to 12 pairs, slender, pale, prominent both sides; *lower surface* of rachis glabrous, of costae, costules, veins and surface between veins bearing a variable number of slender erect hairs, a few longer hairs sometimes present on costules and veins, surface between veins finely pustular; *upper surface* of costae with pale hairs 0.5 mm long, rest of surface bearing very short erect pale hairs. *Sori* supramedial; indusia thin with short capitate hairs and sometimes acicular hairs; sporangia bearing capitate hairs. *Pinnae of small fertile fronds c.* 10 × 1.5 cm; lobes 2 mm wide; costules 4 mm apart; veins to 9 pairs; sori sometimes almost medial; indusia usually lacking acicular hairs.

Distr. *Malesia*: Philippines (Luzon to Mindanao) and N. Moluccas (Talaud Is.).

Ecol. The smaller plants mostly on rocky stream-banks (once on the bank of a rice-paddy), the larger onces in forest, at low and medium altitudes.

Notes. As reported by CHRIST (1907) COPELAND at first distinguished *D. foxii* by its small fronds, much-reduced basal pinnae and almost medial sori, but in all these characters there is no sharp distinction (and the largest fronds in herbaria usually lack the base, so that smaller

basal pinnae might have been present). I suggest that the distinction is one of habitat (as with stream-bank forms of *Pronephrium menisciicarpon*). Middle pinnae of large fronds are similar in aspect to those of *Amphineuron immersum* (BL.) HOLTTUM, but differ from the latter in very oblique widely-spaced lobes, in venation and in glandular hairs.

41. Pneumatopteris finisterrae (BRAUSE) HOLTTUM, *comb. nov.* — *Dryopteris finisterrae* BRAUSE, Bot. Jahrb. 49 (1912) 20. — *Lastrea finisterrae* (BRAUSE) COPEL. Gen. Fil. (1947) 138; Philip. J. Sci. 78 (1951) 426. — *Thelypteris finisterrae* (BRAUSE) REED, Phytologia 17 (1968) 277. — Type: SCHLECHTER 18134, N.E. New Guinea, Finisterre Mts (B; P).

Caudex erect; *stipe* densely short-hairy, basal scales broad, appressed; base of stipe to first normal pinna 35 cm or more; *reduced pinnae* 5–6 pairs, all less than 2 mm long. *Lamina* excluding reduced pinnae to 40 cm long; pinnae to 18 pairs, thin, basal pinnae not distinctive. *Largest pinnae* 7.5 × 0.9 cm; base unequally broadly cuneate; apex acuminate; edges lobed to 0.5 mm from costa; lobes at 45° to costa, their tips rounded, entire or at most slightly crenate; costules 3 mm apart; veins 4–6 pairs, oblique, hardly prominent, basal ones both ending at margin above base of sinus; *lower surface* bearing short erect pale acicular hairs on all parts, also short capitate hairs or small sessile glands; *upper surface* of rachis and costae bearing short antrorse hairs, whole surface of pinna bearing short erect acicular hairs. *Sori* medial; indusia small, thin, long-hairy; sporangia bearing short slender setae; spores with a rather broad entire translucent wing and a few anastomosing cross-wings.

Distr. *Malesia*: N.E. New Guinea (3 collections).

Note. This appears to be allied to *P. costata*. It is aberrant in the slender setae on sporangia, and needs further study.

42. Pneumatopteris versteeghii HOLTTUM, Blumea 21 (1973) 321. — Type: VERSTEEGH BW 10259, W. New Guinea, Genifa Mts (L).

Caudex short-creeping, 2 mm diameter, stipes closely seriate on it; *stipe* 8 cm long, slender, pale, scales very small and appressed. *Lamina* 15–18 cm long; pinnae to 20 pairs; basal pinnae somewhat reduced, at least half as long as the next pair; texture firm but translucent, light olivaceous when dried. *Largest pinnae* 2 × 0.6 cm; base very asymmetric, on basiscopic side very narrowly cuneate, on acroscopic side truncate with a dentate auricle 5–6 mm long; apex obtuse; in middle lobed half-way to costa; lobes sometimes dentate at vein-ends; veins in basal auricle 4 pairs, in middle lobes 2 pairs, basal acroscopic vein passing to base of sinus, basiscopic vein to margin; *lower surfaces* quite glabrous; *upper surface* with short hairs on rachis and a few on bases of costae. *Sori* on basal acroscopic vein of each group; indusia short-hairy; sporangia with capitate hairs.

Distr. *Malesia*: West New Guinea. Only known from the type.

Ecol. In forest on steep rocky soil at 1100 m.

43. Pneumatopteris sumbawensis (C. CHR.) HOLTTUM, Blumea 21 (1973) 323. — *Dryopteris sumbawensis* C. CHR. in Rensch, Hedwigia 74 (1934) 231, t. vii, f. 1. — Type: RENSCH 578, Sumbawa, Batu Dulang (B; BO).

Caudex unknown; *stipe* 2–3 cm long. *Lamina* 30 cm long; pinnae 35–40 pairs; 6 pairs lower pinnae gradually or subabruptly reduced, lowest 3 mm long; lower large pinnae a little narrowed to their bases on basiscopic side; texture thin, drying pale olivaceous. *Largest pinnae* 3.0 × 1.0 cm, subpinnate with basal acroscopic lobe quite free and 2–3 pairs of lobes separately adnate to costa, rest deeply lobed, apex abruptly narrowed to a blunt tip; costules to 3 mm apart; veins free, 3–4 pairs, dark but not prominent beneath, basal acroscopic one sometimes forked; *lower surface* of rachis and costae bearing minute capitate hairs and very short acicular ones, short capitate hairs present all over lower surface of pinnae as in *P. costata*; hairs on *upper surface* of rachis 0.3 mm long, shorter on costae, rest of pinna with sparse very short acicular and capitate hairs. *Sori* medial to supramedial, exindusiate; neither glands nor setae on sporangia.

Distr. *Malesia*: Lesser Sunda Is. (Sumbawa), only known from type.

Note. This is related to *P. costata* which also occurs on Sumbawa, but has very different pinnae.

44. Pneumatopteris keysseriana (ROSENST.) HOLTTUM, Blumea 21 (1973) 320. — *Dryopteris keysseriana* ROSENST. Fedde Rep. 10 (Feb. 1912) 333; v.A.v.R. Handb. Suppl. (1917) 157. — *Lastrea keysseriana* (ROSENST.) COPEL. Gen. Fil. (1947) 139; Philip. J. Sci. 78 (1951) 430. — *Thelypteris keysseriana* (ROSENST.) REED, Phytologia 17 (1968) 286. — Type: KEYSSER 253, N.E. New Guinea, Sattelberg (not seen).

Dryopteris schultzei BRAUSE. Bot. Jahrb. 49 (August 1912) 19; v.A.v.R. Handb. Suppl. (1917) 156. — Type: L. SCHULTZE 253, Sepik District (B). — **Fig. 11i–j.**

Caudex short-creeping with tufted stipes; *stipe* to 70 cm long, pale except base, scales thin, appressed; *reduced basal pinnae* commonly 2–3 pairs, much smaller than normal ones, in one specimen apparently 8 pairs. *Lamina* to 100 cm long; normal pinnae 20 pairs or more; basal pinnae variably narrowed towards their bases, narrower on basiscopic side where the basal lobe is obsolete

or very small. *Largest pinnae* c. 25 × 4 cm (ROSENSTOCK reports 6 cm wide); base unequally broadly cuneate, basal basiscopic lobe shorter than acroscopic; apex acuminate with cauda 3–4 cm long; edges lobed to 1–2 mm from costa with wide sinuses between lobes; lobes slightly tapering, tips rounded to bluntly pointed, edges near tips slightly crenate at vein-ends; costules 5–6 mm apart, at a wide angle to costa; veins to 16 pairs, pale and prominent both sides, basal pair ending at margin near together, at least in distal part of pinna; *lower surface* of rachis bearing very short hairs, similar hairs variably present on lower surface of pinnae, surface between veins slightly pustular; *upper surface* of costae bearing short pale hairs, rest of pinna glabrous. *Sori* supramedial; indusia small with short hairs; sporangia sometimes with capitate hairs; spores with many small wings. *Chromosomes*: n = 36 (T. G. WALKER).

Distr. *Malesia*: Eastern New Guinea.

Ecol. By streams in lowland forest and to 1000 m, common.

Note. Specimens from the type locality, named by ROSENSTOCK, have been seen. The type of *Dryopteris schultzei* differs chiefly in a greater abundance of hairs on the lower surface, some of them between veins.

45. Pneumatopteris caudata (HOLTTUM) HOLTTUM, Blumea 21 (1973) 321. — *Pseudocyclosorus caudatus* HOLTTUM, Blumea 13 (1965) 133. — Type: cult. Hort. Bot. Kew. 545/63, *n.* 12, origin near Lae, N.E. New Guinea (K).

Caudex erect; *stipe* pale, basal scales small, ovate; base of stipe to first normal pinna 15 cm or more; reduced pinnae 2 pairs, 2–3 mm long. *Lamina* excluding reduced pinnae 30 cm long; pinnae 15 pairs; lower pinnae narrowed both sides towards their bases. *Largest pinnae* 8 × 1.5 cm; base strongly asymmetric with minute basal basiscopic lobe, basal acroscopic lobe almost free and not reduced; apex abruptly narrowed to a cauda 2.5 cm long, 2 mm wide; edges lobed to 1 mm from costa; lobes at 45° to costa, entire or slightly toothed at vein-ends, apices rounded; costules 3.5 mm apart; veins 9 pairs, oblique, pale and prominent on lower surface, basal acroscopic vein ending at sinus, basiscopic at margin above base of sinus; *lower surface* of rachis, costae and costules bearing minute acicular hairs, short capitate hairs on costules and veins, surface between veins slightly pustular; *upper surface* hairy on rachis and costae only. *Sori* supramedial; indusia short-hairy; no glands seen on sporangia; spores pale with many small wings. *Chromosomes*: n = 36 (S. K. ROY 1965).

Distr. *Malesia*: Papua New Guinea. Only known from the type.

Note. This is certainly nearly allied to *P. keysseriana* and from a neighbouring locality, but plants of the two cultivated at Kew remained very distinct.

46. Pneumatopteris deficiens HOLTTUM, Blumea 21 (1973) 321. — Type: POSTHUMUS 3183, Flores (BO; K).

Caudex short, erect; *stipe* to 40 cm long, pale, glabrous, covered with thin small scales when young. *Lamina* c. 35 cm long; free pinnae 8 pairs, texture firm; basal pair of pinnae ± reduced, in most cases only 5 mm long; basal large pinnae narrowed evenly towards their bases. *Largest pinnae* 12 × 2.2 cm; base unequally cuneate; apex acuminate, dentate to tip; edges lobed to 1 mm from costa; lobes oblique, acute, edges with slight teeth at ends of veins; costules 5–6 mm apart; veins to 8 pairs, pale and prominent on both sides, basal acroscopic vein ending beside the short sinus-membrane, basiscopic vein to margin above base of sinus; *lower surface* of costae sometimes with minute acicular hairs, short hairs present on margins of lobes, surface between veins slightly pustular; *upper surface* hairy on costae, rest of pinna glabrous. *Sori* a little inframedial; indusia with a few very short hairs; no glands seen on sporangia.

Distr. *Malesia*: Lesser Sunda Is. (Flores), several collections.

Ecol. At 1300 m, on moist banks of earth in wet shady ravines.

47. Pneumatopteris mingendensis (GILLI) HOLTTUM, *comb. nov.* — *Lastrea mingendensis* GILLI, Ann. Nat. Hist. Mus. Wien 81 (1978) 24. — Type: GILLI 265, N.E. New Guinea, Chimbu District (W).

Stipe 15 cm long, pale, glabrous except in groove; base of stipe to first normal pinna 30 cm; *reduced pinnae* 2 pairs, widely spaced, upper ones 2 cm long with basal auricle 7 mm long, lower ones 7 mm long with auricle 4 mm. *Lamina* excluding reduced pinnae 60 cm long; basal normal pinnae somewhat reduced. *Largest pinnae* 13 × 3 cm, lobed to less than 1 mm from costa, lobes on basiscopic side shorter and more oblique than on acroscopic, basal acroscopic lobe 2.0 cm long, basal basiscopic lobe much shorter and 10 mm from base of pinna; apex narrowly caudate, cauda 2–2.5 cm long; costules 5–6 mm apart; veins 10–12 pairs, pale and prominent both sides, basal veins ending far apart at the margin; *lower surface* of rachis and costae bearing many acicular hairs hardly 0.1 mm long, sparse similar hairs on costules, surface between veins not distinctly pustular; *upper surface* of rachis and costae bearing hairs a little longer than those on lower surface, no other hairs present. *Sori* medial; indusia small, glabrous; capitate hairs present on some sporangia; spores pale with many wings of irregular shape.

Distr. *Malesia*: Papua New Guinea. Only known from the type.

Ecol. At 2100 m in *Pandanus* forest.

Note. GILLI reported that indusia are absent, but though small they are certainly present.

48. Pneumatopteris eburnea HOLTTUM, *sp. nov.*

Lamina usque 35 cm longa; pinnae usque 18-jugatae, rigidae, maximae 6.5 × 1.6 cm, infimae leviter redactae, inferiores plurijugatae basin versus angustatae, omnes profunde lobatae; venae liberae, subtus crassae, prominentes, pallidae; pagina inferior perfecte glabra; indusia parva, glabra. — Type: JERMY 14132, Sarawak, Gunong Mulu, 1500–1600 m (BM).

Caudex short-creeping; *stipe* 20–40 cm long, pale above base, glabrous, basal scales broad, thin, not persistent; *reduced pinnae* lacking. *Lamina* to 35 cm long; pinnae to 18 pairs, rigid and brittle when dry; basal pinnae slightly reduced, much narrowed towards their bases on basiscopic side, less so on acroscopic side which is slightly auricled; several successive pairs of pinnae less narrowed at their bases. *Largest pinnae* 6.5 × 1.6 cm, sessile, aerophores not elongate; apex short-acuminate; edges lobed to 1.5 mm from costa, lobes hardly falcate, their tips rounded, edges thickened; costules to 3 mm apart, almost at right angles to costa; veins to 10 pairs, all very oblique, thick, pale and prominent on lower surface, concolorous on upper, basal veins both ending just above base of sinus, sinus-membrane not evident; *lower surfaces* quite glabrous, often with residual narrow scales; *upper surface* of rachis with sparse hairs 0.3 mm long, many hairs 0.4–0.5 mm long on edges of costal groove, no other hairs. *Sori* medial; indusia small, thin but firm, glabrous; sporangia lacking glands, a hair of 3 cells sometimes present on stalks of sporangia; spores pale with many small wings.

Distr. *Malesia*: Borneo (Sarawak: Mt Mulu), known only from type.

Ecol. In gullies on limestone at 1500–1600 m.

49. Pneumatopteris excisa (HOLTTUM) HOLTTUM, Blumea 21 (1973) 321. — *Pseudocyclosorus excisus* HOLTTUM, Blumea 13 (1965) 133. — Type: MILLAR & HOLTTUM NGF 18623, N.E. New Guinea, Eastern Highlands (K; LAE, L).

Caudex erect; base of stipe to first normal pinna 25 cm; *reduced pinnae* 2–3 pairs, very small, remote from basal normal pinna. *Lamina* to 40 cm long; pinnae to 25 pairs; texture firm. *Largest pinnae* of type 10 × 1.5 cm, of another collection 19 × 3 cm, lobed to less than 0.5 mm from costa, lobes with rounded tips and distinct teeth at vein-ends, several lobes reduced near base of pinna especially on basiscopic side, basal acroscopic lobe not free; apex of pinna caudate-acuminate, cauda 2.5 cm long, crenate; costules 3 mm apart; veins of type 8 pairs, pale and prominent both sides, basal veins usually both ending at margin above base of sinus; *lower surface* of rachis and costae bearing very short acicular hairs, scattered similar hairs on costules and a few short capitate ones, surface between veins slightly pustular, glabrous; *upper surface* short-hairy on costae, a few hairs present on costules and veins. *Sori* medial, filling lower surface at maturity; indusia minute, glabrous; no glands seen on sporangia; spores with many very small wings.

Distr. *Malesia*: N.E. New Guinea, several collections at 1300–2000 m.

50. Pneumatopteris regis (COPEL.) HOLTTUM, Blumea 21 (1973) 322. — *Dryopteris regis* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Lastrea regis* COPEL. Philip. J. Sci. 78 (1951) 425, pl. 19. — *Thelypteris regis* (COPEL.) REED, Phytologia 17 (1968) 308. — Type: C. KING 486, Papua, mountains behind Wedan (MICH).

Stipe not seen. *Lamina* 120 cm long including 9 pairs of deeply lobed basal pinnae 1–1.5 cm long and wide; texture firm. *Largest pinnae* 15 × 2.5 cm; base truncate, a little dilated, wider on acroscopic side; apex acuminate; edges lobed to 1 mm from costa; lobes 13 × 4 mm, entire, ends rounded; costules 5 mm apart, at more than 60° to costa; veins 8 pairs, oblique, basal veins both ending at the margin above base of sinus; *lower surface* glabrous; *upper surface* of pinnae glabrous apart from many dark brown hairs on costae, hairs on rachis pale. *Sori* small, inframedial; indusia apparently absent (all sori are old, and indusia might have fallen); no glands seen on the few remaining sporangia; spores not seen.

Distr. *Malesia*: Papua New Guinea. Only known from the type.

51. Pneumatopteris boridensis HOLTTUM, *sp. nov.*

Pinnae basales redactae 6-jugatae, alternae, suprema 3 × 1.3 cm, infima 0.9 cm longa; pinnae normales 17 × 2.3 cm, fertiles 2/3 costam versus lobatae; venae 9–10-jugatae, infimae ambae membranam sinus tangentes vel in pinnis sterilibus infra sinum junctae; indusia magna, tenuia, hirsuta. — Type: FOREMAN & VINAS LAE 60262, S.E. New Guinea, Port Moresby Subdistr., near Boridi village (K).

Caudex short-creeping; *stipe* 22 cm long, pale, glabrous; base of stipe to first normal pinna 55 cm; *reduced pinnae* 6 pairs, alternate, lowest 9 mm long and distinctly auricled, uppermost 3 × 1.3 cm with slight basal auricle. *Lamina* excluding reduced pinnae 70 cm long, texture thin; basal pinnae neither narrowed towards their bases nor auricled. *Largest fertile pinnae* 17 × 2.3 cm (sterile 2.5 cm wide at base); base very broadly cuneate; apex caudate-acuminate, cauda to 3 cm long, crenate; edges lobed to 3.5–4 mm from costa in fertile pinnae, less deeply in sterile; lobes slightly toothed at vein-ends especially where fertile; costules 5 mm apart; veins 9–10 pairs, lowest pair on fertile pinnae just touching base of the short

sinus-membrane, on fertile pinnae sometimes uniting below the membrane; *lower surface* glabrous; *upper surface* of rachis bearing pale hairs more than 0.5 mm long, shorter ones on costae, no others. *Sori* inframedial, basal ones not divergent; indusia large, thin, shrivelling when old, bearing in the middle many slender hairs 0.5 mm long; no glands seen on sporangia.

Distr. *Malesia*: Papua New Guinea, only known from the type.

Ecol. By stream at 1190 m.

52. Pneumatopteris imbricata HOLTTUM, Blumea 21 (1973) 322. — Type: BROOKS 17775, Amboina, Hila, 200 m, on rock by river (BM; BO, L).

Caudex "short and stumpy" (Womersley & Whitmore); *stipe* 5 cm long, basal scales thin, 2 mm wide at base; base of stipe to first normal pinna 45–60 cm; *reduced pinnae* many pairs, 1 cm long, deeply lobed, both basal lobes large and lobed. *Lamina* to 110 cm long, thin, translucent; pinnae 35 pairs, all opposite; basal normal pinnae with enlarged dentate basal lobes, the acroscopic lobe (when dried in a press) overlapping the lower surface of the rachis, basiscopic lobe overlapping the upper surface. *Largest pinnae* 24 × 3.0 cm; base truncate, ± auricled on the acroscopic side; apex narrowly acuminate, serrate to the tip; edges lobed to 1 mm from costa, sinuses between lobes wide, rounded at their bases; lobes oblong, oblique, slightly falcate, their tips broadly rounded, entire, little over 3 mm wide when dried; costules 4.5–5.5 mm apart; veins to 12 pairs, basal ones both to margin above base of the sinus; *lower surfaces* glabrous apart from a few short hairs distally on costae and on sinus-membranes and margin; *upper surface* densely brown-hairy on rachis and costae, rest glabrous. *Sori* small, somewhat inframedial, somewhat impressed on upper surface, exindusiate; sporangia of Guadalcanal specimen bearing short yellow capitate hairs; spores with a rather narrow median wing and some cross-wings.

Distr. Solomon Is. (Guadalcanal) and *E. Malesia*: Moluccas (Halmahera & Amboina).

Note. The sori of the type are young and the sporangia do not show glands; The Halmahera specimen (PLEYTE 370) has old sori with shrivelled glands on sporangia. The Guadalcanal specimen (WOMERSLEY & WHITMORE BSIP 1038) is a little smaller than the type but otherwise closely similar.

53. Pneumatopteris petrophila (COPEL.) HOLTTUM, Blumea 21 (1973) 322. — *Dryopteris petrophila* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Lastrea petrophila* COPEL. Philip. J. Sci. 78 (1951) 424, pl. 18. — *Pseudocyclosorus petrophilus* (COPEL.) HOLTTUM, Blumea 13 (1965) 133. — *Thelypteris petrophila* (COPEL.) REED, Phytologia 17 (1968) 303. — Type: BRASS 11326, W. New Guinea, Bele River (MICH; BM, L).

Caudex short, erect; *stipe* 4–6 cm long, pale, minutely hairy, basal scales small, appressed. *Lamina* 40 cm long, texture very firm; pinnae *c.* 20 pairs, almost opposite, lower 8–10 pairs reduced, rather abruptly and then gradually, lowest 3 × 3 mm, intermediate pinnae lobed and distinctly auricled on the acroscopic base. *Largest pinnae* of type 4 cm long, 8–9 mm wide above base (other specimens to 9 × 1 cm); base subtruncate and ± auricled on acroscopic side, narrower and rounded on basiscopic; apex short-pointed (acuminate on larger specimens); edges lobed 1/2 towards costa; lobes falcate, narrowed a little to blunt tips, entire; costules 3 mm apart, oblique; veins 3–5 pairs, slender and prominent, basal acroscopic vein ending beside sinus-membrane, basiscopic one at margin above base of sinus; *lower surface* of rachis copiously short-hairy, minute acicular and capitate hairs on costae, costules and veins, surface between veins pustular and bearing minute capitate hairs; *upper surface* of costae short-hairy (hairs brown on larger specimens), sparse short hairs present between veins. *Sori* medial or inframedial, exindusiate; sporangia bearing small colourless capitate hairs; spores pale with many small wings. *Chromosomes*: n = 36 (T. G. WALKER).

Distr. *Malesia*: New Guinea. Besides type, several collections in N.E. New Guinea.

Ecol. On wet rocks at *c.* 2000 m.

Note. This is related to *P. latisquamata*; I found both near Edie Creek.

54. Pneumatopteris walkeri HOLTTUM, Blumea 21 (1973) 323. — Type: T. G. WALKER 9980, N.E. New Guinea, Eastern Highlands, Waisa (BM).

Caudex short, erect or suberect; *stipe* 20 cm long, pale, minutely hairy, basal scales thin, appressed; base of stipe to first normal pinna 45–50 cm; *reduced pinnae* 6–8 pairs, 2–3 mm long, with 1–2 pairs transitional to normal pinnae. *Lamina* 55 cm long, excluding reduced pinnae; pinnae 20 pairs; texture thin, drying pale olivaceous. *Largest pinnae* 11 × 1.9 cm; base asymmetric, truncate on acroscopic side, narrowly cuneate on basiscopic side with reduced basal lobe; apex caudate-acuminate, cauda 3 cm long, serrate; edges lobed to 0.5 mm from costa; lobes on acroscopic side of pinna longer than on basiscopic and almost at right angles to costa, lobes on basiscopic side at 45°, all lobes ± dentate near apices; costules 4 mm apart; veins in acroscopic lobes to 9 pairs, in basiscopic lobes sometimes fewer, prominent both sides, pale beneath, basal veins both running to margin above base of sinus; *lower surface* of rachis bearing copious minute acicular hairs, rest glabrous, pustular between veins; *upper surface* with short hairs on rachis and costae only. *Sori* medial; indusia thin, glabrous; no glands seen on sporangia.

Distr. *Malesia*: Papua New Guinea. Only known from the type.

Doubtful

Aspidium glaberrimum RICHARD, Sert. Astrolab. (1834) xviii. — Type: D'URVILLE, Prt Dorei, N.W. New Guinea (P).

There is a photograph at BM of the type, but I did not find the specimen at Paris. I saw another specimen so named, collected by D'URVILLE in New Ireland in 1827. Both specimens differ from the type of *Polystichum truncatum* GAUD. in having entire pinna-lobes. They are very like small plants of *Pneumatopteris sogerensis* but the specimen from New Ireland has capitate hairs on the sporangia. A specimen from the Markham Valley, N.E. New Guinea (WAKEFIELD 1505, BM) is about the same size as the type and has rather large club-shaped glands on the sporangia, but has also rather numerous short hairs on all parts of the lower surface of pinnae.

17. SPHAEROSTEPHANOS

J. SM. in Hook. Gen. Fil. (1839) t. 24; COPEL. Univ. Cal. Publ. Bot. 16 (1929) 60; CHING, Sunyatsenia 5 (1940) 240; COPEL. Gen. Fil. (1947) 144; *emend.* HOLTTUM, Blumea 19 (1971) 39; Kalikasan 4 (1975) 47; Allertonia 1 (1977) 201. — *Thelypteris subg. Sphaerostephanos* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 32.

Mesochlaena R. BR. in Benn. & Br. Pl. Jav. Rar. (1838) 5, *nom. illeg.*; J. SM. in Hook. J. Bot. 3 (1840) 18; C. CHR. Ind. Fil. (1905) xxii.

Proferea PRESL, Epim. Bot. (1851) 259; HOLTTUM, Novit. Bot. Inst. Bot. Univ. Carol. Prag. 1968 (1969) 48.

Cyclosorus sensu CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 162, *p.p.*; *sensu* COPEL. Gen. Fil. (1947) 140, *p.p.*; *sensu* HOLTTUM, Rev. Fl. Mal. 2 (1955) 255, *p.p.*

Theylpteris subg. Glaphyropteridopsis sect. Neocyclosorus K. IWATS. Mem. Coll. Sci. B, 31 (1964) 30, *quoad spec. typ.*

Thelypteris subg. Pneumatopteris sect. Macrocyclosorus K. IWATS. *l.c.* 34, *quoad spec. typ.* — **Fig. 1a–h, q, 12, 13.**

Caudex in most species erect or short-creeping, rarely long-creeping or scandent; scales usually narrow, thin, bearing superficial acicular hairs; much-reduced pinnae present at base of fronds, the transition downwards to these from normal pinnae usually abrupt but in some cases quite gradual (a few species are included which have no reduced basal pinnae but have deeply lobed normal pinnae with glands typical of this genus); aerophores at pinna-bases often swollen, in some species 1–2 mm long (very young fronds then covered with mucilage); apex of frond rarely pinna-like; pinnae in most species lobed (in some very deeply) or crenate, in a few subentire; sinus-membrane almost always distinct, of varying length; veins anastomosing, but in a few species just meeting at the sinus or ending above it; sessile spherical yellow glands usually present on parts of the surface of pinnae or on indusia or sporangia, in a minority of species quite lacking; short capitate hairs lacking; acicular hairs almost always present on both surfaces of costae and costules, lacking on the lower surface in a few species, often present also between veins on either or both surfaces, either erect or appressed, rarely if ever septate; lower surface rarely pustular when dry; sori usually round, in some species (indusiate or not) more or less elongate; indusia usually present; sporangia often bearing yellow

glands distally, less often setae, usually with a gland-tipped hair on the stalk; spores usually bearing many small wings, in some species a continuous wing with cross-wings.

Type species: *Sphaerostephanos asplenioides* J. SM. = *S. polycarpus* (BL.) COPEL.

Distr. Throughout *Malesia* (152 *spp.*), tropical mainland Asia (12 *spp.*), Mascarene Islands and E. Africa (4 *spp.*), Australia and the Pacific (17 *spp.*, only 1 reaching Tahiti).

Ecol. Almost all are forest plants. Nearly all those adapted to open places have long-creeping rhizomes and are widely distributed; allied to one of these are a few species in New Guinea and the Solomons which have a slender scandent caudex, not known in any other genus of the family.

Cytol. Base chromosome number 36; 8 *spp.* examined, all diploid.

Taxon. JOHN SMITH's name *Sphaerostephanos* refers to the yellow glands which fringe the indusium of the type species. COPELAND and CHRISTENSEN treated this name as feminine, but as the Greek *stephanos* is masculine, I regard the compound name also as masculine. SMITH's original specimen had broken indusia (carefully illustrated by FRANCIS BAUER) from which he gained an erroneous idea of their structure. Soon afterwards SMITH received from ROBERT BROWN a better specimen, and his comments on it were published in 1840 under BROWN's name *Mesochlaena* which SMITH regarded as having priority; he then realized that it differed from *Nephrodium* (as interpreted by SCHOTT) only in having an elongate sorus. BROWN's name *Mesochlaena* had been published in 1838 with a very slight description and without any indication of its status, so that it cannot be regarded as a valid generic name, as pointed out by COPELAND in 1929. The first good illustration of the sorus was published by METTENIUS (Fil. Hort. Lips. t. 18, fig. 13. 1857) with the name *Mesochlaena javanica*; this was changed to *Nephrodium javanicum* by HOOKER who published an excellent illustration of a whole plant (Fil. Exot. t. 62. 1859), with *Aspidium polycarpon* BL. as a synonym and reference to SMITH's comments of 1840.

When BEDDOME published the Supplement to his Handbook (1892) he also reverted to the genus *Nephrodium* for *Aspidium polycarpon* BL., and described an additional Malayan species *N. larutense* which also has elongate sori. In Index Filicum (1905) CHRISTENSEN retained the generic name *Mesochlaena* for *M. polycarpa* but transferred BEDDOME's *N. larutense* to *Dryopteris*. VAN ALDERWERELT accepted the generic name *Mesochlaena* in his Handbook (1908), transferring *N. larutense* to it and later adding two more species. In the third Supplement to Index Filicum CHRISTENSEN followed COPELAND in adopting the name *Sphaerostephanos* and transferred to it v.A.v.R.'s names.

The species thus brought together in *Sphaerostephanos* are not a closely allied group, and there are others (*e.g. S. norrisii*) which have slightly elongate sori, so that no clear line can be drawn between species with elongate and those with round sori. For these reasons, in 1955 I transferred the Malayan species with elongate sori to *Cyclosorus*, a genus which I accepted in the sense of CHING (1938), though commenting on the unsatisfactory nature of generic delimitation in the family *Thelypteridaceae* at that time. CHING however had misinterpreted the sorus of the type species of *Sphaerostephanos* and had wrongly reported the spores as trilete, for which reasons he proposed for it a new family (Sunyatsenia 5, 1940, 240).

When I had made a preliminary study of all known species of *Thelypteridaceae* in preparation for the present work, I made a survey of all existing generic names and found that *Sphaerostephanos* was the oldest name for a large group of mainly Malesian species most of which do not have elongate sori. For this reason in 1971 I published a revised concept of the genus, which is here adopted. Species of this genus were variously placed in IWATSUKI's classification of 1964, which makes no reference to the majority of Malesian species; I cite above only infrageneric taxa which he typified by Malesian species.

The main characters of this genus are the presence of much-reduced basal pinnae and of sessile non-resinous spherical yellow glands of an easily recognized type; these glands are not destroyed in the process of drying specimens for the herbarium as those of *Coryphopteris* and *Amphineuron* often are. The species can be arranged in a series beginning with those that have glands on both surfaces of pinnae and on indusia and sporangia, then those lacking glands on the upper surface (there are no species bearing glands on the upper surface and not on the lower), those with glands only on sori and finally those with no glands at all. Species without glands agree with *Pneumatopteris* in having reduced basal pinnae but have a much greater complement of acicular hairs on all parts (especially on sporangia); they lack also short capitate hairs and the peculiar pustules on the lower surface of dried fronds which are characteristic of *Pneumatopteris*.

I also found that some species had very few reduced pinnae and that there is not a sharp distinction in this character between *Sphaerostephanos* and *Pronephrium*. This matter is discussed under *Pronephrium*; I believe that the great majority of species belong clearly to one genus or the other.

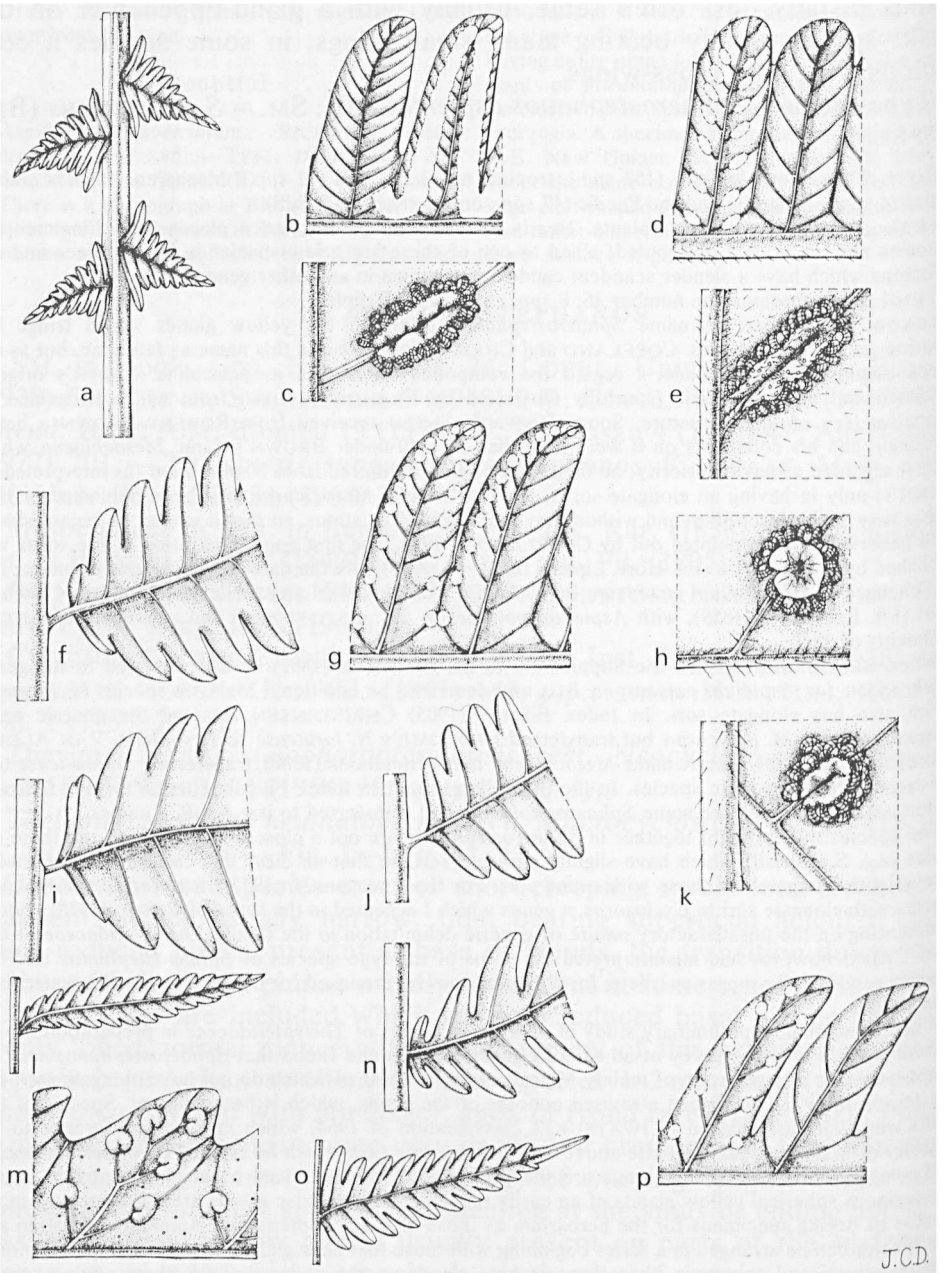

Fig. 12. *Sphaerostephanos polycarpus* (BL.) COPEL. *a.* Reduced pinnae, ×⅔; *b.* venation and position of sori, ×3; *c.* sorus, ×12. — *S. larutensis* (BEDD.) C. CHR. *d.* Venation, sinus-membrane and sori, ×3; *e.* sorus, ×12. — *S. norrisii* (ROSENST.) HOLTTUM. *f.* Base of lower pinna, ×1.5; *g.* venation and sori, ×3; *h.* sorus, ×12. — *S. pilososquamatus* (v.A.v.R.) HOLTTUM. *i.* Base of sterile pinna, ×1.5; *j.* base of fertile pinna, ×1.5; *k.* sorus, ×12. — *S. hispidifolius* (v.A.v.R.) HOLTTUM. *l.* Middle pinna, ×1; *m.* venation and sori, ×8. — *S. inconspicuus* (COPEL.) HOLTTUM. *n.* Base of lower pinna, ×2; *o.* upper pinna, ×1.5; *p.* venation and sori, ×4 (*a–b* YAPP 215, *c* MATTHEW *s.n.*, *d–e* ERNST *s.n.*, *f* KUNSTLER 2360, *g–h* MATTHEW *s.n.*, *i–k* cult. Kew, *l–m* G. F. HOSE 91, *n–p* P. S. SHIM SAN 81677).

As the sessile spherical yellow glands are the most distinctive feature of the genus, I regard the development of these on all parts of the frond as a primitive character. Assuming also that the original species had an erect caudex, *S. polycarpus* might be regarded as a prototype for the genus. It is one of the largest species vegetatively. But it is not a forest plant (a reason for its wide distribution) and it has deeply lobed pinnae, whereas the most widely distributed Malesian forest species with glands on both surfaces is *S. penniger*, which has shallowly lobed pinnae with several pairs of anastomosing veins; it is allied to the arborescent *S. arbuscula* (WILLD.) HOLTTUM of Southern India and the Mascarene Islands. So I suggest that the primitive *Sphaerostephanos* had shallowly-lobed pinnae with anastomosing veins, and that *S. arbuscula* is the nearest surviving species. Several New Guinea species have a slender erect caudex and shallowly-lobed pinnae (*e.g. S. arfakianus*) but have no glands on the upper surface. At least it can be said with some certainty that (as in *Christella*) the few species which have free veins are probably not primitive but represent a secondary development occurring locally in a few areas (*e.g. S. inconspicuus* in Borneo, *S. novoguineensis* in New Guinea and *S. pycnosorus* in Samoa); they do not form a coherent natural group.

A few species have quite gradually reduced basal pinnae (*e.g. S. hastatopinnatus* and *S. arfakianus*, both with an erect caudex) but most have an abrupt (or almost abrupt) transition from normal to reduced pinnae at the base of the frond. A few species which have many reduced pinnae are somewhat intermediate, showing first a gradual reduction downwards and then an abrupt transition to much smaller pinnae (*e.g. S. hispiduliformis*). I suggest that the condition of gradual reduction is the more primitive arrangement, as it alone occurs in *Cyathea*. Apart from *Sphaerostephanos* and *Pneumatopteris*, which are predominantly Malesian in distribution and certainly allied, most other genera have basal pinnae gradually or not at all reduced.

The species with long-creeping rhizome are *S. unitus*, a gland-bearing species very widely distributed with distinct eastern and western varieties, and *S. invisus* which lacks glands and is mainly distributed in the Pacific (its distribution is similar to that of *Pneumatopteris costata*). *S. hirtisorus* (C. CHR.) HOLTTUM in N.E. India and W. China appears to be related to *S. invisus*.

The following key is based on the distribution of glands on the surfaces of pinnae and on sori. I believe that this represents an evolutionary trend, but within it there are many separate bifurcations which, in such a complex group, are not easy to discern. For example, there is a group of species which are related to *S. stipellatus* and have closely appressed hairs on the lower surface of costae and costules; this character may be associated with elongate aerophores and lack of glands on the lower surface of pinnae (as in *S. stipellatus* itself) or with varying combinations of these and other characters. Varying trends may lead on to other groups (*e.g.* elongate aerophores may be associated with erect hairs on the lower surface of costae) and I cannot see how to follow all the trends or delimit sub-groups. It seems to me evident that the present condition of the genus is due to rapid and complex recent evolution, especially in New Guinea, resulting in a difficulty in the delimitation of species, with some necessary inequality of treatment. The destruction of Malesian forests may put a stop to this process or alter it in unpredictable ways.

In some species where glands are not abundant there seems to be some variation in their occurrence; in such cases a species may appear in more than one place in the key.

KEY TO THE SPECIES

1. Glands present between veins on upper surface of pinnae.
 2. Six or more pairs of lower pinnae gradually reduced . . . . . **1. S. debilis**
 2. Transition to reduced basal pinnae (if any) abrupt or subabrupt.
  3. Sori elongate.
   4. No basal reduced pinnae . . . . . **2. S. sudesticus**
   4. Basal reduced pinnae present.
    5. Middle pinnae sessile . . . . . **3. S. polycarpus**
    5. Middle pinnae with stalks 3–10 mm long . . . . . **4. S. eminens**
  3. Sori not elongate.
   6. Sori exindusiate.
    7. Basal veins quite free . . . . . **5. S. williamsii**
    7. Basal veins anastomosing.
     8. Pinnae to 10 × 1.5 cm; reduced pinnae at least 5 pairs . . . . . **6. S. stenodontus**
     8. Pinnae to 21 × 2.5 cm; reduced pinnae 2–3 pairs . . . . . **7. S. flavoviridis**
   6. Sori indusiate.
    9. Reduced pinnae *c.* 30 pairs . . . . . **8. S. trimetralis**
    9. Reduced pinnae rarely more than 12 pairs.
     10. Lower surface of rachis and costae quite glabrous, or with very short hairs on costae only.

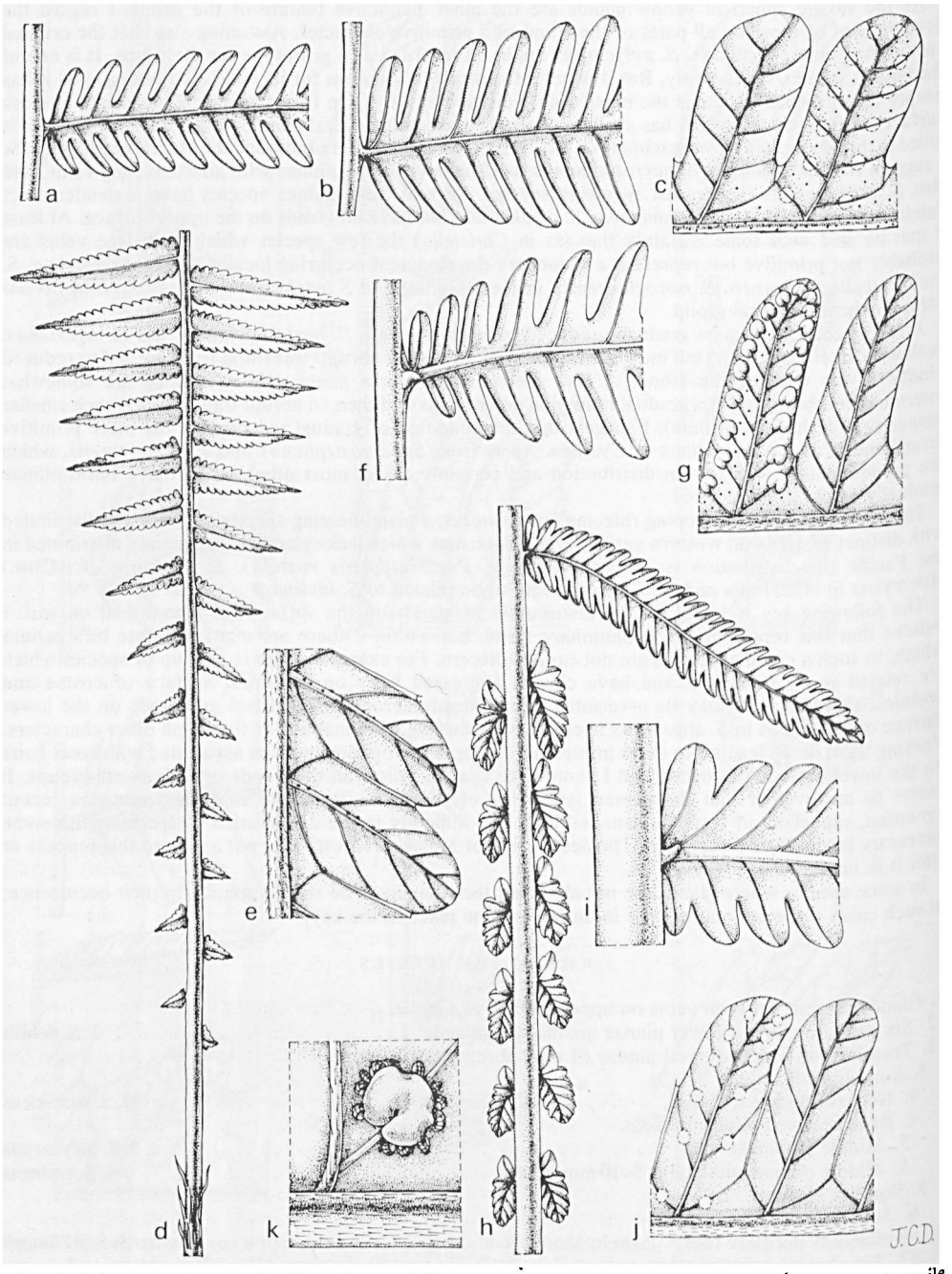

Fig. 13. *Sphaerostephanos alatellus* (CHRIST) HOLTTUM. *a.* Base of fertile pinna, × 1⅓; *b.* base of sterile pinna, × 1⅓; *c.* fertile pinna-lobes, × 4. — *S. archboldii* (C. CHR.) HOLTTUM. *d.* Base of frond, × 1; *e.* pinna-lobes, × 6. — *S. baramensis* (C. CHR.) HOLTTUM. *f.* Base of pinna, × 1⅓; *g.* lobes of fertile pinna, × 3. — *S. batacorum* (ROSENST.) HOLTTUM. *h.* Base of frond, × ⅔; *i.* base of pinna, × 2; *j.* lobes at middle of pinna, × 4; *k.* costa and costule, with appressed hairs, and sorus, × 12 (*a–c* PULLEN 8258, *d–e* BRASS 30856, *f–g* HOLTTUM 1, *h–k* MATTHEW 946).

11. Fronds dimorphous; reduced pinnae all minute . . . . . **9. S. alatellus**
11. Fronds not dimorphous; reduced pinnae conspicuous . . . . . **10. S. daymanianus**
10. Hairs present throughout lower surface of rachis and costae.
12. Sporangia copiously setiferous, rarely also with a gland.
13. Pinnae *c.* 7 pairs, to 13 × 2.7 cm . . . . . **31. S. penniger**
13. Pinnae, if only 7 pairs, much smaller.
14. One pair of veins anastomosing, next pair to sinus-membrane . . **11. S. appendiculatus**
14. 1½–2 pairs anastomosing, 1½ pairs to sinus-membrane . . . . **12. S. pseudomegaphyllus**
12. Sporangia usually bearing glands, sometimes with 1–2 setae.
15. Reduced pinnae 0–3 pairs.
16. Pinnae not more than 10 pairs, reduced ones usually lacking . . . . **13. S. diversilobus**
16. Pinnae at least 20 pairs, reduced ones always present.
17. Pinnae lobed not more than half-way to costa . . . . . **14. S. dichrotrichus**
17. Pinnae lobed fully ¾ . . . . . **15. S. vestigiatus**
15. Reduced pinnae on well-grown plants at least 5 pairs.
18. Pinnae not more than 4 cm wide, their lobes not acute.
19. Pinnae crenate to subentire.
20. Pinnae subentire; sinus-membrane hardly detectable . . . . . **16. S. morotaiensis**
20. Pinnae crenate, at least distally; sinus-membrane evident.
21. Pinnae to 3.5 × 1.0 cm; reduced pinnae all very small . . . . . **17. S. kalkmanii**
21. Pinnae (at least sterile ones) to 7 cm or more long, upper reduced pinnae at least 7 mm long.
22. Pinnae to 12–15 cm long; sinus-membrane distally widened and translucent.
23. Bases of pinnae cuneate, not auricled nor dilated; costules at 45° to costa **18. S. perglanduliferus**
23. Bases of pinnae truncate, lower ones auricled and dilated; costules at *c.* 60° to costa **19. S. veitchii**
22. Pinnae to 8 cm long; sinus-membrane distally not widened nor translucent **20. S. lamii**
19. Pinnae lobed at least ⅓ towards costa.
24. Aerophores elongate . . . . . **21. S. hirsutus**
24. Aerophores not elongate.
25. Bases of pinnae, at least lower ones, dilated both sides.
26. Hairs on lower surface of rachis and costae erect, to 1 mm long on sterile fronds **22. S. acrostichoides**
26. Hairs on lower surface of rachis and costae shorter, antrorse or appressed **23. S. melanorachis**
25. Bases of pinnae not dilated.
27. Only 1 pair of veins truly anastomosing, second acroscopic vein sometimes touching sinus-membrane.
28. Basal pinnae much narrowed at their bases . . . . . **24. S. heterocarpus**
28. Basal pinnae not or little narrowed at their bases.
29. Reduced pinnae all very small . . . . . **25. S. isomorphus**
29. Reduced pinnae to 1.5 cm or more long.
30. Hairs on lower surface of rachis and costae less than 0.1 mm long; no setae on sporangia . . . . . **26. S. dimidiolobatus**
30. Hairs on lower surface of rachis and costae 0.2 mm or more long; sporangia setiferous . . . . . **30. S. productus**
27. At least 1½ pairs of veins truly anastomosing and 1 vein touching sinus-membrane.
31. Pinnae lobed ¾ towards costa, lower ones auricled on acroscopic base **27. S. solutus**
31. Pinnae lobed not over ⅘, lower ones not auricled.
32. Pinnae lobed fully ½, widest in distal half . . . . . **28. S. hernaezii**
32. Pinnae in most cases lobed less than ½, not widened distally.
33. Fertile pinnae little more than 2 cm wide; 1½–2½ pairs of veins truly anastomosing.
34. Reduced pinnae 3–5 pairs, all very small . . . . . **29. S. moseleyi**
34. Reduced pinnae commonly 8 pairs or more, upper ones at least 1 × 1 cm, rounded **30. S. productus**
33. Fertile pinnae commonly 2.5–3.0 cm wide; 3–3½ pairs of veins truly anastomosing **31. S. penniger**
18. Pinnae to 7 cm wide, deeply lobed, lobes narrowly acute . . . . . **31. S. penniger**
1. Glands lacking or rare on upper surface of pinnae.
35. Glands present on lower surface of pinnae between veins.

36. Pinnae 2–4 cm long, 3–4 mm wide, subentire, several lower pairs gradually reduced **32. S. warburgii**
36. Pinnae, if subentire, much wider; transition to reduced basal pinnae ± abrupt.
37. Sporangia bearing several setae, sometimes also a gland.
38. Normal pinnae 3–4 pairs, 11 × 4 cm or larger; reduced pinnae 12–15 pairs **33. S. tandikatensis**
38. Normal pinnae more numerous or smaller.
39. Pinnae opposite, 6–7 pairs, 10 × 2.7 cm or larger . . . . . **34. S. carrii**
39. Not this combination of characters.
40. Sori exindusiate.
41. Pinnae *c.* 12 × 1.5 cm, lobed over $\frac{1}{2}$; reduced pinnae 15 pairs . . . . **35. S. exindusiatus**
41. Pinnae c. 6 × 1.8 cm, lobed less than $\frac{1}{2}$; reduced pinnae 2 pairs . . . . . **36. S. lucbanii**
40. Sori indusiate.
42. Reduced pinnae 1–2 pairs, normal pinnae 2–4 pairs 3.5 cm long . . . . . **37. S. major**
42. Not this combination of characters.
43. Reduced pinnae at least 6 pairs; transition to large pinnae abrupt.
44. Reduced pinnae 25–30 pairs . . . . . **38. S. polyotis**
44. Reduced pinnae rarely more than 12 pairs.
45. Pinnae lobed conspicuously more than $\frac{1}{2}$ way to costa.
46. Pinnae *c.* 12 pairs, 12.5 × 2.4 cm . . . . . **39. S. grandescens**
46. Pinnae 25–30 pairs, proportionately narrower.
47. Pinnae to 21 × 2.5 cm . . . . . **40. S. magnus**
47. Pinnae to 16 × 1.5 cm . . . . . **41. S. santomasii**
45. Pinnae lobed about $\frac{1}{2}$ or little more deeply.
48. Reduced pinnae all small, to 3 mm long . . . . . **42. S. trichochlamys**
48. Reduced pinnae all conspicuous . . . . . **11. S. appendiculatus**
43. Reduced pinnae not more than 4 pairs, transition not abrupt.
49. Texture rigid; pinna-lobes dentate at vein-ends . . . . . **43. S. adenostegius**
49. Texture thin; pinna-lobes entire . . . . . **14. S. dichrotrichus**
37. Sporangia in most cases bearing glands, sometimes a seta with the glands.
50. Pinnae subentire, very narrowly cuneate at basiscopic base . . . . . **44. S. aquatilis**
50. Pinnae otherwise.
51. Reduced pinnae 0–2 (–3) pairs, small, irregularly spaced.
52. Basal veins free . . . . . **45. S. hispidifolius**
52. Basal veins anastomosing.
53. 1 or 2 pairs of pinnae 6–8 cm long and 1 pair very small . . . . . **46. S. uniauriculatus**
53. Normal pinnae several pairs.
54. Upper surface of pinnae bearing appressed hairs between veins.
55. Free pinnae 3–4 pairs below long apical lamina . . . . . **47. S. urdanetensis**
55. Free pinnae more numerous; apical lamina not elongate.
56. Sterile pinnae not more than 3.5 × 1.2 cm.
57. Hairs on lower surfaces all short and mostly appressed.
58. Pinnae 12–15 pairs, 3.5 cm long, symmetrically many-lobed . . . **48. S. batjanensis**
58. Pinnae 5 pairs, *c.* 16 cm long, with few irregular lobes . . . . . **49. S. humilis**
57. Hairs on lower surface of rachis and costae erect, to 1 mm long . **50. S. lastreoides**
56. Sterile pinnae to 8 × 1.8 cm . . . . . **50. S. lastreoides**
54. Upper surface of pinnae lacking appressed hairs between veins.
59. Pinnae 7–10 × 1 cm . . . . . **51. S. cataractorum**
59. Pinnae not over 5.5 cm long, more than 1 cm wide.
60. Pinnae not dimorphous; apical lamina narrow, 10 cm long . . . . **52. S. menadensis**
60. Pinnae dimorphous; apical lamina broadly triangular, shorter . . . **53. S. subcordatus**
51. Reduced pinnae at least 4 pairs, regularly spaced; transition to normal pinnae gradual or abrupt.
61. Aerophores distinctly elongate.
62. Basal veins quite free, not meeting at sinus . . . . . **54. S. novoguineensis**
62. Basal veins meeting at sinus, or anastomosing below it.
63. Pinnae entire or slightly crenate.
64. Pinnae *c.* 5 × 1 cm, distinctly crenate; transition to 15 pairs of reduced pinnae subabrupt **55. S. hispiduliformis**
64. Pinnae larger, almost entire; 12 pairs of lower pinnae gradually reduced **56. S. hastatopinnatus**
63. Pinnae distinctly lobed.

65. Appressed hairs present between veins on upper surface of pinnae.
66. 12 pairs of lower pinnae gradually reduced and 20 pairs of smaller ones **55. S. hispiduliformis**
66. Subabrupt transition to reduced lower pinnae.
67. Pinnae lobed not or little more than $\frac{1}{2}$ way to costa.
68. Reduced pinnae conspicuous, upper ones 1–3 cm long.
69. Pinnae 12 × 1.6 to 20 × 2 cm, gradually acuminate; lower surface of costae glabrous or with sparse short hairs . . . . . **57. S. latebrosus**
69. Pinnae to 14 × 2.5 cm, abruptly short-acuminate; lower surface of costae densely covered with appressed hairs . . . . . **58. S. porphyricola**
68. Reduced pinnae all very small.
70. Lower surface of rachis and costae almost glabrous . . . . . **59. S. caulescens**
70. Lower surface of rachis and costae bearing hairs to 1 mm long.
71. Largest pinnae commonly 15–20 cm long; hairs on rachis pale . . **21. S. hirsutus**
71. Largest pinnae 7 × 1.5 cm; hairs on rachis brown . . . . . **60. S. reconditus**
67. Pinnae lobed conspicuously more than $\frac{1}{2}$ way to costa.
72. Hairs on lower surface of costules antrorsely appressed.
73. Sori supramedial; pinnae to 2.5 cm wide.
74. Basal normal pinnae not narrowed at base . . . . . **61. S. cyrtocaulos**
74. Several pairs of lower pinnae much narrowed at their bases . . **62. S. baramensis**
73. Sori inframedial; pinnae to 1.5 cm wide . . . . . **63. S. batulantensis**
72. Hairs on lower surface of costules not antrorse.
75. Reduced pinnae all conspicuous, lowest 5 mm long . . . . . **64. S. subalpinus**
75. Reduced pinnae all small, uppermost 5 mm long.
76. Dark hairs on both sides of rachis . . . . . **65. S. lobatus**
76. Pallid hairs on both sides of rachis.
77. Lowest pinnae little narrowed at base; reduced pinnae evident . **66. S. ellipticus**
77. Lower pinnae much narrowed at base; all reduced pinnae minute **67. S. foxworthyi**
65. No appressed hairs on upper surface between veins.
78. Hairs on lower surface of costules copious, closely appressed.
79. Reduced pinnae all very small, basal normal pinnae narrowed at base.
80. Pinnae lobed less than $\frac{1}{2}$ towards costa . . . . . **68. S. indrapurae**
80. Pinnae lobed about $\frac{3}{4}$ . . . . . **62. S. baramensis**
79. Reduced pinnae conspicuous, many 10–15 mm long; basal normal pinnae not narrowed at base . . . . . **69. S. batacorum**
78. Hairs on lower surface of costules short, not appressed.
81. Sori indusiate; sporangia glandular, rarely with a seta.
82. Lowest normal pinnae narrowed at base . . . . . **70. S. angustibasis**
82. Lowest normal pinnae not narrowed at base . . . . . **57. S. latebrosus**
81. Sori exindusiate; neither glands nor setae on sporangia.
83. Pinnae thin, lobed to 2 mm from costa . . . . . **71. S. nudisorus**
83. Pinnae subcoriaceous, lobed little more than $\frac{1}{2}$ . . . . . **72. S. paripinnatus**
61. Aerophores not or slightly elongate.
84. Basal veins both passing to sides of sinus-membrane or uniting just below it, not or rarely forming a distinct excurrent vein.
85. Reduced pinnae all with distinct lamina; costules 2.5 mm apart . **73. S. novae-britanniae**
85. Reduced pinnae without distinct lamina; costules 4 mm apart . . . . **74. S. convergens**
84. Basal veins uniting to form an excurrent vein, at least near base of pinna.
86. Sori supramedial; caudex a long-creeping rhizome . . . . . **75. S. unitus**
86. Sori medial or inframedial; caudex not long-creeping.
87. Pinnae to 2.5 cm long; dark hairs on upper surface of rachis . . . **76. S. sessilipinna**
87. Not this combination of characters.
88. Lower surface of rachis glabrous or nearly so; hairs on lower surface of base of costae none or very short.
89. Reduced pinnae all very small.
90. Largest pinnae *c.* 6 cm long . . . . . **77. S. lobangensis**
90. Largest pinnae at least 10 cm long.
91. Fertile pinnae to 16 × 2 cm, lobed at most $\frac{5}{8}$ . . . . . **78. S. gymnorachis**
91. Fertile pinnae to 26 × 3 cm, lobed $\frac{3}{4}$ . . . . . **79. S. pullenii**
89. Reduced pinnae: upper ones 1.5–2 cm long, lower gradually smaller.
92. Pinnae lobed to a depth of 2 mm . . . . . **80. S. gregarius**

92. Pinnae lobed at least $\frac{1}{2}$ way to costa . . . . . **57. S. latebrosus**
88. Lower surface of rachis and costae hairy throughout.
93. Pinnae crenate.
94. Pinnae not more than 4.5 × 1.4 cm; veins 4–5 pairs, 1–$1\frac{1}{2}$ pairs anastomosing.
95. Pinnae 5–6 pairs . . . . . **81. S. tephrophyllus**
95. Pinnae 18 pairs . . . . . **17. S. kalkmanii**
94. Sterile pinnae to 8 × 1.7 cm; $2\frac{1}{2}$ pairs of veins anastomosing; sinus-membrane very short **20. S. lamii**
93. Pinnae distinctly lobed.
96. Fronds dimorphous; sterile pinnae to 25 × 3.5 cm . . . . **82. S. pilososquamatus**
96. Fronds not or little dimorphous, pinnae not over 2.5 cm wide.
97. Pinnae to 9.5 × 0.8–0.9 cm . . . . . **83. S. angustifolius**
97. Pinnae proportionately wider, to at least 1.5 cm wide.
98. Lowest normal pinnae much narrowed at base . . . . . **24. S. heterocarpus**
98. Lowest normal pinnae not narrowed at base.
99. Hairs 1 mm long on lower surface of rachis and costae; indusia with long hairs.
100. Pinnae lobed less than 1/2 way to costa . . . . . **84. S. efogensis**
100. Pinnae lobed more than 1/2 way to costa.
101. Reduced pinnae *c.* 5 pairs . . . . . **85. S. dichrotrichoides**
101. Reduced pinnae many pairs . . . . . **3. S. polycarpus**
99. Hairs in most cases less than 0.5 mm long on lower surface of rachis and costae; glands present on indusia.
102. Lowest veins sometimes both touching sides of sinus-membrane; pinnae lobed 2/3–3/4 . . . . . **86. S. nakaikei**
102. Lowest veins always anastomosing; pinnae lobed *c.* 3/5.
103. Pinnae rigid, lobes of larger ones toothed distally; reduced pinnae not over 8 pairs.
104. Reduced pinnae 4–5 pairs; upper surface of pinnae bearing appressed hairs between veins . . . . . **87. S. woitapensis**
104. Reduced pinnae 8 pairs; upper surface of pinnae lacking appressed hairs **88. S. ekutiensis**
103. Pinnae thin, lobes not toothed; reduced pinnae 12–15 pairs.
105. Hairs on lower surface of costae not appressed.
106. Hairs on lower surface of costae all very short . . . . **57. S. latebrosus**
106. Some hairs 0.5 mm or more long on lower surface of costae **66. S. ellipticus**
105. Lower surface of costae covered with closely appressed hairs **58. S. porphyricola**
35. Glands between veins on lower surface of pinnae lacking.
107. Glands present on lower surface of costules and veins.
108. Pinnae 3–4 pairs, to 1.1 × 0.5 cm, basal pinnae somewhat reduced . . . . **89. S. omatianus**
108. Pinnae more numerous or larger, or several pairs reduced basal pinnae.
109. All pinnae with narrowly cuneate basiscopic base . . . . . **44. S. aquatilis**
109. Pinnae symmetrically broadly cuneate or truncate at base.
110. Few to many pairs of lower pinnae gradually reduced.
111. Pinnae subentire to crenate.
112. Pinnae to 3.5 × 1.0 cm; pinna-lobes with strongly reflexed edges.
113. Sporangia setiferous; 12–14 pairs of lower pinnae gradually reduced . . **90. S. alticola**
113. Sporangia not setiferous; 4–5 pairs of lower pinnae gradually reduced . **91. S. rigidus**
112. Pinnae larger, edges of lobes not strongly reflexed.
114. Sori exindusiate; lower surface of costae and costules glabrous **56. S. hastatopinnatus**
114. Sori indusiate; short hairs abundant on lower surface of rachis and costae **92. S. arfakianus**
111. Pinnae lobed $\frac{1}{3}$–$\frac{2}{5}$ towards costa.
115. 1–4 pairs of basal pinnae gradually reduced . . . . . **43. S. adenostegius**
115. Many pairs of basal reduced pinnae.
116. 7–12 pairs of lower pinnae gradually reduced with subabrupt change to 12 pairs much smaller . . . . . **55. S. hispiduliformis**
116. Similar transition but 2–6 pairs of small basal pinnae . . . . . **93. S. archboldii**
110. Transition to reduced basal pinnae (if any) abrupt or nearly so.

117. Reduced pinnae 0–3 pairs.
118. Pinna-lobes strongly concave beneath . . . . . **91. S. rigidus**
118. Pinnae-lobes not concave beneath.
119. Pinnae widened distally . . . . . **13. S. diversilobus**
119. Pinnae not widened distally.
120. Caudex short-creeping; pinnae lobed *c.* $\frac{2}{5}$ towards costa.
121. Fronds not dimorphous; sori supramedial.
122. Pinnae 3.5 × 1.4 cm, narrowed evenly to apex . . . . . **94. S. tibangensis**
122. Pinnae larger, abruptly short-acuminate . . . . . **95. S. norrisii**
121. Fronds dimorphous; sori medial . . . . . **82. S. pilososquamatus**
120. Caudex slender, erect; pinnae crenate . . . . . **96. S. semimetralis**
117. Reduced pinnae at least 4 pairs.
123. Aerophores elongate.
124. Pinnae crenate.
125. Hairs on lower surface of costae minute . . . . . **97. S. semicordatus**
125. Hairs on lower surface of costae appressed . . . . . **98. S. pterosporus**
124. Pinnae lobed at least 2/5 towards costa.
126. Hairs on lower surface of costules appressed . . . . . **98. S. pterosporus**
126. Hairs on lower surface of costules not appressed.
127. Reduced pinnae 20–30 pairs; normal pinnae lobed less than $\frac{1}{2}$ way to costa.
128. Reduced pinnae acuminate . . . . . **99. S. sagittifolius**
128. Reduced pinnae with rounded tips . . . . . **100. S. foliolosus**
127. Reduced pinnae not more than 12 pairs; normal pinnae lobed $\frac{1}{2}$ way to costa or more deeply.
129. Pinnae lobed $\frac{3}{4}$ to costa.
130. Basal veins anastomosing; upper reduced pinnae 12 mm long . . . **101. S. alpinus**
130. Basal veins free; upper reduced pinnae 3 mm long . . . . **54. S. novoguineensis**
129. Pinnae lobed about $\frac{1}{2}$ to costa.
131. Pinnae *c.* 6.5 × 1.3 cm, lowest narrowed at base; indusia glabrous **102. S. polisianus**
131. Pinnae *c.* 11 × 2 cm, lowest not narrowed at base; indusia bearing long hairs **103. S. hoalensis**
123. Aerophores not elongate.
132. Sori elongate . . . . . **104. S. larutensis**
132. Sori not or little elongate.
133. Reduced pinnae *c.* 30 pairs, deflexed, overlapping.
134. Reduced pinnae acuminate; normal pinnae 20 cm long . . . . . **99. S. sagittifolius**
134. Reduced pinnae with rounded tips; normal pinnae smaller . . . . **38. S. polyotis**
133. Reduced pinnae not over 12 pairs, not overlapping.
135. Sori supramedial.
136. Pinnae lobed $\frac{3}{4}$, sporangia setiferous . . . . . **105. S. loherianus**
136. Pinnae lobed less than $\frac{1}{2}$; sporangia glandular . . . . . **75. S. unitus**
135. Sori not supramedial.
137. Pinnae lobed more than $\frac{1}{2}$.
138. Sori indusiate; sporangia with glands.
139. Largest reduced pinna 7 mm long; hairs on lower surface of costae not appressed **106. S. erectus**
139. Largest reduced pinna 2 mm long; hairs on lower surface of costae appressed **98. S. pterosporus**
138. Sori exindusiate; sporangia setiferous . . . . . **107. S. stresemannii**
137. Pinnae crenate or lobed less than $\frac{1}{2}$.
140. Pinnae not over 1 cm wide; indusia very small or lacking . . . **17. S. kalkmanii**
140. Pinnae more than 1 cm wide; indusia all distinct.
141. Some hairs on lower surface of rachis and costae 1 mm or more long.
142. Pinnae commonly more than 2 cm wide, crenate to a depth of 1 mm.
143. Apex of frond pinna-like, crenate to base . . . . . **108. S. simplicifolius**
143. Apex of frond deeply lobed at base . . . . . **109. S. spenceri**
142. Pinnae to 1.7 cm wide, distinctly lobed . . . . . **84. S. efogensis**
141. Hairs on lower surface of rachis and costae all very short.
144. Largest reduced pinnae 2 mm long . . . . . **98. S. pterosporus**
144. Largest reduced pinnae at least 7 mm long.

145. Sporangia not setiferous.
146. Pinnae opposite; caudex 40 cm tall . . . . . **110. S. mengenianus**
146. Pinnae not opposite; caudex suberect . . . . . **80. S. gregarius**
145. Sporangia setiferous . . . . . **111. S. confertus**
107. Glands lacking on lower surface of costules and veins.
147. Reduced pinnae *c.* 30 pairs.
148. Reduced pinnae acuminate . . . . . **99. S. sagittifolius**
148. Reduced pinnae with rounded tips . . . . . **38. S. polyotis**
147. Reduced pinnae much fewer.
149. Sporangia bearing glands (sometimes a seta also).
150. Hairs on lower surface of costules appressed.
151. Aerophores elongate.
152. Several pairs of lower pinnae gradually reduced . . . . . **112. S. multiauriculatus**
152. Transition to reduced pinnae ± abrupt.
153. Upper reduced pinnae 12 mm, lowest 6 mm long . . . . . **113. S. stipellatus**
153. All reduced pinnae very short.
154. Pinnae lobed less than $\frac{1}{2}$ . . . . . **98. S. pterosporus**
154. Pinnae lobed more than $\frac{1}{2}$.
155. Indusia large, firm . . . . . **114. S. plurifolius**
155. Indusia small, thin.
156. Basal veins anastomosing, second acroscopic vein to sinus-membrane **115. S. hendersonii**
156. Basal veins often connivent at sinus-membrane, next veins both to margin **116. S. posthumii**
151. Aerophores not elongate.
157. Basal acroscopic vein ending beside sinus-membrane, basiscopic vein at margin above base of sinus.
158. Pinnae 15–20 pairs; reduced pinnae 4–7 pairs . . . . . **117. S. inconspicuus**
158. Pinnae to 30 pairs; reduced pinnae 2–3 pairs . . . . . **118. S. subulifolius**
157. Basal veins both touching sinus-membrane or uniting below it.
159. Gradual transition to reduced pinnae at base of frond.
160. Indusia present . . . . . **92. S. arfakianus**
160. Indusia absent . . . . . **112. S. multiauriculatus**
159. Abrupt transition to very small reduced pinnae . . . . . **98. S. pterosporus**
150. Hairs on lower surface of costules not appressed.
161. Basal veins not connivent below sinus.
162. Pinnae deeply lobed.
163. Pinnae to 3.6 × 1.0 cm; veins 3–4 pairs . . . . . **119. S. mjobergii**
163. Pinnae to 10 × 1.5 cm; veins 9–10 pairs . . . . . **54. S. novoguineensis**
162. Pinnae almost entire . . . . . **120. S. mutabilis**
161. Basal veins connivent below sinus or uniting to form an excurrent vein.
164. Pinnae to 4.2 × 1.1 cm; sori elongate with small indusia . . . . . **121. S. uaniensis**
164. Pinnae in most cases much larger; sori otherwise.
165. Ten or more pairs of basal pinnae gradually reduced.
166. Pinna-margins sinuous or slightly crenate . . . . . **56. S. hastatopinnatus**
166. Pinnae deeply lobed . . . . . **122. S. echinosporus**
165. Abrupt transition to reduced pinnae if present.
167. Reduced pinnae 0–4 pairs on mature plants.
168. Pinnae almost entire, 3.5 cm or more wide . . . . . **123. S. peltochlamys**
168. Pinnae distinctly lobed, narrower.
169. Pinnae lobed more than $\frac{1}{2}$ . . . . . **124. S. irayensis**
169. Pinnae lobed less than $\frac{1}{2}$ . . . . . **95. S. norrisii**
167. Reduced pinnae at least 6 pairs on mature plants.
170. Sori supramedial.
171. Caudex a long-creeping rhizome . . . . . **75. S. unitus**
171. Caudex short, erect . . . . . **125. S. lithophyllus**
170. Sori medial or inframedial.
172. Pinnae crenate . . . . . **109. S. spenceri**
172. Pinnae lobed at least $\frac{2}{3}$.
173. Pinnae lobed more than $\frac{1}{2}$ . . . . . **126. S. hamiferus**

173. Pinnae lobed less than $\frac{1}{2}$ . . . . . **80. S. gregarius**
149. Sporangia lacking glands, in most cases bearing setae.
174. Aerophores elongate.
175. Pinnae entire or slightly crenate; veins 18–20 pairs . . . . . **127. S. plurivenosus**
175. Pinnae distinctly lobed; veins rarely more than 12 pairs.
176. Pinnae lobed less than $\frac{1}{2}$.
177. Hairs on lower surface of costae and costules appressed.
178. Lower 12–15 pairs of pinnae gradually reduced, lowest 1 cm long **112. S. multiauriculatus**
178. Transition to small pinnae at base of frond abrupt . . . . . **128. S. squamatellus**
177. Hairs on lower surface of costae and costules not appressed.
179. Reduced pinnae more than 12 pairs; sporangia not setiferous . . **55. S. hispiduliformis**
179. Reduced pinnae to 5 pairs; sporangia setiferous . . . . . **129. S. canescens**
176. Pinnae lobed more than $\frac{1}{2}$.
180. Sporangia always with several setae.
181. Basal 2–3 pairs of pinnae somewhat narrowed at their bases.
182. Pinnae to 11 × 2.1 cm, lobed $\frac{3}{5}$–$\frac{2}{3}$; hairs on lower surface of costules antrorse **130. S. suboppositus**
182. Pinnae to 17 × 2.8 cm, lobed more than $\frac{3}{4}$; hairs on lower surface of costules erect **131. S. makassaricus**
181. All pinnae in lower half of frond narrowed at their bases, lowest much narrowed **132. S. sarasinorum**
180. Sporangia rarely with a seta.
183. Pinnae lobed $\frac{3}{4}$ or more deeply; reduced pinnae all very small.
184. Lower surface of rachis glabrous . . . . . **62. S. baramensis**
184. Lower surface of rachis densely covered with erect brown hairs . **133. S. muluensis**
183. Pinnae lobed at most $\frac{2}{3}$; reduced pinnae 1–1.5 cm long . . . . . **126. S. hamiferus**
174. Aerophores not elongate.
185. Sporangia not setiferous.
186. Pinnae not or little more than 5 cm long.
187. Pinnae crenate; sori inframedial.
188. Pinnae 10–20 pairs; 2–3 pairs of lower ones gradually reduced.
189. Caudex slender, erect; pinnae slightly crenate distally . . . . **134. S. telefominicus**
189. Caudex very short; pinnae crenate throughout . . . . . **135. S. roemerianus**
188. Pinnae to 30 pairs; abrupt change to reduced ones at base . . . **136. S. hellwigensis**
187. Pinnae lobed more than $\frac{1}{2}$; sori supramedial . . . . . **137. S. benoitianus**
186. Pinnae more than 10 cm long.
190. No reduced pinnae; normal pinnae distinctly stalked . . . . . **138. S. neotoppingii**
190. At least 5 pairs lower pinnae gradually or abruptly reduced; all pinnae sessile.
191. Sori elongate and indusiate.
192. Normal pinnae not or little more than 2 cm wide; upper reduced pinnae 4 mm long **139. S. oosorus**
192. Normal pinnae commonly 2.5–3.5 cm wide; reduced pinnae much larger **104. S. larutensis**
191. Sori not elongate, or if so exindusiate.
193. Abrupt transition to 6 pairs of very small basal pinnae . . . . . **140. S. rudis**
193. Basal pinnae not very small.
194. Rachis quite glabrous on lower surface; pinnae almost entire . . **141. S. dimorphus**
194. Rachis hairy on lower surface; pinnae crenate or lobed throughout **142. S. potamios**
185. Sporangia setiferous.
195. Caudex terrestrial and long-creeping, or scandent.
196. Caudex terrestrial; indusia distinct . . . . . **143. S. invisus**
196. Caudex scandent; indusia very small or lacking.
197. Several pairs of lower pinnae gradually smaller and auricled on acroscopic base **144. S. austerus**
197. Transition to basal reduced pinnae abrupt . . . . . **145. S. mundus**
195. Caudex various, not long-creeping nor scandent.
198. Lower 1–5 pairs of pinnae gradually reduced.
199. Pinnae to 2 cm long; no indusia . . . . . **146. S. obtusifolius**
199. Pinnae to at least 4 cm long; indusia present . . . . . **43. S. adenostegius**

198. At least 3 pairs of reduced pinnae distinct from normal ones.
200. Pinnae lobed $\frac{1}{2}$ way to costa or more deeply.
201. Reduced pinnae 20 pairs, all very small . . . . . **147. S. alcasidii**
201. Reduced pinnae to 12 pairs, all conspicuous.
202. Caudex short, erect; pinnae lobed $\frac{1}{2}$ . . . . . **148. S. pilosissimus**
202. Caudex tall, slender, if free-standing; pinnae lobed $\frac{2}{3}$–$\frac{3}{4}$ . . . . . **145. S. mundus**
200. Pinnae lobed less than $\frac{1}{2}$ way to costa.
203. Pinnae to 3.5 cm long, slightly crenate . . . . . **149. S. erwinii**
203. Pinnae in most cases larger, deeply crenate or lobed.
204. Stipe 40–50 cm long; reduced pinnae 3 pairs, small . . . . **82. S. pilososquamatus**
204. Stipe much shorter; reduced pinnae more numerous, conspicuous.
205. Pinnae crenate; no long hairs on lower surface of rachis and costae.
206. Caudex erect; largest fertile pinnae 17 × 2.5 cm . . . . . **150. S. atasripii**
206. Caudex short-creeping; largest pinnae 8 × 2 cm . . . . . **111. S. confertus**
205. Pinnae distinctly lobed; long hairs usually present on lower surface of rachis and costae.
207. Stipe-scales 1 mm long; pinnae to 4 × 1 cm . . . . . **151. S. albosetosus**
207. Stipe-scales 7 mm long; pinnae to 12 × 2 cm . . . . . **152. S. wauensis**

1. Sphaerostephanos debilis (METT.) HOLTTUM, *comb. nov.* — *Phegopteris debilis* METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 123, t. 6 f. 1; v.A.v.R. Handb. (1908) 501. — *Dryopteris debilis* (METT.) C. CHR. Ind. Fil. (1905) 260. — *Cyclosorus debilis* (METT.) COPEL. Gen. Fil. (1947) 142, *non* CHING 1941. — *Thelypteris debilis* (METT.) REED, Phytologia 17 (1968) 270. — Type: ZIPPELIUS, Amboina (L).

Caudex short, erect; *stipe* 3–4 cm long. *Lamina* 30–40 cm long, gradually attenuate both to base and apex; basal pinnae 5 mm long; texture thin. *Largest pinnae* 3.0 cm long, 0.7 cm wide above base; base truncate, 1.0 cm wide, auricled on acroscopic side, slightly dilated on basiscopic, distal part gradually narrowed to a rounded apex, edges slightly crenate; costules 2.5 mm apart; veins 2 pairs, lower pair anastomosing; sparse hairs 1 mm long on *lower surface* of rachis, sparse minute hairs on costae and costules, small spherical glands throughout; minute suberect hairs and glands between veins on *upper surface*. *Sori* inframedial, small, exindusiate; sporangia bearing 1–2 short setae and sometimes a gland distally and a sessile gland on the stalk.

Distr. *Malesia*: Moluccas (Amboina, without collector's name at B, K, L, also one cult. Hort. Bog. at L); W. New Guinea.

Ecol. In New Guinea on rocks by river at 100 m.

Note. The New Guinea specimens (KANEHIRA & HATUSIMA 12837) have lamina 30 cm long with 50 pairs of pinnae, largest pinnae 2.0 cm long, 0.4–0.5 cm wide above base, basal pinnae 3 mm long; a few long hairs are present on lower surface of costae.

2. Sphaerostephanos sudesticus HOLTTUM, *sp. nov.*

Pinnae redactae verisimiliter nullae; *lamina 54 cm longus*; *pinnae 15-jugatae, maximae 17 × 2.2 cm, basi late cuneatae, 3/5 costam versus lobatae, utrinque pilis minutis erectis glandulisque praeditae*; *venae 9-jugatae, basales solum anastomosantes*; *sori mediales, inferiores praesertim elongati, indusiis tenuibus breviter hirsutis et glandulosis tecti*; *sporangia setifera*. — Type: BRASS 27772, Sudest Island, Louisiade Archipelago, terrestrial in openings in forest, alt. 2 m (L).

Caudex not known; stipe 47 cm long, minutely hairy. *Reduced pinnae* not seen; if present, minute and few. *Lamina* 54 cm long; pinnae 15 pairs, alternate; 3–4 pairs upper pinnae adnate to rachis with asymmetric bases; lowest pinnae 2.5 cm wide. *Rachis* minutely hairy on lower surface, hairs on upper surface pale, less than 0.5 mm long. *Middle pinnae* to 17 × 2.2 cm, base broadly cuneate, aerophores not swollen, apex with cauda 2 cm long, edges lobed to 3.5–4 mm from costa (less than 2/3), lobes slightly falcate; costules 5 mm apart, at 60°; veins to 9 pairs, 1 pair anastomosing, next acroscopic vein to sinus-membrane; hairs on *lower surface* of costae 0.2 mm long, slightly antrorse, a little longer distally, similar shorter hairs more sparse on costules, veins and between veins, glands present throughout; hairs on *upper surface* of costae 0.2 mm long, scattered hairs 0.5 mm long on costules and veins, very short erect hairs and glands between veins. *Sori* medial, almost all elongate, lower ones longest; indusia very thin, rather large, bearing sparse short hairs and several glands; sporangia bearing 1–2 short setae.

Distr. *Malesia*: Papua New Guinea (Sudest I.), only known from the type.

Ecol. Terrestrial in openings in forest at 2 m.

3. Sphaerostephanos polycarpus (BL.) COPEL. Un. Cal. Publ. Bot. 16 (1929) 60; Fern Fl. Philip. (1960) 379. — *Aspidium polycarpon* BL. Enum. Pl. Jav. (1828) 156. — *Didymochlaena polycarpa* (BL.) BAK. Syn. Fil. (1867) 248; RACIB. Fl. Btzg 1 (1898) 197. — *Nephrodium polycarpum* (BL.)

KEYS. Pol. Cyath. Herb. Bung. (1873) vii; BEDD. Handb. Suppl. (1892) 74. — *Mesochlaena polycarpa* (BL.) BEDD. Ferns Br. Ind. Suppl. (1876) 13; Handb. (1883) 199; v.A.v.R. Handb. (1908) 232. — *Dryopteris polycarpa* (BL.) CHRIST, Philip. J. Sci. 2 (1907) Bot. 202. — *Cyclosorus polycarpus* (BL.) HOLTTUM, Rev. Fl. Malaya 2 (1955) 283. — *Thelypteris polycarpa* (BL.) K. IWAT. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 32. — Type: BLUME, Noesa Kambangan, Java (L).

Aspidium heterodon BL. Enum. Pl. Jav. (1828) 157. — Type: from Celebes, no collector cited (L).

S. asplenioides J. SM. in Hook. Gen. Fil. (1839) t. 24; KUNZE, Farnkr. 1 (1840) t. 11, 12. — *Mesochlaena asplenioides* J. SM. in Hook. J. Bot. 3 (1840) 18. — *Stegnogramma asplenioides* (J. SM.) FÉE, Gen. Fil. (1852) 204. — Type: origin unrecorded (BM in Herb. J. Sm.).

Mesochlaena javanica R. BR. ex METT. Fil. Hort. Lips. (1856) 96, t. 18 f. 13. — *Aspidium javanicum* METT. Farngatt. IV (1858) 103. — *Nephrodium javanicum* (METT.) HOOK. Fil. Exot. (1859) t. 62. — Type: "Java" (not seen).

Lastrea microchlamys DE VRIESE, Tijdschr. Wisk- Nat. Wet. Amst. 1 (1848) 155. — Type: Cult. Hort. Bot. Lugd.-Bat. (L).

Nephrodium microchlamys BAK. J. Linn. Soc. Bot. 15 (1876) 107. — Type: MOSELEY, Challenger Exp. Kei Isl. (K).

Aspidium perakense BEDD. J. Bot. 26 (1888) 4. — *Nephrodium perakense* (BEDD.) BAK. Ann. Bot. 5 (1891) 319; BEDD. Handb. Suppl. (1892) 80. — *Thelypteris perakensis* (BEDD.) REED, Phytologia 17 (1968) 303. — Type: J. DAY, Perak, Birch's Hill, on exposed rocks (K; E).

Mesochlaena toppingii COPEL. Philip. J. Sci. 12 (1917) Bot. 57; C. CHR. Gard. Bull. Str. Settl. 7 (1934) 254. — *S. toppingii* (COPEL.) C. CHR. Ind. Fil. Suppl. III (1934) 172. — Type: TOPPING 1902, Mt Kinabalu (Herb. Am. Fern Soc.).

S. unijugus COPEL. Philip. J. Sci. 60 (1936) 109, t. 15. — Type: BRASS 2692, Solomon Is., San Cristobal (UC; BRI, MICH). — **Fig. 12a–c.**

Caudex erect; *stipe* c. 10 cm long, bearing many narrow scales 10 mm long. *Reduced pinnae* 20 pairs or more, 2.5–3.5 cm apart, lowest 1 cm long, uppermost 2.5–3 cm, spreading, triangular with broad base dilated almost equally both sides and acute apex, edges of larger ones incised. *Lamina* above reduced pinnae 100–150 cm long; pinnae many pairs, rather close; basal pinnae not narrowed at base, aerophores slightly swollen. *Largest pinnae* commonly 25 × 1.8 cm, largest seen 35 × 2.5 cm; base rather asymmetric, basal acroscopic lobe often elongate; edges lobed more than $\frac{1}{2}$ way to costa; lobes slightly oblique, slightly falcate; costules commonly to 4 mm apart; veins 12–15 pairs, basal pair anastomosing with excurrent vein to sinus, 1–2 pairs passing to sides of sinus-membrane (in smaller fronds sometimes only acroscopic vein); *lower surfaces* bearing glands throughout, acicular hairs on rachis, costae and costules normally short, spreading, in some specimens to 1 mm long; acicular hairs on *upper surface* of costae to 1 mm long, scattered similar hairs on costules and veins, between veins a variable number of glands and very short erect acicular hairs. *Sori* medial, elongate, commonly 1 mm long; indusia with many yellow glands; sporangia also bearing glands; spores with a moderate number of wings of varying size.

Distr. Peninsular Thailand; throughout *Malesia* except Philippines north of 10° and Lesser Sunda Islands east of Lombok; Solomon Islands, Samoa.

Ecol. In open not too dry places, in low country and to 1500 m.

Notes. Quite small plants may be fertile; in these sometimes the second veins may both reach the margin above base of sinus. Specimens with long hairs on the lower surface do not differ from the normal condition in other ways, and length of hairs varies; there is no evident correlation of long hairs with drier habitats, but this is possible.

Aspidium perakense BEDD. was based on young sterile plants growing on a rock; they are very hairy. DAY collected with them fragments of a fertile frond of an abnormal *Christella*; this is the source of BEDDOME'S description of sori.

Mesochlaena toppingii COPEL. was based on a small hairy specimen. *S. unijugus* was also based on a small specimen in which at most the second acroscopic vein passes to the sinus-membrane; the upper surface was almost or quite glandless but similar specimens from New Britain have many glands. Another specimen from the Solomon Islands, otherwise similar, has a fair number of glands on the upper surface.

4. Sphaerostephanos eminens (BAK.) HOLTTUM, *comb. nov.* — *Nephrodium eminens* BAK. J. Bot. 18 (1880) 213. — *Dryopteris eminens* (BAK.) C. CHR. Ind. Fil. (1905) 263; v.A.v.R. Handb. (1908) 214. — Type: BECCARI 455, Sumatra, G. Singgalang 1700 m (FI; K).

Dryopteris pilososquamata var. obtusata v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 12; Handb. Suppl. (1917) 182. — Type: MATTHEW 645, G. Singgalang (BO).

Mesochlaena talamauensis v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 34. — *S. talamauensis* (v.A.v.R.) C. CHR. Ind. Fil. Suppl. III (1934) 172. — Type: BÜNNEMEIJER 873, Sumatra, Talamau, 1750 m (BO).

Caudex erect or suberect. *Stipe* c. 50 cm long, glabrous; base of stipe to first large pinna 110 cm, this part bearing 7 pairs widely-spaced *reduced pinnae*, upper ones broadly triangular, 2.2 cm long and wide, lowest hardly 1 cm long. *Lamina* to 90 cm long, pinnae 16 pairs, lowest almost sessile and slightly narrowed at base, middle ones with stalks 3–12 mm long; apex of frond almost pinna-

like; aerophores not swollen. *Largest pinnae* 30 × 3 cm, base cuneate, apex long-acuminate, lobed about ½ way to costa, lobes distinctly falcate, blunt, entire; costules 7 mm apart at 60°; veins to 12 pairs, concolorous and prominent on *lower surface* but not above, basal 1–1½ pairs anastomosing, 2 pairs to sides of sinus-membrane; pale curved hairs 0.2–0.5 mm long on lower surface of rachis and costae, shorter and somewhat antrorse on costules, glands (no hairs) on veins and surface between veins; hairs 0.5 mm long on *upper surface* of rachis and costae, much shorter on costules, glands present between veins. *Sori* medial, lower ones somewhat divergent, all except distal ones ± elongate; indusia and sporangia bearing glands.

Distr. *Malesia*: Middle to northern Sumatra, several collections.

Notes. The length of pinna-stalks varies in different specimens; those of the type of *M. talamauensis* only 3 mm, on BECCARI's type 12 mm, on a specimen of MATTHEW's from the same locality 5 mm. YATES 699 from Brastagi is rather intermediate between this species and *S. penniger*, with sessile pinnae and setiferous sporangia.

5. Sphaerostephanos williamsii (COPEL.) HOLTTUM, Kalikasan 4 (1975) 53. — *Dryopteris williamsii* COPEL. Brittonia 1 (1931) 67, pl. 1. — *Thelypteris williamsii* CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 255. — *Lastrea williamsii* COPEL. Gen. Fil. (1947) 140; Fern Fl. Philip. (1960) 322. — Type: R. S. WILLIAMS 2216, Mindanao, San Ramon (UC; B, G, NY, US).

Caudex short, erect. *Stipe* 10 cm long, very-short-hairy, basal scales 2 mm long, ovate; base of stipe to first normal pinna 20–30 mm. *Reduced pinnae* 3 pairs, not opposite, irregularly spaced, lowest 4 mm long; transition to normal pinnae abrupt or with one pair intermediate. *Lamina* of type 30 cm long (of NY isotype 40 cm); pinnae 12–14 pairs, 1–2 lower ones narrowed at base; aerophores not enlarged. *Largest pinnae* of type 6.5 × 1.1 cm (of NY isotype 11 × 1.8 cm) lobed to less than 1 mm from costa, apex acuminate; lobes oblique, slightly falcate; costules 2.5–3.5 mm apart, at 60°; veins 8–10 pairs, both basal veins ending above base of sinus; acicular hairs on *lower surface* of rachis and costae short, spreading; whole lower surface of pinna covered with short slender erect hairs and glands; *upper surface* minutely hairy and glandular throughout. *Sori* medial, exindusiate; sporangia bearing many small yellow glands, less often 2–3 short setae; spores with thin translucent wing and cross wings.

Distr. *Malesia*: Philippines (Mindanao, at 150 m), only known from the type.

6. Sphaerostephanos stenodontus (COPEL.) HOLTTUM, Kalikasan 4 (1975) 56. — *Cyclosorus stenodontus* COPEL. Philip. J. Sci. 81 (1952) 28, t. 20; Fern Fl. Philip. (1960) 344. — *Thelypteris stenodonta* REED, Phytologia 17 (1968) 315. — Type: RAMOS & EDAÑO BS 30849, Panay (US).

Caudex not known; base of stipe lacking. *Reduced pinnae* at least 5 pairs, lowest 3–4 mm long; transition to normal pinnae subabrupt. *Lamina* 50 cm long; pinnae 30 pairs, lower ones not narrowed at base. *Largest pinnae* 10 cm long, 1.5 cm wide at dilated base, short-acuminate, lobed 3/5 towards costa, lobes slightly oblique, not falcate; costules 2.5–3 mm apart, at more than 60°; veins 8–9 pairs, 1 pair anastomosing, next acroscopic vein to short sinus-membrane; hairs more than 1 mm long on *lower surface* of rachis, fewer with shorter ones on costae and costules, glands all over surface; scattered long hairs on *upper surface* of costules and veins, short slender appressed hairs and a few glands between veins. *Sori* medial, lacking indusia, basal ones not divergent; sporangia bearing glands.

Distr. *Malesia*: Philippines (Panay), only known from the type.

7. Sphaerostephanos flavoviridis HOLTTUM, *sp. nov.*

Pinnae redactae 2-3-jugatae, superiores 1–2 cm longae; lamina 120 cm longa; pinnae inferiores basi angustatae; pinnae maximae 21 × 2.5 cm, profunde lobatae; venae 12–14-jugatae, infimae anastomosantes; costae subtus pilis minutis praeditae; pagina inter venas utrinque copiose glandulosa; sori mediales, exindusiati; stipites sporangiorum pilis glanduliferis praediti. — Type: JERMY 3694, N.E. New Guinea, Butemu, Morobe Distr. on steep bank in open place (BM).

Caudex not known. Stipe 30 cm long, glabrous. *Reduced pinnae* variable, 2–3 pairs on 13 cm length of rachis, lowest very small, uppermost 1–2 cm long. *Lamina* 120 cm long, somewhat yellow-green when dry; basal pinnae much narrowed at base, next two pairs less so; aerophores not elongate. *Middle pinnae* to 21 × 2.5 cm, almost sessile, base broadly cuneate to subtruncate, apex with cauda 3 cm long, lobed to 2.5–3 mm from costa, lobes hardly falcate, oblong; costules 5 mm apart, at more than 60°; veins 12–14 pairs, basal pair anastomosing with short excurrent vein to sinus, next pair to sides of short sinus-membrane; hairs on *lower surface* of rachis and costae minute, on costules 0.2 mm long, longer on sinus-membrane and edge, glands throughout lower surface; long antrorse hairs on *upper surface* of costae, short on costules and veins, glands and minute hairs between veins. *Sori* medial, basal ones divergent; no indusia seen; sporangia lacking glands or setae on body, hairs on stalks with glandular end-cell; spores with many small wings.

Distr. *Malesia*: Papua New Guinea. Known only from type and another specimen from same locality.

8. Sphaerostephanos trimetralis HOLTTUM, *sp. nov.*

Caudex erectus, brevis; stipes 10 *cm longus, e basi stipitis usque pinna normalis infima* 150 *cm; pinnae redactae* 30*-jugatae, late triangulares; lamina* 150 *cm longa; pinnae maximae* 14 × 1.3 *cm, crenatae; venae* 6–7*-jugatae; rachis costaeque subtus pilis* 0.2 *mm longis adpressis praeditae; pagina inter venas utrinque glandulosa; sori mediales, indusia pilis brevibus et glandulis praedita; sporangia glandulifera.* — Type: HOOGLAND 3391, Papua, Lake Koena (CANB; K, L).

Caudex short, erect. *Stipe* 10 cm long, minutely hairy, basal scales 7 mm long, narrow; base of stipe to lowest normal pinna 150 cm or more. *Reduced pinnae c.* 30 pairs, sub-opposite, 4–6 cm apart, broadly deltoid with symmetric base, upper ones 2 × 1.8 cm, crenate, apex acute. *Lamina* 150 cm long; pinnae subcoriaceous, drying light red-brown; aerophores not enlarged. *Largest pinnae* 14 × 1.3 cm, base truncate, apex acuminate, edges crenate to depth of 1 mm or little more; costules 3 mm apart, at more than 60°; veins 6–7 pairs, 2½ pairs anastomosing to form a zig-zag excurrent vein, 1 pair to short sinus-membrane; *lower surface* of rachis, costae and costules covered with pale antrorse hairs 0.2 mm long, a few short hairs and many glands between veins; hairs on *upper surface* of costae 0.5 mm long, between veins short erect hairs and glands. *Sori* medial; indusia thin, bearing short hairs and glands; sporangia with glands; spores minutely papillose.

Distr. *Malesia*: Papua New Guinea. Only known from the type.

Ecol. Near shore of lake, in marshy vegetation of tall grasses and sedges, alt. 10 m.

9. Sphaerostephanos alatellus (CHRIST) HOLTTUM, *comb. nov.* — *Nephrodium alatellum* CHRIST in K. Schum. & Laut. Fl. Schutzgeb. (1900) 112. — *Aspidium alatellum* (CHRIST) CHRIST, Bull. Herb. Boiss. II, 1 (1901) 454. — *Dryopteris alatella* (CHRIST) C. CHR. Ind. Fil. (1905) 251; v.A.v.R. Handb. (1908) 210. — *Cyclosorus alatellus* (CHRIST) COPEL. Gen. Fil. (1947) 142; Philip. J. Sci. 78 (1951) 445, excl. syn. *Dryopteris stenobasis* C. CHR., *D. logavensis* ROSENST. & *D. pseudostenobasis* COPEL. — Type: LAUTERBACH 2354, N.E. New Guinea, 600 m(B).

Cyclosorus heterocarpus sensu HOLTTUM & ROY, Blumea 13 (1965) 134. — **Fig. 13a–c.**

Caudex short, erect. *Stipe* 15 cm long, basal scales thin, to 7 × 2 mm; base of stipe to first large pinna 40–60 cm. *Reduced pinnae* 4–6 pairs, very small. *Lamina* dimorphous, to 60 cm long; pinnae 20 pairs or more, texture thin, aerophores not elongate, basal pinnae somewhat narrowed at base. *Largest sterile pinnae* 20 × 2.6 cm, *fertile* to 14 × 1.4 cm; base unequally broadly cuneate, apex short-acuminate, edges lobed 2/3–3/4 to costa, lobes slightly falcate with rounded tips; costules of sterile fronds 4.5–5 mm apart, of fertile 3.5–4.5 mm; veins 8–9 pairs (sterile) 6–8 pairs (fertile), basal pair spreading at a wide angle to costule and anastomosing with a short excurrent vein or sometimes meeting just below sinus; next veins both to edge; *lower surface* quite hairless or with some very short hairs on costa only, glands abundant; hairs on *upper surface* of costae short, very short and sparse on costules, between veins many glands. *Sori* medial; indusia small, glandular; sporangia bearing glands.

Distr. *Malesia*: Widely in Eastern New Guinea, in forest at 400–1300 m.

Notes. CHRIST described only a fertile frond and noticed neither glands nor reduced pinnae. COPELAND confused this species with *Amphineuron attenuatum* (O. KTZE) HOLTTUM in the Philippines (Fern Fl. Philip. 341) and with *Dryopteris logavensis* ROSENST. (*Amphineuron pseudostenobasis* (COPEL.) HOLTTUM) in New Guinea. HOLTTUM and ROY misidentified a cultivated plant as *Cyclosorus heterocarpus* and reported a chromosome count 2n = 72.

10. Sphaerostephanos daymanianus HOLTTUM, *sp. nov.*

Caudex erectus, 30–40 *cm altus; stipes usque* 30 *cm longus; pinnae redactae c.* 6–8*-jugatae, superiores* 1.5–2.5 *cm longae, integrae, aerophorae vix* 1 *mm longae; lamina* 150 *cm longa; pinnae maximae* 25 × 2 *cm vel majores, usque* 1/3 *costam versus lobatae; venae* 9*-jugatae,* 1–1½*-jugatae anastomosantes; pagina utrinque inter venas glandulosa; sori inframediales, inferiores leviter divergentes et leviter elongati; indusia glabra, glandulosa; stipites sporangiorum pilis glanduliferis praediti.* — Type: BRASS 23557, Papua, Milne Bay District, Mt Dayman (BM; A, L, LAE).

Caudex erect, 30–40 cm tall, 4–5 cm diam. (BRASS). *Stipe* to 30 cm long, base covered with broad thin scales 10–15 mm long; base of stipe to first large pinna 70 cm or more. *Reduced pinnae* 6–8 pairs, uppermost 1.5–2.5 cm long, broadly triangular, lowest less than 1 mm long. *Lamina* 150 cm long; lower 3–4 pairs normal pinnae gradually narrowed and more shallowly lobed towards base; aerophores hardly 1 mm long. *Largest pinnae* of type 25 × 2.0 cm (of BRASS 23226 36 × 2.4 cm), base subtruncate, apex caudate-acuminate (cauda 3–4 cm), lobed 1/3–2/5 to costa, lobes slightly falcate; costules 4.5 mm apart (to 6 mm in BRASS 23226) at more than 60°; veins to 9 pairs, 1–1½ pairs anastomosing, 1½–2 pairs to sinus-membrane; all *lower surfaces* glandular throughout, no acicular hairs; hairs on *upper surface* of costa 0.5 mm long, very short on costules, glands on all parts of surface. *Sori* inframedial, lower ones slightly divergent and slightly elongate;

indusia thin, bearing glands only; sporangia lacking glands on body, hairs on stalks with terminal gland which is red in young sori.

Distr. *Malesia*: Eastern New Guinea (Milne Bay and Morobe Districts), Bougainville.

Ecol. In forest at 700–1500 m.

Notes. PULLEN 7964 (Milne Bay Distr.) has pinnae to 2.6 cm wide, lobed a little more than ½, with veins to 13 pairs.

WOMERSLEY & MILLAR 8373 (Morobe Distr.) is reported to have had a caudex 150 cm tall; its sori are young and not elongate.

CRAVEN & SCHODDE 277 from Bougainville had a caudex 60 cm tall, base of stipe to first large pinna 95 cm, fronds in all 3.25 m long; my record is that it has glands on body of sporangia, which needs checking.

11. Sphaerostephanos appendiculatus (BL.) HOLTTUM, Kalikasan 4 (1975) 62. — *Gymnogramme appendiculata* BL. Enum. Pl. Jav (1828) *addendum* to p. 112; Fl. Jav. Fil. (1828) 92, t. 39. — *Goniopteris appendiculata* (BL.) PRESL, Tent. Pterid. (1836) t. 7, f. 11. — *Aspidium pilosiusculum* METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 233, *nom. nov.* — *Nephrodium appendiculatum* (BL.) RACIB. Fl. Btzg 1 (1898) 186. — *Dryopteris appendiculata* (BL.) C. CHR. Ind. Fil. (1905) 252; v.A.v.R. Handb. (1908) 213; BACKER & POSTH. Varenfl. Java (1939) 52, f. 9. — *Thelypteris appendiculata* (BL.) REED, Phytologia 17 (1968) 260. — Type: BLUME, Java, Boerangrang (L).

Dryopteris perakensis var. sumatrensis v.A.v.R. Bull. Jard. Bot. Btzg II, 11 (1913) 13. — Type: MATTHEW 516, Sumatra, Padang Pandjang (BO; K).

Dryopteris brunnescens C. CHR. Bot. Jahrb. 66 (1933) 44. — *Thelypteris brunnescens* REED, Phytologia 17 (1968) 265. — Type: KJELLBERG 3534, S. W. Celebes, Rante Lemo (S-PA; BO).

Caudex short-creeping. *Stipe* short, densely short-hairy; base of stipe to first large pinna 15–40 cm. *Reduced pinnae* 6–12(–20) pairs, somewhat deflexed, lowest 3–5 mm long, upper ones 1 cm long, broadly triangular with asymmetric base. *Lamina* 20–45(–70) cm long, reddish when young; apical lamina deeply lobed with gradual transition to upper pinnae, several pairs of which are adnate; free pinnae 10–20 pairs, oblique with upturned tips. *Largest pinnae* commonly to 8.5 × 1.5 cm (to 17 × 2.2 cm); base truncate and distinctly auricled on acroscopic side (bases of upper ones asymmetric), apex short-acuminate, lobed ½ way to costa (largest ones more than ½); lobes oblique with falcate obtusely angled tips; costules 3.5 mm apart in small frond, to 5 mm in large ones; veins 6–7(–9) pairs, one pair anastomosing, next pair to sinus-membrane; *lower surface* of costae and rachis bearing short and long spreading hairs, sparse on costules and veins, very short hairs and glands between veins; short hairs on *upper surface* of costae, very short erect hairs abundant between veins, usually some glands also. *Sori* medial, lower ones not divergent; indusia small with glands and short hairs; sporangia with several setae (to 10), sometimes also a gland.

Distr. *Malesia*: Sumatra, Java, Lesser Sunda Is. (Bali, Flores), SW. & N. Celebes, Philippines (Luzon).

Ecol. On rocks by streams or waterfalls at 400–1200 m.

Notes. *D. brunnescens* was based on a small plant with pinnae to 4.5 cm long. PRICE reports red young fronds on plants in Luzon but I have seen no such report from Java.

12. Sphaerostephanos pseudomegaphyllus (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris megaphylloides* v.A.v.R. Bull. Jard. Bot. Btzg II, 20 (1915) 16, *non* ROSENST. 1913. — *Dryopteris pseudomegaphylla* v.A.v.R. Handb. Suppl. (1917) 180. — Type: BURCK, Sumatra, Padang Pandjang (BO).

Aspidium megaphyllum var. hirsutum METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 233; MIQUEL, *ibid.* 4 (1869) 159. — Type: KORTHALS, Sumatra (L).

Differs from *S. penniger*: fronds smaller; pinnae 7 × 1 to 16 × 2.2 cm, lobed about 1/4–1/3 to costa; veins 8–10 pairs, 1½–2 pairs anastomosing, 1½ pairs to sides of sinus-membrane; dense spreading hairs to 0.5 mm long on lower surface of rachis and costae; indusia densely hairy or with many glands and fewer hairs; sporangia copiously setiferous.

Distr. *Malesia*: Sumatra (Padang Highlands).

13. Sphaerostephanos diversilobus (PRESL) HOLTTUM, Kalikasan 4 (1975) 57. — *Nephrodium diversilobum* PRESL, Epim. Bot. (1851) 47; HOLTTUM, Novit. Bot. Univ. Carol. Prag. 1968 (1969) 39. — *Dryopteris diversiloba* (PRESL) CHRIST, Philip. J. Sci. 2 (1907) Bot. 199, *nomen tantum*; COPEL. Philip. J. Sci. 40 (1929) 297. — *Phegopteris diversiloba* (PRESL) v.A.v.R. Handb. (1908) 503. — *Cyclosorus diversilobus* (PRESL) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 244; COPEL. Fern Fl. Philip. (1960) 357. — *Thelypteris diversiloba* (PRESL) REED, Phytologia 17 (1968) 273. — Lectotype (HOLTTUM 1969): CUMING 102, Luzon (PRC; E, FI-W, G, K, LE).

Goniopteris asymmetrica FÉE, Gen. Fil. (1852) 253. — *Thelypteris asymmetrica* (FÉE) REED, Phytologia 17 (1968) 261. — Specimens cited: CUMING 51, 102; FÉE's specimens of these numbers not seen.

Dryopteris acromanes CHRIST, Philip. J. Sci. 2 (1907) Bot. 200. — *Phegopteris acromanes* (CHRIST) v.A.v.R. Handb. (1908) 505. — Type not selected; specimens cited (which include one of CUMING 51) not seen.

Caudex short, creeping. *Stipe* of sterile frond to

20 cm, of fertile to 30 cm, sparsely hairy. *Reduced pinnae* 2 pairs, very small, seen in isotype at E only. *Lamina* 25 cm long; pinnae 7–9 pairs; basal pinnae gradually narrowed at base, basal basiscopic lobe missing. *Fertile pinnae* to 6.5 × 2.0 cm, *sterile* to 8 cm long, 3 cm wide near apex; lower pinnae and sometimes others widened and more deeply lobed distally, some with irregularly elongate subapical lobes. *Middle pinnae* with ± dilated base, abruptly short-pointed apex, lobed 2/3 to costa apart from widened apical part, lobes hardly falcate, normally entire; costules 4–5 mm apart; veins 7–8 pairs except in elongate distal lobes, 1 pair anastomosing, next acroscopic vein to sinus-membrane; *lower surface* of rachis and costae bearing short erect acicular hairs, also some longer ones, especially on sterile pinnae; short erect hairs between veins on both surfaces, glands few on both surfaces, those on lower surface usually confined to costules and veins. *Sori* medial; indusia thin, densely hairy with a few glands; sporangia with glands; spores with translucent wing and cross-wings.

Distr. *Malesia*: Philippines (Luzon, Panay), in forest at 300–1000 m.

Notes. Some pinnae are irregularly lobed on most specimens; this suggests hybridization. One sterile frond of CUMING 51 at Kew has very long distal lobes which are crenate with pleocnemioid venation. The only specimen seen with reduced basal pinnae is one of CUMING 102 at Edinburgh. The specimens listed by CHRIST in 1907 under *D. diversiloba* represent several other species; he re-described PRESL's species as *D. acromanes* from CUMING 51 and other specimens now apparently lost.

14. Sphaerostephanos dichrotrichus (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris dichrotricha* COPEL. Philip. J. Sci. 6 (1911) Bot. 74. — *Thelypteris dichrotricha* (COPEL.) REED, Phytologia 17 (1968) 272. — Type: C. KING 294, Papua "mainland opposite Samarai island" (MICH; BRI, NSW).

Caudex short-creeping. *Stipe* 40 cm to first reduced pinna, dull reddish with pale hairs 0.5 mm or more long. *Lamina* 65 cm or more long; pinnae to 20 pairs, basal 1–3 pairs gradually reduced, lowest 1–4 cm long; aerophores slightly swollen. *Largest pinnae* 18 × 2.0 cm; base truncate, apex acuminate with entire cauda to 1.5 cm long; edges lobed ±½ way to costa, lobes slightly falcate with round tips; costules 4.5–5 mm apart, at 60° or more; veins 7 pairs, 1–1½ pairs anastomosing, next ½–1 pair to sinus-membrane; rather sparse hairs 1 mm long and many shorter ones on *lower surface* of rachis and costae, shorter on costules and veins, glands and short erect hairs between veins; minute erect hairs and glands between veins on *upper surface*. *Sori* medial; indusia thin, with many hairs, also glands; sporangia usually with 1–2 slender setae (rarely a gland) on body, on stalk a sessile gland; spores with a thin translucent wing and cross-wings.

Distr. *Malesia*: extreme east of New Guinea, Admiralty Islands, at low altitudes.

Notes. Some specimens have more erect hairs than glands on upper surface. In one (LAE 65333) there are 2 pairs of small pinnae near base of stipe and then a gap of 20 cm.

15. Sphaerostephanos vestigiatus (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris vestigiata* COPEL. Un. Cal. Publ. Bot. 18 (1942) 220. — *Cyclosorus vestigiatus* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 446, pl. 27. — *Thelypteris vestigiata* (COPEL.) REED, Phytologia 17 (1968) 323. — Type: BRASS 12317, W. New Guinea, Idenburg River, 1700 m, in forest (MICH; BM, L).

Caudex slender, erect, to 60 cm tall. *Stipe* to 50 cm long, glandular, hairless. *Reduced pinnae* 3 pairs, all very small, 5 cm apart. *Lamina* more than 100 cm long; pinnae 40 pairs, not dimorphous, basal pinnae somewhat narrowed at base, with stalks to 1 mm long, aerophores not swollen. *Largest pinnae* 21 × 2.2 cm, base broadly cuneate, apex caudate-acuminate (cauda 2.5–5.0 cm subentire) lobed to 2–2.5 mm from costa, lobes hardly falcate with rounded tips; costules 4–4.5 mm apart at 60° or more; veins 9–11 pairs, 1 pair anastomosing, next veins both to edge; hairs on *lower surface* of rachis and costae 0.1 mm long (longer distally on costules), surface between veins copiously glandular; *upper surface* of costules and veins with scattered hairs like those on costae, between veins minute erect hairs and glands. *Sori* medial or little supramedial; indusia small, thin, with glands only; sporangia bearing glands on body and gland-tipped hairs on stalk; spores with many small wings.

Distr. *Malesia*: Several collections from eastern New Guinea at *c.* 1500 m.

Note. Some specimens have quite hairless lower surface of rachis and base of costae.

16. Sphaerostephanos morotaiensis HOLTTUM, *sp. nov.*

Caudex brevis, repens; stipes 5 cm longus; pinnae redactae usque 12-jugatae, patentes, superiores 1.5–2 cm longae; lamina 50 cm longa; pinnae 16-jugatae, maximae 7.5 × 1.5 cm, subintegrae; venae 4–5-jugatae; pagina inter venas utrinque pilis minutis erectis glandulisque praedita; sori mediales; indusia brevi-pilosa; sporangia glandulifera. — Type: MAIN & ADEN 758, Morotai, Totodahu, 30 m (K; BO, L, SING).

Caudex short-creeping. *Stipe* 5 cm long, minutely hairy; base of stipe to first normal pinnae 50 cm. *Reduced pinnae* 1.5–2.5 cm apart, to 12 pairs; upper ones 1.5–2 cm long, spreading, broadly triangular, entire; lowest 4 mm long.

Lamina 50 cm long; pinnae 16 pairs, lower ones not narrowed at base nor auricled; aerophores not elongate. *Largest pinnae* 7.5 × 1.5 cm; base truncate, sometimes a little dilated; apex short-acuminate; edges subentire; costules 3–3.5 mm apart on fertile pinnae, 4.5 mm on sterile; veins 4–5 pairs, 3–3½ pairs anastomosing, sinus-membrane hardly detectable; whole *lower surface* (including rachis) covered with very short erect hairs and glands; hairs on *upper surface* of costae 0.3–0.4 mm long, on costules and veins sparse, surface between veins with very short erect hairs and glands. *Sori* medial; indusia small with many short hairs; sporangia bearing glands.

Distr. *Malesia*: Moluccas. Apart from the type and other specimens from Morotai, I refer here SA-AANAM 49 from Obi Island (L) which has larger crenate pinnae (to 18 × 3.0 cm), agreeing in other respects.

17. Sphaerostephanos kalkmanii HOLTTUM, *sp. nov.*

Caudex erectus; pinnae redactae 4-jugatae, omnes minutae; pinnae normales 18-jugatae, usque 3.5 × 1.0 cm, crenatae, costae costulaeque subtus pilis minutis appressis glandulisque praeditae; indusia parva vel nulla; sporangia nec glandulis nec setis instructa. — Type: KALKMAN 4070, W. New Guinea, Orion Mts, Tenma River, 1500 m (BM; LAE, L, SING).

Caudex erect, to at least 15 cm tall. *Stipe* 4–5 cm long, dark, sparsely short-hairy, basal scales *c.* 4 × 1 mm; base of stipe to first large pinna 10–15 cm. *Reduced pinnae* to 4 pairs, all about 1 mm long. *Lamina* 20 cm long; pinnae 18 pairs, subcoriaceous, lower ones not narrowed at base; aerophores slightly swollen. Hairs on lower surface of *rachis* 0.3 mm long, brown, on upper surface a little longer. *Largest pinnae* 2.6–3.5 cm long, 0.7–1.0 cm wide, fertile ones sometimes, not always, smaller than sterile; base subtruncate to broadly cuneate; apex rather abruptly short-pointed; edges crenate, a little more deeply in fertile than in sterile pinnae; costules 2 mm apart; veins all very oblique, 4–5 pairs, 1½ pairs anastomosing, next vein to short sinus-membrane; *lower surface* of costae and costules covered with minute appressed hairs, also glands, a few glands sometimes present on surface between veins; hairs on *upper surface* of costae to 0.5 mm long, on costules and veins shorter, sparse, a few glands sometimes present (?) on surface between veins. *Sori* medial, sometimes covering whole surface at maturity; indusia very small with short hairs and glands, sometimes lacking; sporangia bearing neither glands nor setae; spores minutely spinulose.

Distr. *Malesia*: West New Guinea, 1500 m. Only known from type.

Ecol. "In abandoned garden, rather common".

Note. Possibly nearest to the lowland species *S. lamii*, which has glands between veins on both surfaces. *S. lamii* has longer pinnae, upper reduced pinnae 10 mm long, and veins not very oblique.

18. Sphaerostephanos perglanduliferus (v.A.v.R.) HOLTTUM, Kalikasan 4 (1975) 59. — *Dryopteris perglandulifera* v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 150. — *Thelypteris perglandulifera* (v.A.v.R.) REED, Phytologia 17 (1968) 303. — Type: BROOKS 281, Sumatra, Lebong Tandai, Benkoelen (BO).

D. perglandulifera var. firmior v.A.v.R. *l.c.* — Type: DOCTERS VAN LEEUWEN-REYNVAAN 3284, Sumatra, Haboko (BO).

Phegopteris pseudoarfakiana HOSOKAWA, Tr. Nat. Hist. Soc. Formosa 28 (1938) 147. — *Meniscium pseudoarfakianum* (HOSOKAWA) HOSOKAWA, *ibid.* 32 (1942) 286. — Type: HOSOKAWA, Caroline Is., Palau (TAI).

Dryopteris arbuscula sensu KJELLBERG & CHR. Bot. Jahrb. 66 (1933) 43.

Caudex massive, short, erect; *stipe* 5–15 cm long, densely short-hairy; basal scales 10 mm long, narrow; base of stipe to first normal pinna 20–50 cm; *reduced* pinnae to 10 pairs, lowest 7 × 7 mm, upper ones to 1.5 × 1.5 cm, base broadly cuneate, symmetric, apex obtusely pointed. *Lamina* of type 75 cm long; transition at base to reduced pinnae subabrupt; lowest normal pinnae not auricled at base; aerophores not elongate. *Largest pinnae* of type 14 × 1.7 cm (on small plants, fertile, 7 × 1 cm), base broadly cuneate, apex short-acuminate, edges shallowly crenate; costules 3–4 mm apart, at *c.* 45° to costa; veins 6–7 pairs, 3 pairs anastomosing to form a slightly zig-zag excurrent vein, 1 pair to sides of sinus-membrane; *lower surface* of rachis covered with slender appressed hairs less than 0.5 mm long, hairs on costae minute, glands throughout lower surface; hairs on *upper surface* of rachis pale, 1 mm long, on costae less than 0.5 mm, copious glands between veins. *Sori* medial; indusium bearing glands; sporangia with short setae and glands, a gland at end of short hair on sporangium-stalk.

Distr. *Malesia*: S. Sumatra, Borneo, S.W. Celebes, Philippines (Negros) and Micronesia (Palau).

Ecol. In rocky stream-beds at low to medium altitudes.

Note. This is closely related to *S. penniger*, but appears to be distinct in its erect caudex (seen on several specimens) and narrow crenate pinnae; the stream-bed habitat is recorded for several specimens.

19. Sphaerostephanos veitchii HOLTTUM, Allertonia 1 (1977) 204. — Type: J. G. VEITCH, Solomon Islands, San Cristobal (K).

Nephrodium amboinense var. subglandulosum BAKER, J. Linn. Soc. Bot. 19 (1882) 295. — Type: R. B. COMINS, Solomon Islands (K).

Caudex short, creeping or suberect. *Stipe* of type lacking, of others 10–20 cm, minutely hairy; base of stipe to first large pinna 35–60 cm. *Reduced pinnae* about 7 pairs, lowest 5 mm long, upper ones 1.5–2.5 cm long and wide, broadly triangular with asymmetric base (wider on acroscopic side), crenate. *Lamina* 50–90 cm or more long; basal pinnae not narrowed at base; aerophores not elongate. *Largest pinnae* of type 13 × 1.7 cm, of others to 20 × 2 cm; base broadly truncate to full width, sometimes a little dilated but not auricled; apex acuminate, not caudate; edges crenate to depth of 1–1.5 mm; costules 4 mm apart, at 60° to costa; veins 6 pairs, 2½ pairs anastomosing to form a zig-zag excurrent vein, 1½–2 pairs to sides of sinus-membrane; hairs on *lower surface* of rachis 0.4 mm long (much shorter on some plants from New Guinea), pale, curved, on costae and costules shorter, antrorse, many glands and short erect hairs between veins; *upper surface* of rachis covered with brown hairs more than 0.5 mm long, similar hairs on costae and scattered on costules and veins, glands on surface between veins and sometimes short erect hairs. *Sori* medial, lower ones divergent, those on basal veins from adjacent costules sometimes confluent; indusia small, bearing short hairs and glands; sporangia bearing glands.

Distr. Solomon Islands, and *Malesia*: Eastern New Guinea.

Ecol. In the Solomons by streams in low country and to 800 m; in New Guinea plants in forest at higher altitudes (to 1400 m) are smaller but otherwise not distinct.

20. Sphaerostephanos lamii HOLTTUM, *sp. nov.*

Caudex brevis, repens vel suberectus; stipes 20 cm longus; pinnae redactae 3-5-jugatae, superiores 10 mm longae; lamina 30 cm longa, pinnae 12–15-jugatae, dimorphae; pinnae steriles usque 8.5 × 1.8 cm, crenatae, pagina utrinque glandulifera; pinnae fertiles usque 6.0 × 1.2 cm; sori inframediales; indusia parva, pilis brevibus glandulisque praedita; sporangia glandulifera. — Type: H. J. LAM 748, W. New Guinea, Prauwen bivak, 10 m (L; BO).

Caudex short, creeping or suberect; *stipe* 12–20 cm long, short-hairy in groove; base of stipe to first normal pinna 30–40 cm; *reduced pinnae* 3–5 pairs, not opposite, upper ones to 10 mm long, deflexed with slightly auricled asymmetric base, lowest 3 mm long. *Lamina* 30 cm long; pinnae 8–15 pairs, more or less dimorphous, basal pinnae not narrowed at base, not auricled; aerophores not elongate; *rachis* bearing stiff brown hairs to 1 mm long on both surfaces. *Sterile pinnae* to 8.5 × 1.8 cm, base truncate, apex short-acuminate, edges crenate to a depth of 1 mm; costules 3.5–4 mm apart, at 60° to costa; veins 5–6 pairs, 2½ pairs anastomosing, one pair to sides of sinus-membrane; on *lower surface* hairs at base of costae very short, distally 0.2–0.3 mm (but see note below), rest of lower surface of pinnae glabrous with sessile glands; hairs on *upper surface* of costae hardly 0.5 mm long, rest of upper surface glabrous or with some minute hairs, glands present throughout but fewer than on lower surface, sometimes lacking. *Fertile pinnae* to 6.0 × 1.2 cm, slightly crenate; veins 3–4 pairs; sori near costules, basal ones not divergent; indusia small, with very short hairs and a few glands; sporangia bearing glands.

Distr. *Malesia*: W. New Guinea, several collections from Rouffaer and Mamberamo Rivers, at 10–200 m; Admiralties (Los Negros: GRETHER & WAGNER 4003); a distinct variety in Eastern New Guinea?

Note. A specimen from 820 m in the Southern Highlands of Eastern New Guinea differs in the presence of hairs 1 mm long on the lower surface of costae and scattered long hairs on costules and veins on the upper surface.

21. Sphaerostephanos hirsutus (KUNZE *ex* METT.) HOLTTUM, Kalikasan 4 (1975) 63. — *Nephrodium hirsutum* PRESL, Epim. Bot. (1851) 48, *non* D. DON 1825; HOOK. Sp. Fil. 4 (1862) 70 *p.p.* & t. 240B. — *Aspidium hirsutum* KUNZE *ex* METT. Farngatt. IV (1858) 107, *nom. nov.* — *Dryopteris hirsuta* (KUNZE *ex* METT.) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 214. — *Dryopteris adenophora* C. CHR. Ind. Fil. (1905) 251, *nom. nov. superfl.* — *Cyclosorus adenophorus* (C. CHR.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 242; COPEL. Fern Fl. Philip. (1960) 343. — *Thelypteris adenophora* (C. CHR.) REED, Phytologia 17 (1968) 258. — Type: CUMING 82, Luzon (PRC; K, P).

KEY TO THE VARIETIES

1. Pinnae commonly to 20 × 2.2 cm; sporangia glanduliferous . . . . . **a. *var.* hirsutus**
1. Pinnae to 15 × 1.4 cm; sporangia setiferous **b. *var.* celebicus**

a. *var.* hirsutus

Caudex short, erect, with many branches at its base; *stipe* short; base of stipe to first normal pinna 30–90 cm, basal scales broad, thin, not persistent; *reduced pinnae* to 12 pairs or more, each consisting of an aerophore with a very small rounded blade, uppermost less than 1 cm long. *Lamina* to 120 cm long; transition at base to reduced pinnae abrupt or with an intermediate pair; lowest normal pinnae somewhat narrowed at their bases and sometimes slightly auricled; aerophores to 1 mm long. *Largest pinnae* commonly 12–20 × 1.5–2.2 cm (to 30 × 2.5 cm, *teste* COPELAND), base truncate and somewhat dilated; apex caudate-acuminate (cauda 1.5–2.5 cm long), lobed 2/5–3/5 towards costa; lobes distinctly fal-

cate with rounded or obtuse-pointed tips; costules 3–4 mm apart, at 60° or more to costa; veins 7–8 pairs, 1 pair anastomosing, next pair to sides of sinus-membrane; *lower surface* of rachis and costae with a variable number of long coarse hairs (sometimes only distally on costae) with very short hairs and glands, costules similar, abundant glands between veins; hairs on *upper surface* of rachis and costae 1.5 mm or more long, scattered hairs 1 mm long on costules and veins, between veins abundant appressed hairs and a variable number of glands (often few). *Sori* medial, lower ones not divergent; indusia small, with glands and short hairs; glands on sporangia.

Distr. *Malesia*: throughout Philippines, in forest, at 400–1200 m.

Note. Pubescence in *var. hirsutus* is variable; it is most clearly distinguished from *S. todayensis* (which see), also variable in pubescence, by the small size of its basal reduced pinnae. A more nearly allied species is *S. trichochlamys*.

b. *var.* **celebicus** HOLTTUM, *var. nov.*

A typo speciei differt: pinnis usque 15 × 1.4 *cm*; *pagina inferiore inter venas pilis tenuibus adpressis vestita*; *indusiis nullis vel minutis*; *sporangiis* 3–4 *setis ornatis.* — Type: POSTHUMUS 2743, S.W. Celebes, G. Bonthain, 1500 m (BO).

Distr. *Malesia*: S. W. and Central Celebes & Lesser Sunda Is. (Flores: JAAG 1647).

22. Sphaerostephanos acrostichoides (DESV.) HOLTTUM, *comb. nov.* — *Nephrodium acrostichoides* DESV. Mém. Soc. Linn. Paris 6 (1827) 255. (Not *Thelypteris acrostichoides* (MICHX) NEWL. *nom. inval.*). — Type: Collector unnamed, Timor (P).

Polystichum riedleanum GAUD. in Freyc. Voy. Ur. Phys. Bot. (1828) 327. — *Dryopteris riedleana* (GAUD.) v.A.v.R. Handb. (1908) 230. — Type: GAUDICHAUD, Timor (G).

Nephrodium smithianum PRESL, Epim. Bot. (1851) 46; HOLTTUM, Novit. Bot. Inst. Bot. Univ. Carol. Prag. 1968 (1969) 41 *excl. syn. Aspidium productum* KAULF. — *S. smithianus* (PRESL) HOLTTUM, Kalikasan 4 (1975) 65. — Type: CUMING 279, Guimaras (PRC; B, BM, E, G, K, L).

Dryopteris perpilifera v.A.v.R. Bull. Jard. Bot. Btzg II, 11 (1913) 12; Handb. Suppl. (1917) 183. — *Thelypteris perpilifera* (v.A.v.R.) REED, Phytologia 17 (1968) 303. — Type: LAUTERBACH 68, N.E. New Guinea, Finschhafen (BO; BRI, L, SING).

Dryopteris angusta COPEL. Philip. J. Sci. 9 (1914) Bot. 3; v.A.v.R. Handb. Suppl. (1917) 186. — *Thelypteris angusta* (COPEL.) REED, Phytologia 17 (1968) 259. — Type: C. KING 408, E. New Guinea (MICH; K, NSW).

Dryopteris pseudoarbuscula v.A.v.R. Philip. J. Sci. 11 (1916) Bot. 106; Handb. Suppl. (1917) 504. — Type: C. B. ROBINSON 1962, Amboina (BO; K, L, P).

Dryopteris riparia COPEL. Univ. Cal. Publ. Bot. 18 (1942) 221. — *Cyclosorus riparia* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 456, pl. 37. — *Thelypteris riparia* (COPEL.) REED, Phytologia 17 (1968) 309. — Type: BRASS 13048, New Guinea, Idenburg River, 800 m (UC; BM, BO, L, LAE).

Cyclosorus boholensis COPEL. Philip. J. Sci. 81 (1952) 31, pl. 23; Fern Fl. Philip. (1960) 348. — *Thelypteris boholensis* (COPEL.) REED, Phytologia 17 (1968) 204. — Type: RAMOS BS 42990, Bohol (UC; G).

Cyclosorus reederi COPEL. Amer. Fern J. 43 (1953) 12. — *Thelypteris reederi* (COPEL.) REED, Phytologia 17 (1968) 308. — Type: REEDER 889, N.E. New Guinea, Finsch-hafen (US).

Aspidium arbuscula sensu CHRIST, Ann. Jard. Bot. Btzg 15 (1898) 135. — *Cyclosorus hispidula sensu* COPEL. Philip. J. Sci. 78 (1951) 455. — *Cyclosorus productus sensu* COPEL. Fern Fl. Philip. (1960) 348, *p.p.*

Caudex erect, not or little branched at the base. Base of *stipe* to lowest reduced pinna 3–10 cm, to lowest large pinna 10–30 cm or more; at base of lamina a subabrupt transition to reduced pinnae; number of *reduced pinnae* varying with size of frond, larger ones spreading, triangular with a broad base. *Lamina* of smaller plants fertile at 20 cm long with 15 pairs pinnae, of large plants to 50 cm long. *Largest fertile pinnae* of small plants 3–5 × 0.7–1.0 cm, of largest plants to 10 × 1.0 cm or larger; base broadly cuneate and ± dilated on both sides, apex evenly tapered, edges lobed 1/3–1/2 way to costa; costules at less than 60° to costa, 2–2½ mm apart in small plants; veins 3–4 pairs in small plants, 7–8 pairs in large ones, 1–1½ pairs anastomosing, next acroscopic vein to sinus membrane; *lower surface* of rachis with copious spreading pale hairs ½–1 mm long and shorter ones, long hairs less abundant on costae, lower surface between veins bearing copious glands and some erect short hairs; *upper surface* of rachis with pale hairs 1 mm long, shorter hairs on costae, also scattered on costules and veins, between veins copious short erect hairs and glands. *Sori* medial, on small pinnae covering lower surface; indusia hairy and glandular; sporangia bearing glands.

Distr. *Malesia*: East Java, Lesser Sunda Is. (Sumba, Timor), Central & S.E. Celebes, Philippines (Bohol, Mindanao, Guimaras), Moluccas (Amboina), and New Guinea incl. Admiralty Is.

Ecol. Usually in rocky stream-beds at 0–500 m (to 1500 m in Mindanao and New Guinea). In New Guinea plants of all sizes have been collected, but elsewhere none as large as the larger ones in New Guinea. Types of the various basionyms differ chiefly in size, agreeing well in frond-form, dilated bases of pinnae, pubescence and the distribution of glands. If the larger New Guinea plants (which apparently do not grow in stream-beds) are judged to represent a distinct species, the name *Dry-*

opteris perpilifera v.A.v.R. should be its basionym.

23. Sphaerostephanos melanorachis HOLTTUM, *sp. nov.*

Stipes rachisque atrobrunneus; stipes 7 *cm longus; pinnae redactae* 10*-jugatae, superiores usque* 1.7 × 1.5 *cm; lamina* 55 *cm longa; pinnae dimorphae, steriles usque* 13 × 1.9 *cm, fertiles minores, omnes c.* 1/3 *costam versus lobatae; venae* 8*-jugatae,* 2*-jugatae anastomosantes; rachis costaeque subtus pilis brevibus antrorsis vestita; pagina inter venas utrinque glandulosa; sori mediales; indusia pilis paucis praedita.* — Type: A. H. G. ALSTON 16927, Moluccas, Batjan, Mt Sibela 750 m (BM).

Caudex short, apparently erect. *Stipe* 7 cm, dark brown, minutely hairy; base of stipe to first large pinna 35–40 cm; rachis also very dark. *Reduced pinnae* 10 pairs, upper ones 1.7 × 1.5 cm, triangular with asymmetric base, crenate, slightly deflexed, lowest 4–5 mm long. *Lamina* 55 cm long; pinnae 25 pairs, dimorphous; aerophores not elongate. *Sterile pinnae* to 13 cm long, 1.9 cm wide above truncate dilated base, apex caudate-acuminate (cauda to 1.5 cm); edges lobed to a depth of 3 mm (*c.* 1/3), lobes slightly falcate; costules 4 mm apart, to 60°; veins to 8 pairs, 2 pairs anastomosing, forming a zig-zag excurrent vein, 1 pair to sinus-membrane; *lower surface* of rachis bearing rather sparse pale appressed hairs 0.5 mm long, those on costa also antrorse, 0.2 mm long, sparse short appressed hairs on costules and veins; glands on surface between veins; hairs on *upper surface* of rachis pale, 1 mm long, on costae a little shorter, similar hairs scattered on costules and veins, glands between veins. *Fertile pinnae* to 9.5 cm long, 1.6 cm wide at base, 1.2 cm above base; sori medial; indusia rather small, thin, with a few short hairs; sporangia rarely with a gland.

Distr. *Malesia*: Moluccas (Batjan, Mt Sibela), m.

24. Sphaerostephanos heterocarpus (BL.) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 209. — *Aspidium heterocarpon* BL. Enum. Pl. Jav. (1828) 155; METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 233. — *Nephrodium heterocarpum* (BL.) MOORE, Ind. Fil. (1858) 93; RACIB. Fl. Btzg 1 (1898) 187. — *Dryopteris heterocarpa* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 228; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 380; BACKER & POSTH. Varenfl. Java (1939) 54. — *Cyclosorus heterocarpus* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 180; HOLTTUM, Rev. Fl. Malaya 2 (1955) 269, f. 155; TARD. Fl. Gén. I.-C. 7, pt. 2 (1941) 385; COPEL. Fern Fl. Philip. (1960) 345, *p.p.* — *Thelypteris heterocarpa* (BL.) MORTON, Amer. Fern J. 49 (1959) 113. — Type: BLUME, Java, *ad pedem* Boerangrang (L, *n.* 908, 332–1158).

Polypodium longifolium ROXB. Calc. J. Nat. Hist. 4 (1844) 462. — Type from Amboina (BR).

Nephrodium pubescens BRACK. in Wilkes U.S. Expl. Exp. 16 (1854) 186, *non* DON 1825. — Type: U.S. Expl. Exp. Luzon, near Banos (US).

Dryopteris bordenii CHRIST, Philip. J. Sci. 2 (1907) Bot. 204; v.A.v.R. Handb. (1908) 822. — *Cyclosorus bordenii* (CHRIST) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 243; COPEL. Fern Fl. Philip. (1960) 345, *p.p.* — *Thelypteris bordenii* (CHRIST) REED, Phytologia 17 (1968) 264. — *S. heterocarpus var. bordenii* HOLTTUM, Kalikasan 4 (1975) 67. — Lectotype (HOLTTUM 1975): BORDEN 1237, Luzon, Mt Mariveles (US).

Dryopteris suprastrigosa ROSENST. Fed. Rep. 10 (1912) 335. — *Cyclosorus suprastrigosus* (ROSENST.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 446. — *Thelypteris suprastrigosa* (ROSENST.) REED, Phytologia 17 (1968) 318. — Type: Frau BAMLER 37, N.E. New Guinea, Sattelberg (not seen; at BM is KEYSSER 37 from Sattelberg, named by ROSENST.).

Dryopteris mixta ROSENST. Fed. Rep. 12 (1913) 172. — *Lastrea mixta* (ROSENST.) COPEL. Philip. J. Sci. 78 (1951) 426. — *Thelypteris mixta* (ROSENST.) REED, Phytologia 17 (1968) 293. — Type: KEYSSER S. 141, N.E. New Guinea, Sattelberg (S-PA). — **Fig. 1q.**

Caudex erect, rarely very tall, usually with several branches from base. *Stipe* 5 cm or little more. *Reduced pinnae* commonly 10 pairs (distance apart, and number, depending on size of plant), never less than 6 pairs, uppermost commonly 10 mm long, narrow, auricled, lowest very small. *Lamina* variable in length; pinnae commonly 20–30 pairs; several pairs lower pinnae much narrowed towards their bases, basal one at most slightly auricled; aerophores slightly swollen. *Largest pinnae* 10–20 cm long, 1.2–2.5 cm wide, fertile sometimes narrower than sterile and with shorter hairs, lobed 5/8–3/4 towards costa; costules 3–3½ mm apart; veins 6–12 pairs, basal veins anastomosing at least in basal half of pinna with excurrent vein to sinus, second acroscopic vein sometimes touching side of sinus-membrane; hairs on *lower surface* of costae very short, erect, with scattered longer ones usually not over 0.5 mm long, more sparse similar hairs on costules and veins, copious yellow glands and a variable number of short erect hairs between veins; *upper surface* of costae bearing antrorse pale hairs to 1 mm long with scattered similar hairs on costules and veins; surfaces between veins bearing few to many appressed hairs 0.3–0.4 mm long, sometimes also glands which are never as abundant as on lower surface. Hairs on upper surface of *rachis* pale to brownish, curved, not over 1 mm long; on lower surface erect hairs as on costae. *Sori* medial, lower ones not divergent; indusia firm, usually with a few short hairs and glands; sporangia with glands near annulus.

Distr. Peninsular Thailand; Hainan, Hong Kong; throughout *Malesia*; North Queensland, Solomon Islands, New Hebrides, Fiji, Samoa.

Ecol. In forest, low country to 1500 m.

Notes. As here interpreted, this is a very variable species and varieties are not always sharply distinct; no formal names for them are here given. The following key attempts to distinguish the various forms.

KEY TO THE LOCAL FORMS

1. Lower pinnae lobed at least 2/3 towards costa and at least 1.5 cm wide.
 2. Glands none or rare on upper surface of pinnae.
  3. Fertile pinnae of large plants 2 cm wide (sterile ones sometimes wider); costules 4 mm apart, second acroscopic vein usually touching side of sinus-membrane **typical form**
  3. Fertile pinnae not over 1.5 cm wide; costules 3 mm apart; second acroscopic vein always to margin (*Dryopteris suprastrigosa* ROSENST.) . . . . . **New Guinea**
 2. Glands ± abundant on upper surface of pinnae.
  4. Appressed hairs to 0.5 mm long between veins on upper surface . . . . . **Borneo**
  4. Short suberect hairs between veins on upper surface . . . . . **Moluccas**
1. Lower pinnae lobed not or little more than 1/2 way to costa, rarely more than 1.5 cm wide.
 5. Glands and appressed hairs (sometimes dense) on upper surface . . . . **Borneo** (limestone)
 5. Glands lacking on upper surface; appressed hairs variable, never dense.
  6. Pinnae lobed distinctly more than 1/2; second acroscopic vein to margin.
   7. Pinnae to 16 × 1.6 cm; costules almost at right angles to costa; pinnae more than 20 pairs; sori supramedial . . . . . **Mindanao**
   7. Pinnae to 10 × 1.3 cm; costules at 60°; pinnae to 15 pairs; sori medial (*Nephrodium pubescens* BRACK., *Dryopteris bordenii* CHRIST) . . . . . **Luzon**
  6. Pinnae lobed 1/2 or less deeply; second acroscopic vein usually ending beside sinus-membrane . . . **lowlands of W. Malesia**

The *typical form* occurs in mountain forest in Western Malesia and to Flores. In Malaya there seems to be no sharp distinction between the mountain form and the lowland one which comes at the end of the key. Plants like the lowland form of Malaya occur in Thailand, Hainan and Hong Kong, also in the lowlands of Borneo.

BLUME distinguished varieties *B* and *C* in *Java*. I have found no authentic specimen of the former; *var. C* has rather large almost sterile fronds with sori on basal veins only and is not a distinct variety.

The *Borneo* form with many glands and appressed hairs on the upper surface occurs in Sarawak and Sabah at low to medium altitudes.

The *limestone Bornean* form is abundant in the Gunong Mulu National Park; at higher altitudes and in more exposed positions fronds are smaller and very densely covered with hairs on the upper surface, but there seems to be no sharp distinction between these and plants with larger fronds less densely covered with hairs.

In the *Philippines* neither the typical form nor the lowland form of Western Malesia has been found. From Palawan is one collection somewhat resembling the Borneo form; from Mindanao are two specimens (RAMOS & PASCASIO BS 34476, Surigao Province, and EDAÑO PNH 12581, Davao Province) which seem distinct and are keyed as the Mindanao form, but a third (COPELAND 1643, San Ramon, 500 m) is nearer to the New Guinea form. In Luzon the form represented by *Dryopteris bordenii* (small, with short fronds) appears common; in herbaria it has been confused with the large specimens of *S. lobatus* (COPEL.) HOLTTUM.

Dryopteris suprastrigosa appears to be the common form in eastern New Guinea; few collections have been made in the west. Specimens from North Queensland are similar but less hairy on the upper surface of pinnae. *D. mixta* was described from a small fertile plant with most veins free but does not appear distinct in other characters.

The *Moluccan* form is represented by BROOKS 18112 (Amboina) and KORNASSI 1222 (West Ceram).

BACKER & POSTHUMUS cite *Aspidium dimorphum* KUNZE as a synonym. This was based on a specimen of JUNGHUHN's from Mt Pangerango in W. Java; I have not found it. METTENIUS (*l.c.* 1864) described it briefly as a synonym of *A. heterocarpon var. B* BL. He stated that its aerophores were enlarged, for which reason I doubt whether it belongs here.

25. Sphaerostephanos isomorphus HOLTTUM, *sp. nov.*

Stipes ignotus; *pinnae redactae 6-jugatae, omnes parvae*; *lamina 90 cm long*; *pinnae inferiores basi non angustatae*; *pinnae maximae 14.5 × 2.0 cm, profunde lobatae*; *venae 12-jugatae, infimae anastomosantes*; *costae subtus pilis erectis minutis vestitae*; *pagina inter venas utrinque glandulosa*; *indusia parva, glandulifera*.–Type: FLENLEY, ANU 2062, Papua New Guinea, W. Highlands, Lai valley (K).

Caudex and *stipe* not known. *Reduced pinnae* 6 pairs, 4 cm apart, all very small with enlarged aerophores; one intermediate pair of pinnae also present. *Lamina* 90 cm long; pinnae 40 pairs, light green when dry, firm; lower pinnae not narrowed at base. *Largest pinnae* 14.5 × 2.0 cm, sterile and

fertile isomorphous; base truncate and slightly dilated; apex caudate-acuminate (cauda 2–2.5 cm), edges lobed to 2 mm from costa, lobes slightly falcate; costules 3–3.5 mm apart, at more than 60°; veins to 12 pairs, basal pair only anastomosing with excurrent vein to short sinus-membrane, next veins both to edge; *lower surface* of rachis, costae and costules bearing very short erect hairs and glands, between veins many glands but no hairs; hairs on *upper surface* of costae pale, less than 1 mm long, scattered hairs 0.5 mm long on costules and veins, glands between veins. *Sori* medial, lower ones divergent, those on basal veins from adjacent costules often touching; indusia very small, glandular; sporangia bearing glands.

Distr. *Malesia*: Papua New Guinea, only known from the type.

26. Sphaerostephanos dimidiolobatus HOLTTUM, *sp. nov.*

Pinnae redactae usque 12-jugatae, superiores 2.5–3.0 cm longae; aerophori non elongati; pinnae normales usque 27 × 2.3 cm, dimidio costam versus lobatae; venae 8–10-jugatae, infimae solum anastomosantes; costae costulaeque subtus glanduliferae, glandulae inter venas paucae; pagina superior inter venas glandulis pilisque minutis praedita; indusia parva; sporangia glandulifera. — Type: J.R. CROFT 324, New Ireland, 7 km WNW of Taron, 700 m (K; NSW).

Stipe 22–27 cm long, almost glabrous, slightly flushed with red, scales thin, *c.* 10 × 2 mm; base of stipe to first normal pinna 50–55 cm; *reduced pinnae* 8–12 pairs, uppermost 2.5–3.0 cm long, broadly triangular with subtruncate base slightly auricled both sides, edges crenate, lowest reduced pinna 1 cm long. *Lamina* excluding basal pinnae *c.* 100 cm long; basal pinnae slightly narrowed in basal third, basal lobes both slightly elongate; aerophores not elongate. *Largest pinnae* 20–27 cm long, to 2.3 cm wide; base truncate, not dilated nor auricled; apex narrowly acuminate, not caudate; edges lobed about half-way to costa (on one frond slightly more than half), lobes hardly falcate; costules 4.5–5 mm apart, at more than 60° to costa; veins 8–10 pairs, slender, slightly prominent when dry, basal pair at a broad angle to costule, anastomosing with an excurrent vein to the sinus, next pair usually both to sides of sinus-membrane; *lower surface* of rachis bearing very short hairs and some to 0.5 mm long, costae minutely hairy near base only, with glands throughout, few short hairs and many glands on costules, few glands between veins; *upper surface* of rachis and costae bearing hairs 0.5 mm long, minute hairs on costules and veins, between veins a variable number of glands and very short erect hairs. *Sori* medial; indusia small, shrivelled, with a few short hairs and (?) glands; glands present on body of some sporangia, more commonly sessile on stalks of sporangia; spores not seen (sori old).

Distr. *Malesia*: Papua New Guinea (S. New Ireland), 2 collections.

Ecol. In forest at 650–700 m.

27. Sphaerostephanos solutus HOLTTUM, *sp. nov.* — *Aspidium hispidulum* DECNE *var. solutum* MIQUEL, Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 160. — *Aspidium hispidulum var. β* METT. *ibid.* 1 (1864) 234. — Type: SPANOGHE (?), Timor (L, *n.* 908, 333–406).

Base of frond lacking. *Lamina* of specimen 55 cm long with 20 pairs pinnae. *Largest pinnae* 19 × 2.1 cm, base truncate with acroscopic lobe of many pinnae elongate, apex caudate-acuminate, edges lobed to 2.5 mm from costa, lobes falcate; costules 4–4.5 mm apart, at 60°; veins 12 pairs, 1–1½ pairs anastomosing, one vein or a pair to sinus-membrane; hairs on *lower surface* of costae and rachis sparse, erect, 0.3 mm long, similar but shorter and more sparse on costules, glands also present; between veins glands and sparse short erect hairs; hairs on *upper surface* of costae 0.3 mm long, similar hairs scattered on costules and veins, very short erect hairs and glands between veins. *Sori* medial, lower ones not divergent; indusia thin, with a few glands and short hairs; sporangia with glands on body.

Distr. *Malesia*: Lesser Sunda Is. (Timor), only known from the type.

Note. The type bears the name *Aspidium solutum n. sp.* in BLUME's hand, also *Aspidium hispidulum var. β* METT. and is evidently the one referred to by METTENIUS and MIQUEL, but they give ZIPPELIUS as collector whereas the specimen here cited bears the collector's name SPANOGHE. *A. hispidulum* DECNE (P) = *Christella hispidula.*

28. Sphaerostephanos hernaezii HOLTTUM, *sp. nov.*

Caudex suberectus; stipes 10–15 cm longus; pinnae redactae c. 6-jugatae, superiores 5–6 mm longae; lamina 45 cm longa; pinnae 9-jugatae, inferiores usque 11.5 × 2.5 cm, basin versus sensim angustatae, dimidio costam versus lobatae; costulae 7 mm inter se distantes; venae 9-jugatae; pagina utrinque pilis erectis brevibus glandulisque praedita; sori mediales, indusia pilis brevibus vestita. — Type: M. G. PRICE & B. E. HERNAEZ 75, Western Samar (K).

Caudex suberect. Stipe 10–15 cm long, glabrous apart from short hairs in groove; basal scales 8 × 1 mm, copiously setiferous; base of stipe to first large pinna 45 cm. *Reduced pinnae c.* 6 pairs, uppermost 5–6 mm long, lowest 2 mm. *Lamina* to 45 cm long; pinnae to 9 pairs, widely spaced, basal ones longest; apical lamina almost pinna-like but with widened base; aerophores not elongate. *Basal pinnae* to 11.5 × 2.5 cm, widest 1/3 from apex and gradually narrowed to narrowly cuneate base, in middle lobed half way to costa, apex

short-acuminate; lobes slightly falcate, tapered from base to an obtuse tip; costules to 7 mm apart; veins to 9 pairs, 1½ pairs anastomosing, one vein or a pair to short sinus-membrane; hairs on *lower surface* of rachis and costae 0.2–0.3 mm long, antrorsely curved, shorter hairs on costules and veins, between veins minute erect hairs and copious glands; hairs on *upper surface* of rachis and costae to 0.5 mm, rest as lower surface. *Upper pinnae* gradually less narrowed at base but uppermost somewhat narrowed. *Sori* medial, basal ones a little divergent and a little elongate along veins; indusium with copious short hairs and some glands; no glands nor hairs on sporangia.

Distr. *Malesia*: Philippines (Samar), only known from the type.

Ecol. In primary forest on limestone and limestone-derived soil.

Note. Young plants have fewer and short pinnae but almost equally wide, with few lobes and widely-spaced costules.

29. Sphaerostephanos moseleyi HOLTTUM, *sp. nov.*

S. pennigero affinis, ab eo differt: *fronde minore*; *pinnis redactis 3–5-jugatis, omnibus parvis*; *pinnis normalibus 7–12-jugatis, fertilibus usque 15 × 2.1 cm*; *venis 2½-jugatis anastomosantibus*; *sporangiis nec setiferis nec glanduliferis.* — Type: MOSELEY *s.n.* Challenger Exp., Aru Islands (K; BM).

Caudex short-creeping; *stipe* 20–35 cm long, basal scales 7 × 1 mm; base of stipe to first normal pinna 35–65 cm; *reduced pinnae* 3–5 pairs, lowest very small, uppermost *c.* 5 mm long. *Lamina* to 50 cm long; pinnae 7–12 pairs. *Largest fertile pinnae* 15 × 2.1 cm, shaped as in *S. penniger* but with costules at a very wide angle to costa; veins 8 pairs, 2½ pairs anastomosing, 1 pair to sinus-membrane; pubescence as in *S. penniger* but some short erect hairs in addition to glands between veins on both surfaces. *Sori* medial, lower ones divergent, those on basal veins from adjacent costules sometimes confluent; indusia copiously glandular; sporangia lacking glands or hairs distally, glands at ends of hairs on sporangium-stalks conspicuous.

Distr. *Malesia*: S.E. Moluccas (Aru Is.).

Notes. In addition to the type are BUWALDA 4984 and 5169, both from Kobroör I., the former much like the type. Number 5169 (from forest in steep rocky limestone country) is sterile, with longer fronds than the type and pinnae to 24 × 2.7 cm, with 13–14 pairs of veins but only 2½ pairs anastomosing, 2 or 3 pairs passing to a long sinus-membrane.

30. Sphaerostephanos productus (KAULF.) HOLTTUM, Kalikasan 4 (1975) 59. — *Aspidium productum* KAULF. Enum. Fil. Chamisso (1824) 237; METT. Farngatt. IV (1858) 109. — *Dryopteris producta* (KAULF.) C. CHR. Ind. Fil (1905) 286; v.A.v.R. Handb. (1908) 230. — *Cyclosorus productus* (KAULF.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 248; COPEL. Fern Fl. Philip. (1960) 348, *nomen tantum.* — *Thelypteris producta* (KAULF.) REED, Phytologia 17 (1968) 306. — Type: CHAMISSO, Manila (LE).

Nephrodium philippinense BAK. Ann. Bot. 5 (1891) 327. — *Dryopteris basilaris* C. CHR. Ind. Fil. (1905) 254, *nom. nov. superfl.*; CHRIST, Philip. J. Sci. 2 (1907) Bot. 186; v.A.v.R. Handb. (1908) 820. — *Dryopteris philippinensis* (BAK.) COPEL. Philip. J. Sci. 56 (1935) 100. — Lectotype (HOLTTUM 1975): CUMING 10, Luzon (K).

Dryopteris luzonica var. puberula CHRIST, Philip. J. Sci. 2 (1907) Bot. 197. — Type: BOLSTER 175, Luzon (P).

Dryopteris kotoensis HAYATA, Ic. Pl. Formosa 5 (1915) 279, f. 107. — *Cyclosorus truncatus var. kotoensis* H. ITO, Bot. Mag. Tokyo 51 (1937) 729. — *Thelypteris kotoensis* (HAYATA) K. IWATS. Acta Phytotax. Geobot. 21 (1964) 42; Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 189. — *S. kotoensis* (HAYATA) HOLTTUM in C. M. Kuo, Fl. Taiwan 1 (1975) 436. — Type: KAWAKAMI & SASAKI *s.n.* July 1912, Taiwan, Kotosho I. (TI; seen by IWATSUKI).

Dryopteris pseudohirsuta ROSENST. Meded. Rijksherb. *n.* 31 (1917) 7. — *Thelypteris pseudohirsuta* (ROSENST.) REED, Phytologia 17 (1968) 306. — Type: CUMING 82, *partim* (L).

Cyclosorus serratus COPEL. Philip. J. Sci. 81 (1952) 36; Fern Fl. Philip. (1960) 365. — Type: COPELAND P. P. E. 19, Luzon, Lamao River (MICH; K).

Cyclosorus weberi COPEL. Philip. J. Sci. 81 (1952) 36, t. 25; Fern Fl. Philip. (1960) 366. — *Thelypteris weberi* (COPEL.) REED, Phytologia 17 (1968) 324. — Type: WEBER 1174, Mindanao (US; K).

Cyclosorus rigidus COPEL. Philip. J. Sci. 81 (1952) 27; Fern Fl. Philip. (1960) 340, not *C. rigidus* (RIDL.) COPEL. 1951. — *Thelypteris ugoensis* REED, Phytologia 17 (1968) 322, *nom. nov.* — Type: RAMOS BS 5744, Luzon, Mt Ugo (MICH).

Cyclosorus leucadenius COPEL. Philip. J. Sci. 81 (1952) 27; Fern Fl. Philip. (1960) 339. — *Thelypteris leucadenia* (COPEL.) REED, Phytologia 17 (1968) 287. — Type: ELMER 8999, Luzon, Baguio (MICH; K, E, L, BO).

S. punctatus HOLTTUM, Kalikasan 4 (1975) 60. — Type: ELMER 16642, Luzon, Mt Bulusan (US; K, L, G, BO, NSW).

Cyclosorus megaphyllus sensu COPEL. Fern Fl. Philip. (1960) 367.

Cyclosorus nitidulus sensu COPEL. Fern Fl. Philip. (1960) 364, *p.p.*

Caudex short-creeping, branched. Size of *fronds* very variable, with pinnae from 10 × 1 to 30 × 2.7 cm. *Stipe* short; basal scales 10–20 mm long, narrow. *Reduced pinnae* 6–12 pairs, not

deflexed, broadly ovate to bluntly triangular, subentire, uppermost commonly 1–1.5 cm long and wide, lowest 0.5 cm. *Normal pinnae* crenate in smallest fronds, commonly lobed almost 1/3, in largest fronds 1/2 towards costa; costules always at about 45° to costa except in largest fronds; veins 4–11 pairs, in almost all cases 1½ pairs anastomosing and 1 pair to sinus-membrane; hairs on *lower surface* of costae near base very short (rarely with some more than 0.5 mm long), to 0.2 mm or more long distally, very short and sparse on costules and veins, many glands and few hairs between veins; hairs on *upper surface* of costae to 0.5 mm long, on costules and veins all very short, glands between veins abundant. Hairs on lower surface of *rachis* variable, 0.2–0.5 mm or more long, on upper surface to 1 mm long. *Sori* medial, lower ones not or little divergent; indusia firm, bearing glands and sometimes a few short hairs; sporangia bearing 1–2 setae or glands on body and a spherical gland at end of hair on stalk; spores with many small wings.

Distr. *Malesia*: Philippines (Luzon to Mindanao); Taiwan (Orchid Island only).

Ecol. In forest at low and medium altitudes.

Notes. In 1975 I distinguished *S. punctatus*, with large pinnae lobed fully half-way to costa and costules at a rather broad angle, but these do not appear to be sharply distinct; such specimens occur also on Orchid Island (S.E. of Taiwan) along with others indistinguishable from the type of *Nephrodium philippinense* BAK. The specimen originally described by KAULFUSS has pinnae 0.9 cm; the type of *Cyclosorus serratus* COPEL. 10 × 0.8 cm, the type of *Nephrodium philippinense* 18 × 1.4 cm; some other types come between these extremes.

The name *Nephrodium basilare* PRESL (Epim. Bot. 258) was published as a substitute for *N. caudiculatum* J. SM. *non* PRESL (Hook. J. Bot. 3:411), but SMITH's name was a *nomen nudum*, and the first valid name based on the specimens cited by SMITH was *N. philippinense* BAK. When transferring this to *Dryopteris*, CHRISTENSEN (1905) preferred the epithet *basilaris* because of the existence of *Phegopteris philippinensis* METT.

METTENIUS evidently did not see the CHAMISSO specimen (he cited CUMING LI, which I cannot trace), but he gave a fairly good description, mentioning the glands on the lower surface which no other author noticed. HOOKER and BAKER made no reference to *Aspidium productum* KAULF. CHRISTENSEN, CHING, COPELAND and REED transferred the species to other genera without describing it. When describing *Dryopteris producta*, VAN ALDERWERELT referred to METTENIUS, but did not copy METTENIUS's description; he gave a better description under *D. basilaris*. COPELAND misconstrued the species in his Fern Flora of the Philippines, placing it as a synonym of *Nephrodium nitidulum* PRESL, which belongs to the genus *Pneumatopteris*.

31. Sphaerostephanos penniger (HOOK.) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 209. — *Aspidium pennigerum sensu* BL. Enum. Pl. Jav. (1828) 153. — *Nephrodium pennigerum* HOOK. Spec. Fil. 4 (1862) 82, *nom. nov.*; RACIB. Fl. Btzg 1 (1898) 190. — Type: BLUME, Java, Boerangrang (L).

Aspidium megaphyllum METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 233; MIQUEL, *ibid.* 4 (1869) 159. — *Dryopteris megaphylla* (METT.) C. CHR. Ind. Fil. (1905) 277; v.A.v.R. Handb. (1908) 218; BACKER & POSTH. Varenfl. Java (1939) 50. — *Cyclosorus megaphyllus* (METT.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 225; HOLTTUM, Rev. Fl. Mal. 2 (1955) 268, f. 154. — *Thelypteris megaphylla* (METT.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 34. — Type: METTENIUS cited REINWARDT and ZIPPELIUS, Java (L).

Aspidium multilineatum WALL., *nom. nud.* — *Nephrodium pennigerum var. multilineatum* CLARKE, Trans. Linn. Soc. Bot. 1 (1880) 532. — *Nephrodium multilineatum* BEDD. Handb. Suppl. (1892) 80 (not *Aspidium multilineatum* METT. 1858). — *Dryopteris multilineata* (BEDD.) O. KTZE, Rev. Gen. Pl. 2 (1891) 811; v.A.v.R. Handb. (1908) 219. — Type: WALLICH 353, Penang (K).

Aspidium abortivum sensu METT. Farngatt. IV (1858) 110, *quoad* ZOLLINGER 3525 *tantum*.

Nephrodium abruptum sensu HOOK. Spec. Fil. 4 (1862) 78, *p.p.*, t. 241 B. — **Fig. 1a–h.**

KEY TO THE VARIETIES

1. Lower pinnae not over 4 cm wide, lobed not more than 1/3 towards costae.
   2. Normal pinnae to 25 pairs, reduced pinnae 10–15 pairs . . . . . **a. *var.* penniger**
   2. Normal pinnae 7 pairs; reduced pinnae 5 pairs **c. *var.* karoensis**
1. Lower pinnae to 7 cm wide, lobed to 3 mm from costa . . . . . **b. *var.* excellens**

a. *var.* penniger

Caudex short-creeping. *Stipe* 8–10 cm long; scales to 10 × 1 mm, closely setiferous; base of stipe to first large plant 80 cm. *Reduced pinnae* 10–15 pairs, upper ones to 3 × 2 cm, spreading, triangular with a not quite truncate symmetric base, blunt apex and subentire edges, lowest on a large plant 1 × 1 cm. *Lamina* to 100 cm long; pinnae 25 pairs; basal pinnae not or slightly narrowed at base; apex not pinna-like; aerophores slightly swollen. *Largest pinnae* commonly 20 × 2.8 cm (to 30 × 4 cm), lobed to a depth of 3–5 mm, lobes oblique, subdeltoid, broadly pointed; costules 5.5–7 mm apart, at 60°; veins 8–12 pairs, 3–3½ pairs anastomosing to form a zig-zag excurrent vein,

1–2 pairs to sinus-membrane; hairs on *lower surface* of rachis and base of costae very short, distally on costa and costules 0.2–0.3 mm, somewhat antrorse, between veins many glands; hairs on *upper surface* of costae 0.5 mm long, minute on costules, many glands between veins. *Sori* medial, lower ones not divergent; indusia glandular with a few short acicular hairs; sporangia with short setae and glands on body, hair on stalk often with a conspicuous terminal gland.

Distr. Peninsular Thailand, in *Malesia*: Malaya, Sumatra, Borneo, Java, Lesser Sunda Is. (Bali, Lombok), S.W. and N. Celebes.

Notes. On p. 78 of Species Filicum vol. 4 (which was printed off in fascicles of 16 pages) HOOKER cited his specimens of this species under *Nephrodium abruptum* and with them specimens belonging to six other species; his plate 241B certainly represents a specimen of *S. penniger*. In the next fascicle, on p. 82, he revised his opinion and cited all his specimens of the present species under *N. pennigerum*, based on *Aspidium pennigerum* BL. stating correctly that they agreed with a specimen so named by BLUME. HOOKER's description is a translation of BLUME's; his name, in *Nephrodium*, ranks as a new name.

BLUME's name was based on a misinterpretation of *Polypodium pennigerum* FORST. which represents a New Zealand species very different from the Java one, and in citing BLUME HOOKER excluded the FORSTER name; in his fifth volume HOOKER retained *Polypodium pennigerum* FORST. for the New Zealand fern, which is exindusiate.

HOOKER's confusions on p. 78 misled BEDDOME, who united an Indian species with the Malesian *S. penniger* under the name *Nephrodium abruptum* in Ferns of S. India, and then under *N. pennigerum* (Handb. p. 277). In the Supplement to his Handbook BEDDOME separated the two, adopting WALLICH's name *multilineatum* for the Malesian species; this in turn led to confusions in the name of another Indian species.

b. *var.* **excellens** (BL.) HOLTTUM, *stat. nov.* — *Aspidium excellens* BL. Enum. Pl. Jav. (1828) 160; C. CHR. Ind. Fil. (1905) 73. — *Proferea excellens* (BL.) PRESL, Epim. Bot. (1851) 259; HOLTTUM, Novit. Bot. Univ. Carol. Prag. 1968 (1969) 48. — *Pleocnemia excellens* (BL.) v.A.v.R. Handb. (1908) 171. — *Tectaria excellens* C. CHR. Ind. Fil. Suppl. III (1834) 179. — Type: BLUME, Java (PRC; L, K).

Upper part of frond indistinguishable from the typical form of *S. penniger*; lower pinnae greatly enlarged, lowest 30 × 7 cm, lobed to 3 mm from costa, costules 9 mm apart, lobes falcate and tapered to an acute tip, venation in lobes pleocnemioid, in largest lobes aeroles of more than one series along costule.

Distr. *Malesia*: Java, only one collection.

Note. In the Rijksherbarium at Leiden are two sheets, one bearing the apical part of a frond, the other a lower part of the same frond, but not the base. The base of the frond appears to have been divided between HOOKER (one pair of pinnae) and PRESL who had the three lowest pairs of large pinnae and two pairs of reduced pinnae.

c. *var.* **karoensis** HOLTTUM, *var. nov.*

A typo speciei differt: fronde minore; pinnis redactis 5-jugatis; pinnis evolutis 7-jugatis, usque 13 × 2.7 *cm, infimis basin versus valde angustatis; sporangiis setiferis, non glanduliferis.* — Type: MOLESWORTH ALLEN 2407, Sumatra, Prapat by Lake Toba (K).

Distr. *Malesia*: N. Sumatra, only known from the type.

32. Sphaerostephanos warburgii (KUHN & CHRIST) HOLTTUM, Allertonia 1 (1977) 202. — *Aspidium warburgii* KUHN & CHRIST in Warburg, Monsunia 1 (1900) 81. — *Dryopteris warburgii* (KUHN & CHRIST) C. CHR. Ind. Fil. (1905) 98; v.A.v.R. Handb. (1908) 180. — *Cyclosorus warburgii* (KUHN & CHRIST) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 250; COPEL. Philip. J. Sci. 78 (1951) 441. — *Thelypteris warburgii* (KUHN & CHRIST) B. C. STONE, Micronesica 2 (1966) 3. — Type: WARBURG, N.E. New Guinea, Sattelberg (B).

Dryopteris calcicola C. CHR. Bot. Jahrb. 66 (1933) 44. — Type: KJELLBERG 2611, S.E. Celebes, Kosali-Porema (S-PA; BM).

Caudex short, erect. *Stipe* 1–3 cm long. *Lamina* 10–15 cm long; pinnae to 18 pairs, several lower pairs gradually smaller, lowest 3–5 mm long. *Largest pinnae* 1.5–1.8 cm long, 0.3–0.4 cm wide, distinctly stalked, base unequally cuneate, edges entire or rarely crenulate, apex rounded or obtusely pointed; costules 1.5 mm apart, at 45°, distal ones unbranched, rest forked once or twice, branches of neighbouring ones anastomosing; *lower surface* of costae bearing short hairs, sometimes with scattered long ones, glands throughout between veins; *upper surface* glabrous apart from costae and costules, not glandular. Hairs on *rachis* to 1 mm long, both sides. *Sori* uniseriate on each side of the costa; indusia with a few short hairs; sporangia bearing glands, on specimens from Tenimbar Islands and Celebes also setae.

Distr. Micronesia (Guam, Admiralty Is.), and *Malesia*: New Guinea, S.E. Moluccas (Tenimber Is.), and Central & S.E. Celebes.

Note. Specimens from Guam only differ from those of New Guinea by their larger size (frond to 30 cm long, pinnae to 3 cm long), agreeing in glandular sporangia. The type of *D. calcicola*, from limestone, differs in fewer glands on lower surface of pinnae, densely hairy indusia and setose sporangia.

Ecol. On rocky stream banks.

33. Sphaerostephanos tandikatensis (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris tandikatensis* v.A.v.R. Bull. Jard. Bot. Btzg II, 11 (1913) 11; Handb. Suppl. (1917) 178, 503. — Type: MATTHEW 635, Sumatra, G. Tandikat (BO).

Caudex short-creeping. *Stipe* 4–5 cm long, short-hairy; basal scales 3–4 × 1 mm; base of stipe to first large pinna 35–45 cm. *Reduced pinnae* 12–15 pairs, broadly ovate, uppermost 10 × 8 mm with a small auricle on acroscopic base, lowest 3–4 mm long. *Lamina* to 45 cm long; pinnae 3–4 pairs, lowest pinna usually a little reduced; apex of lamina pinna-like, larger than pinnae on fronds of young plants; aerophores slightly swollen. *Pinnae* of type to 11 × 4 cm, of another specimen to 17 × 6.5 cm, widest at or above middle, base abruptly broad-cuneate, of lower ones asymmetric; apex abruptly short-cuspidate; edges entire, or crenate distally; costules 3.5–4.5 mm apart, at 60° or rather less; veins 12–14 pairs, almost all anastomosing, combined excurrent veins almost straight, mostly continuous; *lower surface* of costae and costules densely covered with erect hairs 0.1 mm long, veins and surface less densely, glands present on veins and surface between them; *upper surface* covered with appressed hairs 0.3 mm long, no longer hairs present. Hairs on both sides of *rachis* also short. *Sori* all supramedial, those on veins from adjacent costules often coalescing; indusia small, short-hairy; sporangia with many setae.

Distr. *Malesia*: South and Central Sumatra, 720–1400 m, several collections.

34. Sphaerostephanos carrii HOLTTUM, *sp. nov.*

Pinnae redactae 4-jugatae, superiores 1.5 cm longae; lamina usque 45 cm longa; pinnae 6–7-jugatae, omnes oppositae, 10 × 2.7 cm vel majores, vix usque 1/3 costam versus lobatae; lamina inter venas subtus glandulosa, supra glabra eglandulosa; indusia tenuia, pilis brevibus glandulisque praedita; sporangia setifera. — Type: C. E. CARR 14202, Papua, Boridi, 1500 m (K; BM, L, LAE).

Caudex short-creeping or suberect. *Stipe* 12–20 cm long; basal scales 7–10 × 1.5–2 mm, thin, setiferous; base of stipe to first large pinna 40–50 cm. *Reduced pinnae* 4–5 pairs, lowest 4 mm long, uppermost 1.5 cm, deflexed and auricled. *Lamina* 30–45 cm long; pinnae 6–7 pairs, opposite; lowest pinnae narrowed in basal 1/3 on basiscopic side, truncate but not auricled on acroscopic side; apical lamina almost pinna-like but larger and more deeply lobed at base; texture thin; aerophores not elongate. *Suprabasal pinnae* 10–17 × 2.7–3.5 cm, base truncate, apex abruptly short-acuminate, edges lobed rather less than 1/3 to costa, lobes slightly falcate with rounded tips; costules 5–6 mm apart; veins 10–12 pairs, 2½ pairs anastomosing, 1–1½ pairs passing to sinus membrane; *lower surface* of costae and costules bearing short spreading hairs, distally on costa to 0.5 mm long, short erect hairs and sparse glands between veins; hairs of *upper surface* of costae mixed in length, longest 1 mm or more, scattered similar long hairs on costules and veins, surface between veins glabrous. Hairs on lower surface of *rachis* rather sparse, 1–1.5 mm long, on upper surface copious, mostly 0.5 mm, longest 1–1.5 mm. *Sori* medial, basal ones not divergent; indusia bearing short hairs and a few glands; sporangia setiferous.

Distr. *Malesia*: Eastern New Guinea, 3 collections.

35. Sphaerostephanos exindusiatus HOLTTUM, *sp nov.*

Pinnae redactae 15-jugatae, superiores vix 10 mm longae; lamina 60 cm longa; aerophora 2 mm longa; pinnae maximae 12 × 1.5 cm, 3/5 costam versus lobatae; venae 8-jugatae; costa subtus pilis erectis 0.5 mm longis praedita, lamina inter venas glandulosa; pagina superior omnino pilis appressis vestita; sori exindusiati, sporangia setifera. — Type: POSTHUMUS 3494, S.W. Celebes, near Patapang, 1200 m, on river bank (BO).

Caudex short, thick, suberect. Stipe 15–20 cm long, densely scaly throughout when young; scales to 10 × 2 mm, thin; base of stipe to first large pinna 50 cm. *Reduced pinnae* at least 15 pairs, 1.5–2 cm apart, lowest 4 mm long, uppermost hardly 10 mm. *Lamina* 60 cm long; pinnae 25 pairs or more; lower pinnae not or little narrowed at base; aerophores 2 mm long. *Largest pinnae* 12 × 1.5 cm, base truncate and a little dilated both sides, apex narrowly acuminate, edges lobed about 3/5 to costa, lobes slightly falcate; costules 3–3.5 mm apart; veins to 8 pairs, 1 pair anastomosing, next acroscopic vein to side of sinus-membrane; *lower surface* of costae and costules bearing rather sparse erect hairs 0.5 mm long, surface between veins copiously glandular; hairs on *upper surface* of rachis and costae 1 mm long, scattered similar hairs on costules and veins, whole surface covered with slender appressed hairs. *Sori* inframedial, exindusiate; young sporangia bearing several short setae.

Distr. *Malesia*: S.W. Celebes, only known from the type.

36. Sphaerostephanos lucbanii HOLTTUM, *sp. nov.*

Pinnae redactae 2-jugatae; lamina 25 cm longa; pinnae liberae 7-jugatae, tenues, maximae 6 × 1.8 cm, 1/3–2/5 costam versus lobatae; venae 5–6-jugatae; costae subtus pilis usque 1 mm longis vestitae, pagina inter venas pilis erectis glandulisque praedita; pagina superior pilis appressis vestita; sori exindusiati; sporangia setifera. — Type: M. G. PRICE 2720A, Luzon, Mt Banahaw, streamside at 1000 m (K).

Caudex slender, short-creeping. *Stipe* 5 cm long, densely short-hairy, scales 3 mm long; base of stipe to first large pinna 11 cm. *Reduced pinnae*

2 pairs on largest frond, lower ones 6×3 mm, upper one deflexed, 10×6 mm, crenate, base asymmetric. *Lamina* 25 cm long, thin, apex narrowly triangular, 13 cm long, deeply lobed and grading to upper pinnae, venation in its basal lobes as in *Haplodictyum*; free pinnae 7 pairs, lowest distinctly stalked, somewhat narrowed at base on basiscopic side, aerophores swollen. *Largest pinnae* 6×1.8 cm, base truncate, apex shortly pointed, edges lobed 1/3–2/5 to costa, lobes rounded, entire; costules 4.5 mm apart, at 60°; veins 5–6 pairs, 1 pair anastomosing with long excurrent vein, next acroscopic vein to short sinus-membrane; hairs on *lower surface* of costae rather sparse, pale, slender, 0.5–1 mm long, on costules same but few, between veins slender erect hairs 0.2 mm long and glands; hairs on *upper surface* of costae 0.5 mm long, rest of upper surface covered with slender appressed hairs 0.2–0.3 mm long. Hairs on both sides of *rachis* slender, to 1.5 mm long. *Sori* medial, exindusiate; sporangia setiferous.

Distr. *Malesia*: Philippines (Luzon), only known from the type.

Note. Under the same number and near the same locality Mr PRICE also collected very much smaller plants with lamina to 7 cm long, pinnae 2 pairs, 1 cm long, subentire, but fully fertile. These small plants (separated as *n.* 2720B) agree in sori and in pubescence with the larger ones above described. They agree also closely in all respects with *Dryopteris diminuta* COPEL. from Mindanao, which I have transferred to *Pronephrium*. Mr PRICE calls my attention to the plants described by COPELAND as *Dryopteris bakeri* in Philip. J. Sci. 38 (1929) 135; one of them had much larger pinnae than the rest. It is thus possible that the whole collection 2720 represents different stages of plants on one species.

37. Sphaerostephanos major (COPEL.) HOLTTUM, *comb. nov.* — *Haplodictyum majus* COPEL. in Elmer, Leafl. Philip. Bot. 9 (1920) 3110; Fern Fl. Philip. (1960) 378; HOLTTUM, Kalikasan 2 (1973) 61. — Type: RAMOS BS 13992, Luzon, Mountain Prov., Apayao (MICH).

Cyclosorus dimorphus COPEL. Philip. J. Sci. 83 (1954) 99, pl. 5, *non* (BRAUSE) COPEL. 1960. — Type: EDAÑO PNH 17282, Luzon, Mountain Prov., Mt Magnas (MICH).

? *Dryopteris bakeri sensu* COPEL. Philip. J. Sci 38 (1929) 135.

Caudex short-creeping; *fronds* dimorphous. *Sterile frond. Stipe* to 4 cm long; base of stipe to first large pinna 6–12 cm; *reduced pinnae* 1–2 pairs, very small; *apical lamina* 12–20 cm long, deeply lobed, 2.5–4 cm wide at base, veins in lobes mostly forked, the branches uniting to form a series of costular areoles, base of lamina grading into 2–4 pairs of pinnae closely placed; *pinnae* on largest frond 3.5×2 cm, broadly pointed, lobed to about 1/3, with long spreading hairs on lower surface of costae, short erect hairs and glands between veins, upper surface covered with short appressed hairs. *Fertile frond. Stipe* 13 cm or more, base of stipe to first large pinna 20–27 cm; *reduced pinnae* as sterile but more widely spaced; *apical lamina* to 12×2 cm, veins mostly not forked; *pinnae* to 2.5×1.4 cm, more widely spaced and less deeply lobed than sterile; *sori* on both apical lamina and pinnae, basal ones sometimes a little elongate; indusium small with many hairs; sporangia with 2–3 long setae and sometimes also a gland.

Distr. *Malesia*: Philippines (mountains of northern Luzon).

38. Sphaerostephanos polyotis (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris polyotis* C. CHR. Bot. Jahrb. 66 (1933) 46. — *Thelypteris polyotis* (C. CHR.) REED, Phytologia 17 (1968) 305. — Type: KJELLBERG 1718, S.W. Celebes, Todjamboe, below 1000 m (BO; BM).

Caudex short, suberect. *Stipe* 5–10 cm long; base of stipe to first normal pinna 35–70 cm. *Reduced pinnae* 25–30 pairs, 1 cm apart on type (to 2.5 cm on other specimens), lowest 4–5 mm long, uppermost 1.5–2.0 cm long, deflexed with basal acroscopic lobe 7 mm long, basiscopic lobe shorter, edges incised, apex obtuse or rounded. *Lamina* of type 75 cm long; normal pinnae 25 pairs, basal ones a little narrowed towards their bases, with enlarged basal lobes; aerophores not elongate. Lower surface of *rachis* densely short-hairy, hairs to 0.5 mm long; upper surface with antrorse pale hairs. *Largest pinnae* of type 7×1.0 cm (of WALKER 12187 14×2.0 cm); base truncate; apex acuminate; edges lobed 1/2–2/3 towards costa; costules 3–3.5 mm apart, at 60° to costa; veins of type to 5 pairs, of WALKER 12187 10–12 pairs, in both cases 1 pair anastomosing and next acroscopic vein ending beside sinus-membrane; *lower surface* of costae densely covered with erect hairs of mixed length to 0.5 mm, more sparse hairs and sometimes glands on costules (not seen on type), surface between veins of WALKER 12187 bearing short erect hairs and a few glands; *upper surface* ± closely covered with short appressed hairs. *Sori* medial; indusia bearing short hairs and sometimes a few glands; sporangia bearing glands and sometimes setae.

Distr. *Malesia*: S.W. Central Celebes (Latimodjong Mts).

Notes. Additional collections are T. G. WALKER 12186–12188, 12270, 12273, 12282 (BM). Most of these are larger than the type, but 12188 has normal pinnae of the same size as the type with fewer reduced pinnae. WALKER's specimens also have some glands on the lower surface of costules and between veins, but setae more abundant than glands on sporangia. This species and *S. foliolosus* are related to *S. hispiduliformis*

of New Guinea, but the transition from normal to reduced pinnae at the base of fronds of the latter is not abrupt.

39. Sphaerostephanos grandescens HOLTTUM, *sp. nov.*

Pinnae redactae c. 6-jugatae, omnes parvae; lamina 45 cm longa; pinnae 12-jugatae, 2/3 vel ultra costam versus lobatae; costulae 5 mm inter se distantes; pagina subtus inter venas sparsim glandulifera, supra omnino pilis appressis vestita; indusia pilis brevibus paucis praedita, sporangia setifera. — Type: MERRILL 6094, Mindoro, Mt Halcon (MICH).

Stipe 7–14 cm long, glabrescent; base of stipe to first large pinna 45 cm or more. *Reduced pinnae* 6 pairs, 3rd from base 3–4 mm long, upper ones apparently not much larger. *Lamina* 45 cm long; pinnae 12–13 pairs, basal pair widest above middle, narrowed to base which is 1.2 cm wide, not auricled; aerophores elongate, less than 1 mm long. *Largest pinnae* 12.5 × 2.4 cm, base broadly cuneate, apex acuminate, edges lobed to 3.5 mm from costa (more than 2/3), lobes oblique, slightly falcate, a little narrowed distally; costules 5 mm apart, at less than 60°; veins to 9 pairs, 1 pair anastomosing, next acroscopic vein usually to side of sinus-membrane; hairs on *lower surface* of costae less than 0.5 mm long, antrorse distally, on costules same but sparse, sparse glands on costules and on surface between veins; hairs on *upper surface* of costae 0.6 mm, scattered similar hairs on costules and veins, whole surface covered with slender hairs 0.3–0.4 mm long. Hairs on lower surface of *rachis* pale, curved, spreading, 0.6 mm long, on upper surface similar but appressed. *Sori* medial, lower ones not divergent; indusia rather firm, with a few short hairs only; sporangia setiferous.

Distr. *Malesia*: Philippines (Mindoro: Mt Halcon).

Note. This specimen was named *Dryopteris bordenii* (here placed as a variety of *S. heterocarpus*) by CHRIST, but has much wider pinnae and setiferous sporangia and elongate aerophores; it is near *S. magnus*, but smaller.

40. Sphaerostephanos magnus (COPEL.) HOLTTUM, *comb. nov.* — *Cyclosorus magnus* COPEL. Philip. J. Sci. 81 (1952) 30; Fern Fl. Philip. (1960) 346. — *Thelypteris magnus* (COPEL.) REED, Phytologia 17 (1968) 291. — Type: MERRILL 6952, Negros (MICH; B, P).

Stipe 10 cm, glabrescent; scales broadly ovate, thin, 2.5 mm wide; base of stipe to first normal pinna to 85 cm. *Reduced pinnae* many pairs, each consisting of an aerophore more than 1 mm long and a minute green blade. *Lamina* to 100 cm long; pinnae *c.* 30 pairs; basal pinnae apparently not narrowed at their bases. *Largest pinnae* 21 × 2.5 cm, base subtruncate, apex acuminate, edges lobed 3/5 to costa, lobes falcate, somewhat narrowed distally; costules 5 mm apart, at more than 60°; veins to 9 pairs, basal pair anastomosing, next pair to sides of sinus-membrane; hairs on *lower surface* of rachis sparse, to 1 mm long, on costae and costules very short throughout with much longer ones also distally; many glands throughout lower surface; *upper surface* covered with slender appressed hairs, with scattered longer ones on costules and veins. Sori small, medial, lower ones not divergent; indusia bearing glands; sporangia setiferous, sometimes also a gland present.

Distr. *Malesia*: Philippines (Negros). Known from two collections, the other being ELMER 9845 which consists in part of the present species, in part of *Pneumatopteris nitidulus* (PRESL) HOLTTUM.

41. Sphaerostephanos santomasii HOLTTUM, Kalikasan 4 (1975) 62. — Type: M. G. PRICE 1034, Luzon, Benguet Prov., Mt Santo Tomas, 2000 m (K; PNH).

Caudex short, erect. *Stipe* 5–10 cm long, basal scales narrow, 8 mm long; base of stipe to first large pinna 40–75 cm. *Reduced pinnae* 3–4 cm apart, upper ones 3 mm long, lowest very small. *Lamina* to 55 cm long; pinnae to 30 pairs; several pairs lower pinnae narrowed towards their bases, a basal short pair sometimes present; aerophores to 1 mm long. *Largest pinnae* to 16 × 1.5 cm (rarely to 2 cm wide), base truncate, apex acuminate, edges lobed 3/5–2/3 to costa, lobes slightly falcate; costules 3–4 mm apart, at 60° or more; veins 7–10 pairs, basal pair anastomosing, next pair to edge or acroscopic one to sinus-membrane; *lower surface* of costae of sterile pinnae bearing pale spreading hairs 1 mm long and more numerous shorter antrorse hairs, longer hairs on fertile pinnae less than 1 mm, similar hairs more sparse on costules, surface between veins bearing glands and a variable number of slender appressed hairs; hairs on *upper surface* of costae 1 mm long, scattered similar hairs on costules and veins, whole surface covered with slender appressed hairs 0.3–0.5 mm long. *Sori* medial, lower ones not divergent; indusia small, bearing a few short hairs; sporangia copiously setiferous.

Distr. *Malesia*: Philippines (Northern Luzon: Mt Santo Tomas, Mt Nangaoto and Mt Data: ALCASID PNH 1750), at 2000 m.

42. Sphaerostephanos trichochlamys HOLTTUM, *sp. nov.*

Caudex brevis, erectus; stipes 8 cm longus; pinnae redactae usque 9-jugatae, superiores 3 mm longae; lamina 45 cm longa; pinnae maximae 13 × 1.7 cm, dimidio costam versus lobatae; rachis costaeque subtus pilis multis usque 1.5 mm longis vestita, pagina inter venas pilis erectis glandulisque praedita; indusia pilosa; sporangia setifera. — Type: HOLTTUM 4, Mt Kinabalu (K).

Caudex erect, short. *Stipe* 8 cm long, dark reddish; base of stipe to first large pinna 50 cm. *Reduced pinnae* to 9 pairs, uppermost 3 mm long, rest very small, with aerophores to 1 mm long. *Lamina* to 45 cm long; pinnae to 20 pairs, red when young, lower ones narrowed towards their bases. Hairs on *rachis*, both surfaces, to more than 1 mm long, with shorter ones also on lower surface. *Largest pinnae* 13 × 1.7 cm (sterile to 2 cm wide), base (except lower ones) truncate, apex short-acuminate, edges lobed ½ way to costa; costules 3–4 mm apart, falcate distally; veins 7–8 pairs, thick and prominent below in sterile fronds, basal pair anastomosing, next acroscopic vein to sinus-membrane; *lower surface* of costae densely covered with spreading hairs 1–1.5 mm long and much shorter ones, similar but more sparse hairs on costules and veins; surface between veins bearing short erect hairs and glands; *upper surface* of costae densely antrorse-hairy, sparse long hairs on costules and veins, surface between veins with a variable number of fine appressed hairs. *Sori* medial, lower ones not divergent; indusia firm, bearing many hairs 0.3 mm long; sporangia copiously setiferous.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu, many specimens; Sarawak: G. Mulu).

Ecol. In forest at *c.* 1500 m, not near streams; young fronds red, not mucilaginous.

Notes. This is closely allied to *S. hirsutus* but is smaller and much more densely hairy, with copiously setose sporangia. A specimen from 2275 m on G. Mulu has few sori which have small glabrous indusia.

43. Sphaerostephanos adenostegius (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris adenostegia* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Cyclosorus adenostegius* (COPEL.) COPEL. Gen. Fil. (1947) 142; Philip. J. Sci. 78 (1951) 442, pl. 6B. — *Thelypteris adenostegia* (COPEL.) REED, Phytologia 17 (1968) 258. — Type: BRASS 10282, near Lake Habbema, New Guinea, 2800 m, in forest (GH).

Pronephrium nothofageti HOLTTUM, Blumea 20 (1972) 118. — Type: T. G. WALKER 8788, New Guinea, Finisterre Range, 2400 m, in *Nothofagus* forest (BM).

Rhizome short-creeping, 3–4 mm diameter. *Stipe* commonly to 30 cm long, minutely hairy, basal scales 5 × 1 mm. *Lamina* 20–30 cm long; pinnae 8–10 pairs, lower ones with stalks 1–2 mm long, lowest 1–4 pairs ± reduced, lowest sometimes 1.3 cm long; texture firm; aerophores not elongate; frond-apex deltoid, deeply lobed. *Largest pinnae* 5–8 cm long, 1.3–1.6 cm wide, base subtruncate and sometimes slightly auricled, edges lobed about 1/3 to costa, lobes slightly dentate at ends of veins; costules 4–4½ mm apart; veins to 5 pairs, one pair anastomosing, next acroscopic vein to side of sinus-membrane; hairs on *lower surface* of rachis pale, ± curved, to 0.5 mm long, on costae 0.2–0.3 mm long, slightly antrorse, sparse glands usually present on costules and on surface between veins; hairs on *upper surface* of rachis as lower, on costae short and sparse, scattered longer hairs on costules and veins, slender appressed hairs to 0.5 mm long more or less abundant between veins. *Sori* medial; indusia small, with a few short hairs and glands; sporangia bearing 1–3 slender setae; spores with a rather broad translucent wing and cross-wings.

Distr. *Malesia*: Eastern New Guinea, several localities in forest at 2300–2900 m.

44. Sphaerostephanos aquatilis (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris aquatilis* COPEL. Philip. J. Sci. 6 (1911) Bot. 75. — *Thelypteris aquatilis* (COPEL.) REED, Phytologia 17 (1968) 260. — Type: C. KING 182, Papua (MICH, BO, NSW, P).

Dryopteris caudiculata ROSENST. Fedde Repert. 9 (1911) 426, *non* v.A.v.R. 1908. — Type: as above (BO).

Caudex short, erect. *Stipe* to 18 cm long, pale with dark base, short-hairy. *Lamina* to 45 cm long, apical section narrowly triangular and deeply lobed; pinnae 20 pairs or more, well spaced, lower 3–4 pairs gradually smaller, lowest 0.8–1.3 cm long; in smaller fronds only 1 pair pinnae somewhat reduced. *Largest pinnae* of type collection 8.5 × 1.0 cm, of BRASS 6725 14 × 0.8 cm; base very narrowly cuneate on basiscopic side, at *c.* 45° on acroscopic; apex acuminate; edges very slightly crenate; costules little over 2 mm apart, at 45°; veins of type 3 pairs, 2 pairs anastomosing; sinus-membrane hardly evident; hairs on *lower surface* of costae copious, antrorse, on costules sparse, rest of lower surface glabrous, glands present on costae and costules only of type (also between veins on BRASS 6725); *upper surface* bearing hairs on costae only, sparse distally. *Sori* medial to supramedial; indusia rather large, glabrous or sometimes bearing glands or a few short hairs; sporangia bearing glands.

Distr. *Malesia*: S.E. Papua New Guinea; 2 collections (BRASS 6725, Fly River).

Ecol. At low altitude by streams in flood zone.

Note. Possibly not distinct from *S. mutabilis*.

45. Sphaerostephanos hispidifolius (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris hispidifolia* v.A.v.R. Bull. Jard. Bot. Btzg II, 20 (1915) 15; Handb. Suppl. (1917) 186. — *Thelypteris hispidifolia* (v.A.v.R.) REED, Phytologia 17 (1968) 283. — Lectotype (selected here): JAHERI 1124, Borneo (BO).

Nephrodium hispidulum (*non* (DECNE) BAK.) CHRIST, Ann. Jard. Bot. Btzg 20 (1906) 107. — **Fig. 12l–m.**

Caudex short-creeping, with a dense mass of roots. *Stipe* 6–10 cm long, slender, reddish, short-

hairy; basal scales 4 mm long, narrow; base of stipe to first large pinna 10–17 cm. *Reduced pinnae* usually 1–2 pairs, 1–2 mm long, rarely lacking. *Lamina* 20–30 cm long, apex not pinna-like; pinnae 10–15 pairs, lower ones with stalks 1–2 mm long; texture firm, aerophores not enlarged. *Largest fertile pinnae* 3.5–6 cm long, 0.6–0.8 cm wide (sterile to 7.5 × 0.9 cm), base narrowly cuneate on basiscopic side, more broadly on acroscopic, apex acuminate, edges lobed ½ way to costa (or more deeply in largest pinnae), lobes oblique; costules 3 mm apart, at 45° to costa; veins 3–4 pairs, basal acroscopic vein ending exactly at base of sinus, basal basiscopic vein to edge very near base of sinus; rather sparse stiff hairs to 1 mm long on *lower surface* of rachis, base of costae and margins of lobes, costa distally glabrous, some glands present on lower surface between veins; *upper surface* of pinnae glabrous apart from slender hairs 0.5 mm long on costae. *Sori* medial; indusia firm, glabrous; sporangia bearing glands.

Distr. *Malesia*: Borneo; collections from several localities.

Ecol. On rocks and earth of stream banks, in the flood zone.

Note. v.A.v.R. in the Supplement to his Handbook describes the basal veins "uniting at or a little below the sinus", but in the specimens examined by me they usually end separately, though near together, their tips sometimes touching near base of pinnae.

46. Sphaerostephanos uniauriculatus (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris uniauriculata* COPEL. Philip. J. Sci. 9 (1914) Bot. 3. — *Thelypteris uniauriculata* (COPEL.) REED, Phytologia 17 (1968) 322. — Type: C. KING 406, Papua (MICH; BM, P).

Caudex short, suberect or creeping. *Stipe* 20–27 cm long, minutely hairy. *Reduced pinnae* one on each side of rachis, not opposite, *c.* 5 mm long. *Lamina* consisting of a large terminal leaflet and 2 pinnae (not opposite), sometimes a second pair also; aerophores slightly swollen. *Apical lamina c.* 18 cm long, fertile 3.4–3.7 cm wide, sterile 4.2 cm; base truncate or cordate, edges crenate; costules 5 mm apart along midrib; veins 8 pairs, almost all anastomosing; texture firm. *Sterile pinnae* to 8 × 3.2 cm, widest 1/3 from apex, base broadly rounded to truncate, apex short-pointed, edges irregularly sinuous; costules 4–4.5 mm apart; veins 6 pairs, 3 distal veins reaching the margin, rest anastomosing; sinus-membrane hardly developed; hairs on *lower surface* of costae, costules and veins very short, somewhat antrorse, a few short hairs and some glands on surface between veins; *upper surface* glabrous apart from hairs on costae and costules. *Fertile pinnae* to 6.5 × 2.5 cm; sori exindusiate, distal ones medial, lower ones divergent, those on basal veins of adjacent costules sometimes confluent; sporangia bearing glands.

Distr. *Malesia*: Papua, known only from type and KING 383 (P).

Note. KING 383 includes a young plant which has a cordate-based apical lamina and one pair of pinnae 6 × 8 mm, also an older plant with 2 pairs of pinnae and a single reduced pinna. COPELAND stated that there is a group of hairs in place of an indusium, but I did not see this.

47. Sphaerostephanos urdanetensis (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris urdanetensis* COPEL. in Elmer Leafl. Philip. Bot. 5 (1913) 1682. — *Cyclosorus urdanetensis* (COPEL.) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 355. — *Thelypteris urdanetensis* (COPEL.) REED, Phytologia 17 (1968) 322. — Type: ELMER 13762, Mindanao, Mt Urdaneta (MICH).

Dryopteris matutumensis COPEL. Philip. J. Sci. 40 (1929) 299, pl. 3. — *Cyclosorus matutumensis* (COPEL.) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 355. — *Thelypteris matutumensis* (COPEL.) REED, Phytologia 17 (1968) 291. — Type: COPELAND *s.n.* May 1917, Mindanao, Mt Matutum, 2000 m (MICH; UC).

Caudex short, creeping; base of stipe to first normal pinna 3–5 cm (sterile), 10–18 cm (fertile); *reduced pinnae* 2–3 pairs, to 4–5 mm long. *Lamina* excluding reduced pinnae to 20 cm long, consisting of an apical lamina 12–15 cm long, to 3 cm wide, deeply lobed and grading to pinnae at its base, with 3–5 pairs of free pinnae; basal pinnae narrowed towards their bases on basiscopic side, widest 1/3 from apex. *Largest pinnae* 1.5 × 0.8 cm (type of *D. matutumensis*); apex broadly pointed to rounded; edges crenate; costules 2 mm apart; veins 2–3 pairs, one pair anastomosing near base of pinna, free elsewhere; *lower surface* of rachis bearing thick curved pale brown hairs 0.5 mm long, hairs on costae shorter, yellow glands present throughout; *upper surface* of rachis as lower, of pinnae covered throughout with slender appressed hairs. *Sori* on apical lamina medial or supramedial, on pinnae near costae, one on each basal vein; indusia small, dark, firm, glabrous or with a few glands or short hairs; sporangia bearing glands.

Distr. *Malesia*: Philippines (Mindanao).

Note. The type of *D. matutumensis* has larger fronds than that of *D. urdanetensis* and has a few hairs on indusia, but agrees in other characters.

48. Sphaerostephanos batjanensis (ROSENST.) HOLTTUM, *comb. nov.* — *Dryopteris batjanensis* ROSENST. Meded. Rijksherb. *n.* 31 (1917) 5. — *Thelypteris batjanensis* (ROSENST.) REED, Phytologia 17 (1968) 263. — Type: DE VRIESE & TEYSMANN 589, Moluccas, Batjan (L).

Aspidium canescens forma gymnogrammoides CHRIST, Ann. Jard. Bot. Btzg 15 (1898) 131. — Type: SARASIN 137, N. Celebes, G. Masarang (BAS).

Caudex short, erect. *Base of stipe* to first large pinna of sterile fronds 5–12 cm, of fertile to 30 cm. *Reduced pinnae* 1–2 pairs, very small, irregularly spaced. *Lamina* to 30 cm long; pinnae 12–15 pairs, basal 2–3 pairs deflexed and slightly reduced, lowest narrowed towards base on basiscopic side. *Sterile pinnae* to 3.5 cm long, 1.2 cm wide above base which is a little dilated and sometimes auricled on acroscopic side; apex abruptly short-pointed; edges lobed to a depth of 1.5 mm; costules 3 mm apart; veins to 6 pairs, pale and prominent on lower surface, 1½ pairs anastomosing, next pair to sinus-membrane; *lower surface* of rachis, costae and costules covered with appressed pale hairs 0.3–0.4 mm long, copious glands on surface between veins; *upper surface* of pinnae covered throughout with slender appressed hairs 0.3 mm long, no glands; hairs on rachis more than 0.5 mm long. *Fertile pinnae* a little smaller than sterile; sori almost covering lower surface; indusia firm, rather large, hairy; sporangia bearing glands.

Distr. *Malesia*: N. Celebes & Moluccas (Batjan, Ceram).

Note. The specimen of DE VRIESE & TEYSMANN 589 at Kew is labelled Ceram, not Batjan; it agrees with the Leiden specimen.

49. Sphaerostephanos humilis HOLTTUM, *sp. nov.*

Pinnae 5-jugatae, usque 1.6 × 1.1 *cm, inferiores non decrescentes, subtus ubique glanduliferae, supra pilis adpressis vestitae; sori mediales; indusia magna, glandulis pilisque brevibus praedita; sporangia copiose glandulifera.* — Type: W. MEIJER 9826, Central Celebes, Mt Nokilalaki, 1500–2000 m (L).

Caudex short-creeping; *stipe* of sterile fronds 4–5 cm, of fertile 6–13 cm, short-hairy throughout, basal scales thin, *c.* 3 × 1.5 mm. *Sterile frond* to *c.* 14 cm long, consisting of an apical lamina 8.5 cm long, 1.2 cm wide, lobed to a depth of 2–2.5 mm, and 5 pairs of pinnae, basal pinnae variably somewhat reduced, no very small reduced pinnae present; *largest pinnae* 1.6 × 1.1 cm, subsessile, widening from the base to widest part near apex, irregularly shallowly lobed (most deeply towards apex) with 3–4 lobes on each side; costules 3–5 mm apart; veins to 4 pairs, basal pair anastomosing, next pair to margin; *lower surface* of rachis bearing rather sparse pale hairs 0.4 mm long, costae covered sparsely with very short appressed hairs, glands copious throughout lower surface which is not pustular; *upper surface* of rachis hairy as lower, whole upper surface of pinnae covered with appressed hairs 0.3 mm long. *Fertile fronds* with apical lamina a little narrower than sterile, edges of lobes dentate at ends of veins; pinnae to 1.4 × 0.9 cm; sori medial; indusia rather large, firm, with a few glands and usually a few short hairs; sporangia copiously glandular; spores spinulose.

Distr. *Malesia*: Central Celebes. Only known from the type.

50. Sphaerostephanos lastreoides (PRESL) HOLTTUM, Kalikasan 4 (1975) 54. — *Pronephrium lastreoides* PRESL, Epim. Bot. (1851) 259; Holttum, Novit. Bot. Univ. Carol. Prag. 1968 (1969) 49. — Type: "Java (JUNGHUHN, comm. Vriese 1850)" (PRC).

Cyclosorus duplosetosus COPEL. Philip. J. Sci. 81 (1952) 32; Fern Fl. Philip. (1960) 354. — *Thelypteris duplosetosus* (COPEL.) REED, Phytologia 17 (1968) 274. — Type: MERRILL 9530, Palawan, Mt Capoas (MICH).

Caudex short, creeping. *Stipe* to 5 cm (sterile), to 15 cm (fertile) covered with short pale hairs; base of stipe to first large pinna 10–20 cm. *Reduced pinnae* 1–2 pairs, small, irregularly spaced. *Lamina* to 15 cm long; free pinnae *c.* 10 pairs, lower ones with short stalks and narrowed at base on basiscopic side; apical lamina short, acuminate; aerophores not elongate. *Supramedial pinnae* to 2.3 × 0.9 cm, base truncate, apex abruptly obtuse-pointed, lobed to about ½ way to costa; costules 3 mm apart; veins 3–4 pairs, basal pair anastomosing with excurrent vein to sinus, next pair to edge; sparse pale spreading hairs 1 mm long and many much shorter ones on *lower surface* of costae and costules, glands on surface between veins; scattered long hairs on *upper surface* of costae, costules and veins, whole surface covered with slender appressed hairs 0.2–0.3 mm long. *Rachis* also with spreading hairs 1 mm long and shorter ones on both surfaces. *Sori* medial; indusia with short hairs; sporangia bearing glands.

Distr. *Malesia*: Philippines (Palawan, Luzon, Negros, Mindanao).

Notes. Part of CUMING 251 from Luzon, in several herbaria, exactly matches the type of this species; nothing like it is otherwise known from Java. Probably the type was a CUMING specimen misplaced by PRESL. M. G. PRICE 2734, from Mindanao, Agusan del Sur Prov., is like the type in all essentials but a little larger; its fertile pinnae are the same size as sterile pinnae on the Kew specimen of CUMING 251, which has smaller fertile ones.

M. G. PRICE 690, from Mt Halcon, Mindoro, differs from the above description only in larger size: lamina to 35 cm long, pinnae 20 pairs, largest 7 × 1.7 cm. It may represent a distinct local variety.

A. LOHER *s.n.* March 1915, from Rizal Province, Luzon, differs in having shallowly crenate pinnae, and slender appressed hairs on lower surface of costules.

51. Sphaerostephanos cataractorum (WAGN. & GRETH.) HOLTTUM, *comb. nov.* — *Cyclosorus cataractorum* WAGN. & GRETH. Un. Cal. Publ. Bot. 23 (1948) 50, pl. 16. — *Thelypteris catarac-*

torum (WAGN. & GRETH.) REED, Phytologia 17 (1968) 266. — Type: GRETHER & WAGNER 3971, Admiralty Islands, Manus I. (UC; NSW).

Caudex short, erect. *Stipe* 10–20 cm long, pallid; basal scales narrow, 5 mm long. *Lamina* to 30 cm long; pinnae to 16 pairs; basal pinnae reduced, sometimes one or both to a very narrow leaflet less than 1 cm long; apex of frond sometimes almost pinna-like; texture thin; aerophores not elongate. *Largest pinnae* to 10 × 0.9 cm, widest at middle, base very narrowly cuneate, apex acuminate, edges lobed ½ way to costa, lobes very oblique, slightly falcate, acute; costules 4–4.5 mm apart, at 45°; veins 5–6 pairs, basal pair anastomosing with excurrent vein to sinus, next acroscopic vein to side of short sinus-membrane; *lower surface* of pinnae quite glabrous with resinous pale glands between veins; *upper surface* short-hairy on costae, otherwise glabrous. *Rachis* glabrous on lower surface or with very short hairs; hairs on upper surface thick, brown, curved, 0.3–0.4 mm long. *Sori* medial; indusium firm, glabrous; sporangia bearing glands.

Distr. Admiralty Islands, New Britain, Bougainville, in *Malesia*: Eastern New Guinea.

Ecol. By streams in flood-zone at altitudes to 250 m.

Note. This is very similar to *S. hispidifolius* of Borneo, but has veins always anastomosing and almost glabrous pinnae. The resinous glands on lower surface are usually flattened when dry, not spherical as normally in this genus.

52. Sphaerostephanos menadensis HOLTTUM, *sp. nov.*

Pinnae redactae 2-jugatae, minutae; lamina 20 cm longa, pars apicalis angusta 10 cm longa; pinnae 6-jugatae, infimae basin versus valde angustatae, mediales 5.5 × 1.6 cm, dimidio costam versus lobatae; costae subtus pilis minutis vestitae; pagina inter venas subtus glandulifera, supra eglandulosa; indusia glabra, sporangia setifera. — Type: KOORDERS 17133, Celebes, Menado, 1800–2000 m (L).

Base of *stipe* to first large pinna 25 cm. *Reduced pinnae* 2 pairs, very small and widely spaced. *Terminal lamina* 10 cm long, narrowly deltoid; free pinnae 6 pairs, lowest deflexed and gradually much narrowed towards their bases, widest above middle; aerophores not elongate. *Middle pinnae* to 5.5 × 1.6 cm, base truncate, apex abruptly caudate, edges lobed ½ way to costa, lobes falcate; costules 3.5 mm apart, at more than 60°; veins 6 pairs (fertile) 7–8 pairs (sterile), 1 pair anastomosing, next pair of the acroscopic one only to sinus-membrane; long coarse hairs on *lower surface* of rachis, very short ones on costae and costules, surfaces between veins bearing glands only; hairs on *upper surface* of costules and veins all very short, neither hairs nor glands between veins. *Sori* medial; indusia glabrous; sporangia bearing glands.

Distr. *Malesia*: N.E. Celebes; only known from the type.

53. Sphaerostephanos subcordatus HOLTTUM, *sp nov.*

Pinnae redactae unijugatae, parvae; frondes dimorphae; pinnae usque 8-jugatae, steriles 3 × 1.2 cm, fertiles 1.7 × 0.9 cm, usque 1/3 costam versus lobatae; costae subtus brevi-pilosae, pagina inter venas glabra glandulis paucis praedita; pagina superior inter venas glabra, eglandulosa. indusia parva, glabra; sporangia glandulosa — Type: M. G. PRICE & B. F. HERNAEZ 61, Western Samar (K).

Caudex short, creeping, 3 mm diameter when dry. *Stipe* of sterile fronds 5–7 cm, of fertile 15–18 cm to first large pinna below which are 2 much-reduced pinnae, not opposite. *Lamina* 15 cm long, apex broadly deltoid and deeply lobed, free pinnae to 8 pairs, basal ones slightly reduced, deflexed, with stalks 1 mm long and asymmetric base; aerophores not elongate. *Largest sterile pinnae* 3 × 1.2 cm, in some cases 1.5 cm wide near apex; base truncate to subcordate; apex abruptly blunt-pointed; edges lobed to a depth of 2 mm, more deeply near apex if it is widened, lobes rounded; costules 4 mm apart, at less than 60°; veins 4–5 pairs, basal pair anastomosing, next acroscopic vein to sinus-membrane; hairs on *lower surface* of costae 0.2 mm long, antrorsely curved, more sparse and shorter on costules, surface between veins glabrous with a few glands; hairs on *upper surface* of costae sparse, 0.4 mm long, similar or longer ones scattered on costules and veins; surface between veins glabrous. Hairs on lower surface of *rachis* 0.3–0.4 mm long, thick and curved, on upper surface rather sparse, 1 mm long. *Sori* medial, lower ones sometimes a little elongate; indusia small, glabrous; sporangia with glands.

Distr. *Malesia*: Philippines (W. Samar), only known from the type.

Ecol. On limestone-derived soils, in forest.

54. Sphaerostephanos novoguineensis (BRAUSE) HOLTTUM, *comb. nov.* — *Dryopteris novoguineensis* BRAUSE, Bot. Jahrb. 49 (1912) 21; v.A.v.R. Handb. Suppl. (1917) 159. — *Lastrea novoguineensis* (BRAUSE) COPEL. Gen. Fil. (1947) 139; Philip. J. Sci. 78 (1951) 426. — *Thelypteris novoguineensis* (BRAUSE) REED, Phytologia 17 (1968) 297. — Type: SCHLECHTER 17719, N.E. New Guinea, Kani Mts, 1000 m (B; P).

Dryopteris glaucescens BRAUSE, Bot. Jahrb. 56 (1920) 85; COPEL. Philip. J. Sci. 78 (1951) 426. — *Thelypteris glaucescens* (BRAUSE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 251. — Type: LEDERMANN 13034, N.E. New Guinea, Sepik Dist. 1400 m (B).

Caudex short, creeping. *Stipe* 10–15 cm long; basal scales thin, 10 × 2.5 mm; base of stipe to first large pinna 20–45 cm. *Reduced pinnae* 3–8 pairs,

not more than 3 mm long. *Lamina* to 80 cm long; pinnae to 25 pairs, lower ones not narrowed at base; aerophores to more than 1 mm long. *Pinnae* somewhat dimorphous, sterile to 10 × 1.7 cm, fertile to 7.5 × 1.2 cm; base truncate, basal acroscopic lobe to 4 mm longer than next; apex short-acuminate; edges lobed to less than 1 mm from costa, lobes falcate; costules 3 mm apart (sterile), 2.5 mm (fertile); veins 10 pairs, basal acroscopic vein passing to side of sinus-membrane, basiscopic vein to edge above it; *lower surface* of costae bearing many short hairs and less abundant long ones to 1 mm (long hairs sometimes lacking), similar hairs on costules, glands sometimes few present on surface between veins; *upper surface* with hairs 1 mm long scattered on costae, costules and veins, surface between veins ± closely covered with fine appressed hairs. *Sori* medial to supramedial; indusia large, firm, with short hairs and sometimes glands; sporangia bearing glands; spores finely spinulose.

Distr. *Malesia*: Eastern New Guinea, several collections, in forest at 850–1400 m.

Note. The type of *D. glaucescens* differs from that of *D. novoguineensis* in the absence of long hairs on lower surface of rachis and costae and the presence of glands on indusia.

55. Sphaerostephanos hispiduliformis (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris hispiduliformis* C. CHR. Ind. Fil. Suppl. III (1934) 88, new name for *Dryopteris hispidula* BRAUSE, Bot. Jahrb. 56 (1920) 102, *non* (SW.) O. KTZE 1891. — *Thelypteris hispiduliformis* (C. CHR.) REED, Phytologia 17 (1968) 283. — Type: LEDERMANN 11758, N.E. New Guinea, Sepik Distr. 2070 m, in forest (B).

KEY TO THE VARIETIES

1. Caudex to 150 cm tall; lower surface of pinnae lacking glands between veins
   a. *var.* **hispiduliformis**
1. Caudex short; lower surface of pinnae between veins copiously glandular.
   2. Fronds to 90 cm long; pinnae to 14 × 1.5 cm; hairs on lower surface of costae 0.1 mm long
      b. *var.* **vinkii**
   2. Fronds to 40 cm long; pinnae to 5 × 1 cm; hairs on lower surface of costae 1 mm long
      c. *var.* **brassii**

a. *var.* **hispiduliformis**

Caudex erect, to 150 cm tall; *stipe* 10–15 cm long, basal scales broad, thin; base of stipe to pinnae of maximum size 60 cm or more, whole frond to 150 cm long; *reduced pinnae* 1.5–2.0 cm apart, broadly triangular, *c.* 12 pairs gradually increasing upwards from very small basal ones to 1 cm, then 7–12 pairs grading to pinnae of maximum size; aerophores more than 1 mm long. *Largest pinnae* 11 cm long, to 1.7 cm wide at dilated base, rather evenly tapered to apex, lobed *c.* 2/5 towards costa; costules to 3.5 mm apart, at more than 60° to costa; veins 7–9 pairs, 1½ pairs anastomosing, 1–1½ pairs ending beside sinus-membrane; *lower surface* of costae with spreading pale hairs 1 mm long and shorter ones, hairs on costules more sparse, a few short hairs between veins, glands confined to costules and veins, sometimes lacking; hairs on *upper surface* of costae more than 1 mm long, scattered similar hairs on costules and veins, fine appressed hairs all over surface. *Sori* medial; indusia bearing hairs and glands, sporangia with neither; spores covered with very small wings.

Distr. *Malesia*: Eastern New Guinea, in mountain forest at *c.* 2000 m.

b. *var.* **vinkii** HOLTTUM, *var. nov.*

A typo speciei differt: *caudice breve*; *pinnis* 1/3 *costam versus lobatis*; *costis subtus pilis minutis erectis vestitis*; *pagina inferiore inter venas copiose glandulifera.* — Type of variety: VINK 17605, N.E. New Guinea, W. Sepik Distr., in low secondary growth on limestone (L).

Distr. *Malesia*: Papua New Guinea (Sepik).

c. *var.* **brassii** HOLTTUM, *var. nov.* — *Dryopteris strigosissima* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 221. — *Cyclosorus strigosissimus* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 456, pl. 36. — *Thelypteris strigosissima* (COPEL.) REED, Phytologia 17 (1968) 316. — Type: BRASS 11436, New Guinea, Bele River, 2200 m, on limestone cliff in shade (MICH).

Differs from *var. vinkii*: fronds much smaller; reduced pinnae contiguous, lower ones wider than long; largest pinnae 5 × 1 cm, crenate to a depth of 1 mm; long hairs present on lower surface of costae.

Distr. *Malesia*: Papua New Guinea.

Notes. The greater number of glands on the lower surface may be due to the limestone habitat of *var. vinkii* and *var. brassii* (plants of *S. heterocarpus* on limestone are densely glandular), also their short caudex. But there is no evidence that LEDERMANN's type did not grow on limestone. When more information is available it may be better to regard *var. vinkii* and *var. brassii* as representing a distinct species, for which COPELAND's epithet *strigosissimus* would be available.

56. Sphaerostephanos hastatopinnatus (BRAUSE) HOLTTUM, *comb. nov.* — *Dryopteris hastatopinnata* BRAUSE, Bot. Jahrb. 56 (1920) 112. — *Thelypteris hastatopinnata* (BRAUSE) REED, Phytologia 17 (1968) 281. — Type: LEDERMANN 8237, N.E. New Guinea, Sepik Distr., 200 m on rocks in stream-bed in forest (B; K).

Plants varying much in size according to habitat. *Caudex* erect, short. *Stipe* 3–4 cm on type, to

15 cm on large plant. *Lamina* of type 45 cm long, of large plant 130 cm; pinnae 28 pairs on type, 35 pairs on large plant; 10–20 pairs lower pinnae in all cases gradually smaller, lowest 5–10 mm long; apex of frond almost pinna-like; aerophores distinctly swollen, to almost 1 mm long in large fronds. *Reduced pinnae* broadly and symmetrically triangular, spreading, subentire. *Largest pinnae* of type 10 × 1.3 cm, of a large plant 20 × 3.0 cm; base truncate, dilated and more or less auricled both sides (upper ones auricled on acroscopic side only), apex short-acuminate, edges sinuous or slightly crenate; costules of small plants 2.5–3 mm apart, of a large one to 4.5 mm, at more than 60°; veins 3–7 pairs, almost all anastomosing; sinus-membrane hardly developed; *lower surface* of pinnae quite glabrous or with a few hairs on costae, glands sometimes present on and between veins; hairs on *upper surface* of costae slender, brown, to 0.5 mm long, none elsewhere, a few glands rarely present. Lower surface of *rachis* glabrous or with sparse appressed hairs, upper surface bearing copious red-brown hairs 1 mm long. *Sori* medial, lower ones ± elongate and sometimes confluent; no indusia; sporangia bearing glands.

Distr. *Malesia*: Central Celebes, Moluccas (Ceram) and widely distributed in New Guinea.

Ecol. On river banks in forest at low altitudes, up to 650 m. The type was probably stunted owing to its rocky habitat and perhaps exposed position.

57. Sphaerostephanos latebrosus (KUNZE *ex* METT.) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 209. — *Aspidium latebrosum* KUNZE *ex* METT. Farngatt. IV (1858) 104; BAK. Syn. Fil. (1867) 294; MIQUEL, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 159. — *Dryopteris latebrosa* (METT.) C. CHR. Ind. Fil. (1905) 274; v.A.v.R. Handb. (1908) 221. — *Thelypteris latebrosa* (METT.) REED, Phytologia 17 (1968) 287. — Type: ZOLLINGER 354 pt, Java (L, *n.* 908, 333–517 only).

Nephrodium glaucostipes BEDD. Handb. Suppl. (1892) 80. — *Dryopteris glaucostipes* (BEDD.) C. CHR. Ind. Fil. (1905) 268; Gard. Bull. Str. Settl. 4 (1929) 389; v.A.v.R. Handb. (1908) 226. — *Cyclosorus heterocarpus var. glaucostipes* (BEDD.) HOLTTUM, Rev. Fl. Mal. 2 (1955) 271. — *Thelypteris heterocarpus var. glaucostipes* (BEDD.) REED, Phytologia 17 (1968) 282. — Type: KING's Collector (KUNSTLER) 2046, Perak, Larut (K; CAL, SING).

Dryopteris todayensis CHRIST, Philip. J. Sci. 2 (1907) Bot. 193; v.A.v.R. Handb. Suppl. (1917) 184. — *Cyclosorus todayensis* (CHRIST) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 249; COPEL. Fern Fl. Philip. (1960) 344. — *Thelypteris todayensis* (CHRIST) REED, Phytologia 17 (1968) 319. — *Sphaerostephanos todayensis* (CHRIST) HOLTTUM, Kalikasan 4 (1975) 58. — Type: COPELAND 1463, Mindanao, Mt Apo 1220 m (P; US, B).

Dryopteris angustipes COPEL. Philip. J. Sci. 7 (1912) Bot. 60; v.A.v.R. Handb. Suppl. (1917) 184. — *Thelypteris angustipes* (COPEL.) REED, Phytologia 17 (1968) 260. — Type: BROOKS 110, Sarawak (MICH; BM).

Cyclosorus sagittifolioides COPEL. Philip. J. Sci. 81 (1952) 29, 30, pl. 21; Fern Fl. Philip. (1960) 344. — *Thelypteris sagittifolioides* (COPEL.) REED, Phytologia 17 (1968) 311. — Type: EDAÑO BS 24832, Samar, Catubig River (US).

Cyclosorus halconensis COPEL. Philip. J. Sci. 81 (1952) 29; Fern Fl. Philip. (1960) 345. — *Thelypteris halconensis* (COPEL.) REED, Phytologia 17 (1968) 305. — Type: EDAÑO PNH 3849, Mindoro, Mt Halcon (MICH; L).

Cyclosorus polypterus COPEL. Philip. J. Sci. 84 (1955) 161. — *Thelypteris polyptera* (COPEL.) REED, Phytologia 17 (1968) 305. — Type: EDAÑO 7852 (PNH 21373), Negros, Canlaon Volcano 650 m (MICH).

Caudex erect, not or little branched at base. *Stipe* 6–12 cm long; base of stipe to first large pinna 45–70 cm. *Reduced pinnae* 10–15 pairs, 2.5–4 cm apart, lowest commonly 5 mm long, gradually increasing upwards to 2.5–3 cm, larger ones narrowly triangular, somewhat deflexed, with acroscopic auricle, edges incised, apex broad-pointed; transition to large pinnae subabrupt; aerophores elongate, in some cases 1 mm or rarely more (type of *C. sagittifolioides*). *Lamina* above reduced pinnae to 60 cm or more long; basal large pinnae not narrowed at base. *Rachis* lower surface commonly quite glabrous, in some specimens with sparse long hairs or some very short ones; hairs on upper surface to 1 mm long, usually appressed (spreading in some Philippine specimens). *Largest pinnae* 12 × 1.6 to 20 × 2.0 cm; base truncate, usually a little dilated both sides; apex acuminate; edges lobed about half-way to costa or a little more in large pinnae; costules 3.5–4.5 mm apart; veins 7–8 pairs, basal pair anastomosing, one or both of next pair to sinus-membrane; *lower surface* of costae usually glabrous at base with very short antrorse hairs distally, in some cases very short hairs and a few somewhat longer throughout; costules as costae but with shorter hairs (if any); rest of lower surface usually quite glabrous with many glands; *upper surface* with long hairs on costae, similar hairs scattered on costules and veins, rest of surface bearing a variable number of fine appressed short hairs. *Sori* medial, lower ones not divergent; indusia glabrous or with a few short hairs, usually also glands; sporangia bearing glands, rarely a seta; spores with many very small wings.

Distr. *Malesia*: Western Malesia, Philippines.

Ecol. In forest, low altitudes to 800 m.

Notes. In Malaya, Sumatra and Java all lower surfaces are almost glabrous, but in nearly all

cases there are short hairs on distal parts of costae; aerophores are little elongate. In Sabah (Mt Kinabalu) and the Philippines some hairs are nearly always present and aerophores are more developed. In the type of *Cyclosorus sagittifolioides* some aerophores are 2 mm long, and short erect hairs are present on lower surface between veins.

Some Philippine specimens seem rather intermediate between this species and *S. hirsutus*; they may be hybrids. Hybrids with *S. heterocarpus* in Sabah are also possible. The solitary erect caudex of *S. latebrosus*, large upper reduced pinnae and broad base of lowest normal pinnae seem distinctive.

58. Sphaerostephanos porphyricola (COPEL.) HOLTTUM, Kalikasan 4 (1975) 59. — *Dryopteris porphyricola* COPEL. Philip. J. Sci. 7 (1912) Bot. 60; v.A.v.R. Handb. Suppl. (1917) 186. — *Thelypteris porphyricola* (COPEL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 287, *nomen tantum*. — *Cyclosorus porphyricola* (COPEL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 248; HOLTTUM, Rev. Fl. Malaya 2 (1955) 271. — Type: BROOKS 112, Sarawak, Bau (MICH; BM).

Dryopteris angustipes sensu C. CHR. Gard. Bull. Str. Settl. 4 (1929) 389.

Caudex erect, short. *Stipe* 10 cm long; base of stipe to first large pinna 35 cm. *Reduced pinnae* to 12 pairs, 1.5 cm apart, uppermost 1–1.5 cm long, deflexed, narrowly triangular with auricle on acroscopic base, edges incised, lowest ones 3–5 mm long. *Lamina* 55 cm long; pinnae to 20 pairs or more, lowest ones narrowed a little at base on basiscopic side only; aerophores elongate, to less than 1 mm long; young fronds covered with mucilage. Lower surface of *rachis* almost glabrous or with very short hairs, also many glands; upper surface copiously hairy. *Largest pinnae* 14 × 2.5 cm (sterile to 15 × 3 cm), base subtruncate, apex abruptly short-acuminate; edges lobed 2/5 to costa, lobes distinctly falcate with forward-pointing tips; costules 3–4.5 mm apart; veins 7–9 pairs, 1 pair anastomosing, next pair to sinus-membrane; *lower surface* of costae, costules and veins covered with fine short closely appressed hairs, also glands; surface between veins bearing copious glands and a variable number of short fine appressed hairs; hairs on *upper surface* of costae antrorse, pale, similar hairs sometimes scattered on costules and veins, surface between veins typically covered closely with slender appressed hairs 0.5 mm long, fewer such hairs on specimens from Malaya. *Sori* medial, lower ones not divergent but sometimes a little elongate; indusia bearing short hairs and glands; sporangia with glands.

Distr. *Malesia*: Malaya and Borneo (Sarawak; Sulu Arch.: Tawi-Tawi).

Ecol. In forest at low altitudes.

Note. This is closely allied to *S. latebrosus*; more field observations are needed.

59. Sphaerostephanos caulescens HOLTTUM, *sp. nov.* — *Dryopteris porphyricola* (*non* COPEL.) C. CHR. Gard. Bull. Str. Settl. 7 (1934) 244.

Caudex erectus; *stipes 5 cm longus*; *pinnae redactae usque 8-jugatae, omnes minutae*; *aerophora 1 mm longa*; *pinnae majores* 13.5 × 1.5–2.0 *cm, dimidio costam versus lobatae*; *rachis subtus fere glabra*; *pagina inter venas subtus glandulifera, supra pilis appressis vestita*; *indusia fere glabra*; *sporangia glandulifera*. — Type: G. P. LEWIS 284, Sarawak, G. Mulu (K).

Caudex erect, to at least 20 cm tall. *Stipe* 5 cm long, base covered with large thin scales; base of stipe to first large pinna 40 cm. *Reduced pinnae* to 8 pairs, when young covered with mucilage, all very small, with aerophores 1 mm long. Lower surface of *rachis* often bearing narrow scales, otherwise almost glabrous, upper surface with hairs 1 mm long closely appressed, with some longer and spreading. *Lamina* to 75 cm long; pinnae to more than 30 pairs, not opposite; basal pinnae (at least sterile ones) narrowed at their bases. *Largest fertile pinnae* 13.5 × 2.0 cm (sterile sometimes larger, to 20 × 3 cm); base truncate; apex acuminate (sometimes with cauda 1.5 cm long); edges lobed about $\frac{1}{2}$ way to costa; costules *c.* 3.5 mm apart, at 60°; veins *c.* 7 pairs, 1 pair anastomosing, next pair to sides of sinus-membrane; *lower surface* of costae almost glabrous at base, with appressed hairs to 0.2 mm long distally, costules similar, surfaces between veins bearing copious glands; hairs on *upper surface* of costae to 1 mm long, similar hairs scattered on costules and veins, short appressed hairs on surface between veins. *Sori* medial, lower ones not divergent; indusia glabrous or with few very short hairs; sporangia bearing glands.

Distr. *Malesia*: Borneo (N. Sarawak; Sabah), N. Celebes, and Moluccas (Batjan).

Ecol. In forest near streams at 500–1500 m.

Note. This is near *S. magnus*, but pinnae of *S. caulescens* (except largest sterile ones) are generally smaller and less deeply lobed, with different pubescence and glandular sporangia.

60. Sphaerostephanos reconditus HOLTTUM, *sp nov.*

Pinnae redactae c. 6-jugatae, parvae; *pinnae normales usque* 7.2 × 1.5 *cm, dimidio costam versus lobatae*; *venae 5–6-jugatae, infimae solum anastomosantes*; *costulae subtus pilis adpressis vestitae*; *pagina inferior inter venas pilis adpressis glandulisque praedita*; *sori mediales*; *indusia dense pilosa*; *sporangia copiose glandulifera*. — Type: B. S. PARRIS 6872, Sarawak, Gunong Mulu (CGE).

Caudex short, erect or suberect; *stipe* 5 cm long; base of stipe to first normal pinna 30 cm;

reduced pinnae all very small, 3–4 cm apart. *Lamina* excluding reduced pinnae 30 cm long; pinnae c. 12 pairs; basal pinnae much narrowed in basal third, above base 2 cm wide; aerophores when dried barely 0.5 mm long, on living plant "yellow". Lower surface of *rachis* densely hairy, hairs thick, curved, brown, 1 mm long with shorter pale ones (brown hairs more numerous on basal part); upper surface with thicker brown hairs and shorter pale ones. *Suprabasal pinnae* to 7.2× 1.5 cm; base truncate and slightly auricled; apex short-acuminate; edges lobed not quite half-way to costa; costules 3.5–4.5 mm apart, at c. 60°; veins 5–6 pairs, hardly prominent, 1 pair anastomosing, next acroscopic vein or pair passing to sinus-membrane; *lower surface* of costae bearing pale antrorse hairs which are appressed distally, 0.5 mm long, also glands, costules covered with slender appressed hairs, between veins some appressed hairs and rather sparse glands; *upper surface* of costae bearing pale hairs, no long hairs on costules or veins, between veins sparse appressed hairs. *Sori* medial or a little inframedial, lower ones not divergent; indusia densely hairy, sometimes with a gland; sporangia bearing many glands.

Distr. *Malesia*: Borneo (Sarawak: Mt Mulu), only known from type.

Ecol. In forest clearing in Hidden Valley at 450 m; very young fronds covered with mucilage.

61. Sphaerostephanos cyrtocaulos (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris cyrtocaulos* v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 201. — *Thelypteris cyrtocaulos* (v.A.v.R.) REED, Phytologia 17 (1968) 270. — Lectotype (here selected): BÜNNEMEIJER 9922, Sumatra, G. Kerinci, 2100 m (BO; L).

Caudex erect. *Stipe* 10–15 cm long; base of stipe to first large pinna 40–75 cm. *Reduced pinnae* 8 pairs or more, 2–3 mm long; aerophores to 2 mm long. *Lamina* to 75 cm long; pinnae more than 20 pairs, well spaced; lowest pinnae not narrowed at base, nor auricled. Hairs on both sides of *rachis* short. *Largest pinnae* of lectotype 12× 2.5 cm (possibly larger on sterile fronds); base truncate; apex acuminate with cauda to 1.5 cm; edges lobed to 2.5–3 mm from costa (about 3/4), lobes slightly falcate; costules 4–4.5 mm apart at more than 60°; veins 8–11 pairs, basal pair anastomosing, next pair both to edge above base of sinus; hairs on *lower surface* of costae and costules 0.2 mm long, appressed, a few also on veins, glands present on and between veins; hairs on *upper surface* of costae 1 mm long, antrorse, similar hairs scattered on costules and veins, pale appressed hairs over whole surface. *Sori* rather supramedial; indusia firm, rather large, with short hairs; sporangia bearing glands; spores densely short-spinulose.

Distr. *Malesia*: Sumatra (on and near G. Kerinci), 1800–2300 m, in forest.

Note. VAN ALDERWERELT cited three collections by BÜNNEMEIJER without indicating a type; the largest one is here selected. One other collection is known from a neighbouring locality.

62. Sphaerostephanos baramensis (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris baramensis* C. CHR. Gard. Bull. Str. Settl. 7 (1934) 246. — *Thelypteris baramensis* (C. CHR.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 287. — Type: MJÖBERG 5 partim, Sarawak, Baram Valley, 900–1200 m (BM). — **Fig. 13f–g.**

Caudex short, erect. *Stipe* 5–10 cm long, basal scales thin, to 2 mm wide at base; base of stipe to first large pinna 40–60 cm. *Reduced pinnae* to 10 pairs, 4–6 cm apart, c. 2 mm long, with aerophores c. 1 mm long. *Lamina* to at least 70 cm long; pinnae to 20 pairs, lower ones often opposite, upper ones usually not; 3–4 pairs lower pinnae much narrowed towards their bases; middle pinnae often distinctly stalked; aerophores 1–2 mm long. Lower surface of *rachis* glabrous; hairs on upper surface less than 1 mm long, brown, appressed. *Largest pinnae* commonly 15× 2.5 cm, largest on type 24× 4 cm; apex of wider pinnae rather abruptly caudate-acuminate; edges lobed to 3 mm from costa; lobes falcate; costules commonly 4 mm apart, on large fronds to 7 mm; veins 10–12 pairs, prominent on lower surface, tips of basal veins touching sides of short sinus-membrane or sometimes uniting just below the sinus to form a short excurrent vein; *lower surface* of costae and costules covered with antrorsely curved hairs 0.2–0.3 mm long, those on costules closely appressed; surface between veins bearing a variable number of small glands and short appressed hairs; *upper surface* of costae bearing pale antrorse hairs less than 1 mm long, hairs on costules much shorter, surface between veins of type covered with short appressed hairs, of other specimens glabrous or with appressed hairs near costa only. *Sori* a little supramedial; indusia rather large, firm, glabrous or with short hairs; sporangia sometimes with a small gland, not setiferous.

Distr. *Malesia*: Borneo (Northern Sarawak, E. Kalimantan and Sabah), in forest at 900–1500 m.

63. Sphaerostephanos batulantensis HOLTTUM, *sp nov.*

Caudex brevis, repens; *stipes* 10 *cm longus*; *pinnae redactae usque* 10-*jugatae, superiores* 4–5 *mm longae*; *pinnae maximae* 11× 1.5 *cm*, 2/3 *costam versus lobatae*; *costulae subtus pilis brevibus appressis vestitae, pagina inter venas glandulifera*; *pagina superior omnino pilis appressis vestita*; *sporangia glandulifera*. — Type: KOSTERMANS 18850, W. Sumbawa, Mt Batulante, 900 m (L; BO, K).

Caudex short, prostrate, c. 5 mm diameter. *Stipe* 10 cm long; base of stipe to first large pinna 40 cm or more. *Reduced pinnae* to 10 pairs, upper ones

4–5 mm long. *Lamina* 45 cm long; lowest pinnae narrowed to a base 5 mm wide; aerophores hardly 1 mm long. Lower surface of *rachis* densely covered with pale erect hairs 0.3 mm long, hairs on upper surface to 1 mm long, pale. *Largest pinnae* 11 × 1.5 cm; base subtruncate, not auricled; apex acuminate; edges lobed 2/3 to costa or a little more deeply, lobes falcate; costules 3–4 mm apart, at more than 60°; veins 8–9 pairs, basal pair anastomosing, next acroscopic vein sometimes to sinus-membrane; *lower surface* of costae hairy as rachis, hairs on distal part longer and antrorse; lower surface of costules covered with short appressed hairs; surface between veins bearing glands and a few short erect hairs; *upper surface* covered entirely with fine appressed hairs, no long hairs on costules or veins. *Sori* a little inframedial, lower ones not divergent; indusia thin with many hairs 0.3 mm long; sporangia bearing glands.

Distr. *Malesia*: Lesser Sunda Is. (W. Sumbawa: Mt Batulante, 900 m); only known from the type.

64. Sphaerostephanos subalpinus (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris subalpina* v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 200. — *Thelypteris subalpina* REED, Phytologia 17 (1968) 317. — Type: BEGUIN 1496, Ternate, N. Formadjahi, 1200 m (BO; L).

Polypodium acutum ROXB. Calc. J. Nat. Hist. 4 (1844) 492, *non* BURM. *f.*; MORTON, Contr. U.S. Nat. Herb. 38 (1974) 335. — Type: "Amboina" (probably C. SMITH, Ceram).

Aspidium hispidulum DECNE *var. ternatense* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 160. — Type: TEYSMANN, Ternate (L).

Caudex short, creeping. *Stipe* 10 cm long; base of stipe to first large pinna 30–35 cm. *Reduced pinnae* 1.5–2.0 cm apart, *c.* 10 pairs, upper ones 1.5 cm long, deflexed, narrowly triangular, deeply lobed, with basiscopic auricle to 10 mm long, lowest 5 mm long. *Lamina* 60–70 cm long; pinnae to 30 pairs, basal ones not narrowed at base; aerophores *c.* 1 mm long. Lower surface of *rachis* covered with very short hairs and sparse longer ones to 1 mm long; hairs on upper surface pale or brownish, to 1 mm long. *Largest pinnae* to 15 × 2.0 cm, base subtruncate and a little dilated both sides; apex caudate-acuminate; edges lobed to 2 mm from costa, lobes falcate, narrowed above their bases; costules to 4 mm apart; veins 8–10 pairs, basal pair anastomosing near base of pinna, near apex both touching sides of short sinus-membrane; hairs on *lower surface* of costae near base 0.2–0.3 mm long, suberect, distally to 0.7 mm, hairs on costules similar, glands present throughout lower surface; hairs on *upper surface* of costa mostly less than 1 mm long, with scattered longer ones, similar longer hairs scattered on costules and veins; a few appressed hairs sometimes present between veins. *Sori* a little supramedial, basal ones not divergent; indusia fairly large, with a few short hairs and sometimes glands; sporangia with 1–2 glands.

Distr. *Malesia*: Moluccas (Ternate, several collections; Halmahera; Ceram?).

65. Sphaerostephanos lobatus (COPEL.) HOLTTUM, Kalikasan 4 (1975) 64. — *Cyclosorus lobatus* (COPEL.) COPEL. Philip. J. Sci. 81 (1952) 33; Fern Fl. Philip. (1960) 356. — *Thelypteris lobata* (COPEL.) REED, Phytologia 17 (1968) 289. — Type: COPELAND 1966, Luzon, Baguio (MICH).

Dryopteris canescens var. lobata CHRIST, Philip. J. Sci. 2 (1907) Bot. 198, *quoad* COPELAND 1866 (1966).

Cyclosorus bordenii sensu COPEL. Fern Fl Philip. (1960) 345, *p.p.*

Caudex short, creeping. *Stipe* 5–8 cm long; base of stipe to first large pinna 40 cm or more (shorter on sterile fronds). *Reduced pinnae* 4–8 pairs, all very small with thick aerophores 1 mm long. *Lamina* commonly to 35 cm long; pinnae to *c.* 16 pairs; basal pinnae much narrowed towards their bases. *Rachis* bearing thick curved dark red hairs to 1 mm long on both surfaces. *Largest suprabasal pinnae* acuminate, to 15 × 1.7 cm (basal pinnae to 2 cm wide) on larger plants, on type abruptly short-pointed, *c.* 8 × 1.7 cm, lobed 2/3–3/4 to costa; costules to 4 mm apart; veins 7–9 pairs, basal pair anastomosing, next pair both to edge; hairs on *lower surface* of costae at base 0.1–0.2 mm, distally to almost 1 mm long, not appressed; hairs on costules sparse; copious glands on surface between veins; hairs on *upper surface* of costae less than 1 mm long, scattered similar hairs on costules and veins at least distally on pinna-lobes, surface between veins bearing a variable number of fine appressed hairs. *Sori* inframedial; indusia small, glabrous or with a few glands; sporangia bearing glands.

Distr. *Malesia*: Philippines (Luzon, many collections), in forest at 700–1000 m.

Note. On Mt Makiling a large form of this species, above described, is common. On mountains further north are plants (including the type) with shorter abruptly pointed pinnae but closely similar in pubescence and in reduced pinnae to the plants on Mt Makiling. COPELAND placed most of the Mt Makiling plants in *Cyclosorus bordenii* (here included in *Sphaerostephanos heterocarpus*). He failed to notice the reduced basal pinnae of the type of *C. lobatus*. The plants here named *S. sessilipinna* and *S. urdanetensis* are very similar to the type of *S. lobatus* except in size of pinnae.

66. Sphaerostephanos ellipticus (ROSENST.) HOLTTUM, Kalikasan 4 (1975) 66. — *Dryopteris elliptica* ROSENST. Meded. Rijksherb. Leiden *n.* 31 (1917) 6. — *Cyclosorus ellipticus* (ROSENST.) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 351, *nomen tantum.* — *Thelypteris elliptica*

(ROSENST.) REED, Phytologia 17 (1968) 274. — Type: ELMER 13976 *partim*, Mindanao, Mt Urdaneta (L, *n.* 914, 130–95; FI, G, K, U).

KEY TO THE VARIETIES

1. Basal veins free on distal part of pinnae; lower surface of rachis hairy . . . **a. *var.* ellipticus**
1. Basal veins not free in distal part of pinnae; lower surface of rachis almost glabrous **b. *var.* glabrior**

a. *var.* ellipticus

Caudex short, probably erect. *Stipe* 4–7 cm long, covered with very short hairs; base of stipe to first large pinna 35 cm. *Reduced pinnae* to 6 pairs, 3–4 cm apart, uppermost 3–5 mm long, lowest 2 mm or less. *Lamina* 45 cm long; pinnae to 18 pairs; basal pinnae slightly narrowed at base; aerophores hardly 1 mm long. Lower surface of *rachis* covered with very short hairs and rather sparse ones to 1 mm long; upper surface with uniform hairs 1 mm. *Largest pinnae* 8.5 × 1.6 cm, base truncate, apex short-acuminate, edges lobed 2/3 towards costa; costules 3.5 mm apart, at more than 60°; veins 8–9 pairs, basal pair near base of pinnae anastomosing with short excurrent vein to sinus, near apex of pinnae just meeting at the sinus-membrane; *lower surface* of costae hairy as rachis but longest hairs less than 1 mm, hairs on costules sparse, between veins very short erect hairs and glands; hairs on *upper surface* of costae 1 mm long, similar or shorter hairs scattered on costules and veins, short appressed hairs copious to rather sparse between veins. *Sori* inframedial; indusium firm with short stiff hairs; sporangia sometimes with glands.

Distr. *Malesia*: Philippines (Mindanao), only known from type.

Note. ELMER's *n.* 13976 included specimens of another species *S. norrisii*; COPELAND's description of 1960 applies to the latter.

b. *var.* glabrior HOLTTUM, *var. nov.*

A speciei typica differt: pinnis 3/5 costam versus lobatis; venis semper anastomosantibus; rachidi subtus fere glabra; costis subtus pilis 0.1–0.2 mm longis praeditis. — Type: M. G. PRICE 2558, Negros Oriental, Amlan, near river, 600–800 m (K).

Distr. *Malesia*: Philippines (Negros Oriental), only known from the type.

67. Sphaerostephanos foxworthyi HOLTTUM, *sp. nov.*

S. elliptico (Rosenst.) Holttum affinis, differt: pinnis redactis omnibus minutis; pinnis evolutis inferioribus basin versus valde angustatis. — Type: FOXWORTHY BS 2441, Luzon, Tayabas Prov. Mt Banajao (K).

Caudex short, creeping. *Stipe* 12 cm long, glabrescent; scales broad and thin; base of stipe to first large pinna 36 cm. *Reduced* pinnae 5 pairs, each consisting of an aerophore without detectable blade. *Lamina* 50 cm long; pinnae *c.* 20 pairs; lowest 2 pairs much narrowed towards their bases; aerophores thick, to 1 mm long. *Rachis* bearing pale, erect hairs 0.2 mm long on lower surface, not dense. *Largest pinnae* 13 × 1.8 cm; base subtruncate; apex acuminate, sometimes with cauda 1–2 cm long; edges lobed 2/3–3/4 to costa; costules 4–4.5 mm apart, at 60°; veins 9 pairs, 1 pair anastomosing, next pair usually both to margin; *lower surface* of costae near base bearing erect hairs 0.1–0.2 mm long, distally hairs to 0.4 mm, antrorsely curved, not appressed, hairs on costules few, between veins many glands, not hairs; *upper surface* of costae bearing antrorse hairs less than 1 mm long, rest of surface covered with fine appressed hairs 0.2–0.3 mm long. *Sori* medial, lower ones divergent; indusia thin with glands and a few short hairs; sporangia bearing glands.

Distr. *Malesia*: Philippines (Luzon), only known from the type.

68. Sphaerostephanos indrapurae HOLTTUM, *sp. nov.*

Pinnae redactae usque 10-jugatae, superiores 3 mm longae, aerophoris elongatis praeditae; pinnae steriles usque 13 × 2.3 cm, fertiles 9 × 1.7 cm, c. 2/5 costam versus lobatae; rachis subtus glabra, costae costulaeque pilis appressis vestitae; pagina inter venas glandulifera; pagina superior inter venas glabra; indusia glabra, sporangia glandulifera. — Type: C. G. MATTHEW 655, Sumatra, G. Kerinci 1500 m (BO; K).

Stipe 10 cm long; base of stipe to first large pinna 50 cm. *Reduced pinnae* 10 pairs, blade of largest 3 mm long, with elongate aerophore. *Lamina* 50–60 cm long; pinnae *c.* 20 pairs, several lower pairs much narrowed towards their bases, only upper ones truncate to full width at base. *Rachis* glabrous on lower surface; hairs on upper surface slender, less than 1 mm long. *Largest pinnae* 13 × 2.3 cm (sterile), 9 × 1.7 cm (fertile), lobed *c.* 2/5 towards costa, lobes with blunt forward-pointing tips; apex abruptly short-acuminate; costules 5 mm (sterile) 4 mm (fertile) apart; veins 6–8 pairs, basal pair anastomosing, one or both of next pair ending at sinus-membrane; *lower surface* of costae and costules covered with fine closely appressed hairs 0.2–0.4 mm long, surface between veins bearing glands; hairs on *upper surface* of costae 0.5 mm long, sparse very short ones on costules, no others. *Sori* medial, lower ones a little divergent; indusia glabrous; sporangia bearing glands.

Distr. *Malesia*: Central Sumatra (Mt Kerinci), 1500 m, only known from the type.

69. Sphaerostephanos batacorum (ROSENST.)

HOLTTUM, *comb. nov.* — *Dryopteris batacorum* ROSENST. Fedde Rep. 13 (1914) 217, *excl. var. winkleri*; v.A.v.R. Handb. Suppl. (1917) 185. — *Thelypteris batacorum* (ROSENST.) REED, Phytologia 17 (1968) 263. — Type: J. WINKLER 158, Sumatra, Batak Lands (S-PA).

Dryopteris stipellata var. obtusata v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 151. — Syntypes: BROOKS 277, Sumatra, Lebong Tandai; 249, Tambang Sawah (BO; BM). — **Fig. 13h–k.**

Caudex short; erect (?). *Stipe* 5–10 cm long; base of stipe to first large pinna 30–50 cm. *Reduced pinnae* to 20 pairs, 1.5–2 cm apart, deflexed, largest 1.5–2 cm long, 8 mm wide, with acroscopic auricle 8 mm long, edges shallowly lobed, apex broadly obtuse. *Lamina* to 60 cm long; pinnae to 30 pairs, basal ones sometimes narrowed a little at base on basiscopic side; aerophores thick, to 2 mm long. *Rachis* beneath bearing short pale appressed or ± spreading hairs 0.1–0.2 mm long, hairs on upper surface 1 mm long. *Largest pinnae* 9 × 1.6 cm; base truncate; apex abruptly short-pointed; edges lobed 1/3–2/5 to costa; costules 3–3.5 mm apart; veins to 8 pairs, basal pair anastomosing, one or both of next pair to sinus-membrane; hairs on *lower surface* of costa and costules pale, closely appressed, 0.2–0.3 mm long; surface between veins bearing glands which in some specimens are sparse (most abundant on reduced pinnae); hairs on *upper surface* of costae less than 1 mm long, sometimes no long hairs on costules, rest of upper surface glabrous. *Sori* medial; indusia rather large, glabrous, sometimes with a few glands; sporangia sometimes with a gland.

Distr. *Malesia*: Sumatra, several collections, at 850–1000 m.

Note. The type is a small specimen; the above description is prepared partly from larger specimens collected on G. Singgalang and G. Kerinci which agree in shape and pubescence of frond and of reduced pinnae.

70. Sphaerostephanos angustibasis HOLTTUM, *sp. nov.*

Caudex erectus, gracilis; pinnae redactae 6-jugatae, superiores 5 mm longae, auriculatae; aerophora elongata; pinnae usque 9.5 × 2.1 cm, inferiores basi angustatae, 2/3 costam versus lobatae; costae subtus patenti-pilosae; pagina inter venas subtus glandulosa; indusia sporangiaque glandulifera. — Type: ALSTON 16724, Tidore, G. Kiematuba (BM).

Caudex slender, to 20 cm tall. *Stipe* 15 cm long, short-hairy; base of stipe to first large pinna 60 cm. *Reduced pinnae c.* 6 pairs, subopposite, upper ones 5 mm long, deflexed, narrow, with basal acroscopic auricle 4 mm long. *Lamina* 38 cm long; pinnae to 15 pairs, almost all opposite, lower 3–4 pairs narrowed towards their bases, basal pair 5–7 mm wide at base; aerophores 1 mm long. Lower surface of *rachis* bearing curved brown hairs and very short ones, brown hairs on upper surface more uniform. *Largest pinnae* 9 × 2.1 cm, base truncate, apex short-acuminate, edges lobed up to 2/3 towards costa, lobes slightly falcate; costules 5 mm apart, at more than 60°; veins 7–8 pairs, all at a wide angle to costule, pale and prominent both sides, basal pair anastomosing, next pair both to edge; most hairs on *lower surface* of costae minute, with some longer, erect, on costules all short, glands present throughout lower surface; *upper surface* of costae covered with brown hairs, similar hairs scattered on costules and veins, surface between veins glabrous. *Sori* medial; indusia small, with glands and a few hairs; sporangia with many glands, sometimes also with a seta; spores with many small wings.

Distr. *Malesia*: Moluccas (Tidore), only known from the type.

71. Sphaerostephanos nudisorus HOLTTUM, *sp. nov.*

Pinnae redactae 12-jugatae, superiores 3 mm longae; aerophora 2 mm longa; pinnae normales usque 15 × 1.8 cm, profunde lobatae; rachis subtus glabra, costae subtus pilis minutis erectis praeditae; pagina inter venas subtus glandulifera, supra glabra; sori mediales, exindusiati; sporangia nec glandulis nec setis praedita. — Type: T. G. WALKER 12269, Central Celebes (BM).

Caudex not known. *Stipe* 5 cm long, glabrous; base of stipe to first large pinna 50 cm. *Reduced pinnae c.* 12 pairs, upper ones 3 mm long, with aerophores 2 mm long. *Lamina* 95 cm long; pinnae *c.* 40 pairs, lowest not narrowed at base; one pair of intermediate length between normal and reduced pinnae. Lower surface of *rachis* bearing glands and small scales only, upper surface covered with hairs 1 mm long. *Largest pinnae* 15 × 1.8 cm; base truncate with basal acroscopic lobe 2 mm longer than next; apex acuminate with cauda 1.5–2 cm long; edges lobed to 2 mm from costa, lobes oblong, hardly falcate, with rounded ends; costules 4 mm apart, at more than 60°; veins 8 pairs, basal pair anastomosing near base of pinna, near apex just meeting at the sinus; hairs on *lower surface* of costae very short, erect, glands abundant all over lower surface; hairs on *upper surface* of costae 1 mm long, similar hairs scattered on costules and veins, rest of upper surface glabrous. *Sori* medial, exindusiate; neither glands nor setae on sporangia; spores minutely spinulose.

Distr. *Malesia*: Central Celebes, only known from the type.

72. Sphaerostephanos paripinnatus (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris paripinnata* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Cyclosorus paripinnatus* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 448, pl.

28. — *Thelypteris paripinnata* (COPEL.) REED, Phytologia 17 (1968) 302. — Type: BRASS 12435, New Guinea, Idenburg River (MICH; BO, L).

Caudex probably erect. *Stipe* 10 cm long, glabrous, basal scales narrow; base of stipe to first large pinna 60 cm. *Reduced pinnae* to 10 pairs, each consisting of an aerophore 2 mm long and a minute blade; transition to normal pinnae abrupt. *Lamina* to 75 cm long; apical section long and deeply lobed with gradual transition to pinnae; pinnae 20 pairs, their ends much upcurved, subcoriaceous. *Largest pinnae* 21 × 2.5 cm; base truncate to subcordate, apical 3–5 cm gradually attenuate and crenate, middle part lobed more than $\frac{1}{2}$ way to costa, lobes somewhat narrowed, not falcate; costules to 6 mm apart, almost at right angles to costa; veins 11–12 pairs, at a very wide angle to costule, basal pair anastomosing, next pair both to sides of short sinus-membrane; *lower surface* of rachis, costae and costules with spreading hairs 0.4 mm long, shorter erect hairs and glands between veins; hairs on *upper surface* of costa 1 mm long, similar hairs scattered on costules and veins, no hairs nor glands between veins. *Sori* medial, basal ones divergent; no indusia; sporangia lacking hairs and glands on body, hairs on stalk with yellow gland, often 2; spores not seen.

Distr. *Malesia*: W. New Guinea. Only known from the type.

Ecol. At 1700 m, "a large clump-fern common in rain-forest gullies".

73. Sphaerostephanos novae-britanniae HOLTTUM, *sp. nov.*

Caudex erectus; *pinnae redactae 7-jugatae, superiores 7 mm longae*; *pinnae normales oppositae, usque 8 × 1.2 cm, 2/3 costam versus lobatae*; *venae infimae raro anastomosantes*; *costae subtus pilis erectis praeditae*; *pagina inter venas subtus glandulifera, supra pilis brevibus suberectis praedita*; *indusia brevi-pilosa, sporangia glandulifera.* — Type: STEVENS & LELEAN LAE 58644, New Britain, Subdistr. Pomio, 890 m (K).

Caudex erect, to 15 cm tall. *Stipe* 4 cm long, scales at base thin, 8 × 1 mm, closely setiferous; base of stipe to first large pinna 27 cm. *Reduced pinnae* 3 cm apart, *c.* 7 pairs, uppermost 7 mm long, 5 mm wide at slightly asymmetric base, edges lobed, apex acute. *Lamina* 40 cm long; pinnae 22 pairs, almost all opposite, basal ones with 3 basal lobes gradually smaller, base 6 mm wide, not auricled; aerophores not elongate. Hairs on lower surface of *rachis* 0.3–0.4 mm long, erect, on upper surface more than 0.5 mm long. *Largest pinnae* 8 × 1.2 cm; base broadly cuneate, apex acuminate with cauda 10 × 2 mm; edges lobed 2/3 to costa; costules 2.5 mm apart, at 60°; veins to 7 pairs, basal veins either meeting just below the short sinus-membrane or touching its sides, rarely joining to form an excurrent vein below the sinus; hairs on *lower surface* of costae as rachis, few on costules, surface between veins densely glandular with some short erect hairs; hairs on *upper surface* of costae pale, more than 0.5 mm long, similar hairs scattered on costules and veins, surface between veins bearing suberect hairs 0.2 mm long and sometimes a few glands. *Sori* inframedial, basal ones not divergent; indusia large, firm, short-hairy; sporangia sometimes bearing glands.

Distr. *Malesia*: New Guinea (New Britain), only known from the type.

74. Sphaerostephanos convergens HOLTTUM, *sp. nov.*

Pinnae redactae 4–5-jugatae, omnes parvae; *aerophora non elongata*; *pinnae usque* 6.5 × 1.3 cm, *3/5 costam versus lobatae*; *venae infimae conniventes, non anastomosantes*; *costae subtus pilis erectis usque 1 mm longis praeditae*; *pagina inter venas utrinque pilis brevibus erectis praedita, subtus etiam glandulifera*; *indusia pilosa*; *sporangia glandulifera.* — Type: M. G. PRICE & B. F. HERNAEZ 164, Western Samar, 500 m (K).

Caudex short, suberect, bearing a close tuft of fronds. *Stipe* 4 cm long; basal scales 7 × 0.8 mm, thin; base of stipe to first large pinna 20 cm. *Reduced pinnae* 4–5 pairs, uppermost 2 mm long; aerophores swollen, hardly elongate. *Lamina* 28 cm long; pinnae 10–12 pairs, lowest 1–2 pairs somewhat narrowed at their bases. Hairs on lower surface of *rachis* erect, pale, 0.3 mm long, with some more than 1 mm long also; hairs on upper surface more than 1 mm long. *Largest pinnae* 6.5 × 1.3 cm; base truncate; apex short-acuminate; edges lobed *c.* 3/5 to costa, lobes slightly falcate, separated by sinuses nearly 1 mm wide; costules 4 mm apart, at 60°; veins to 6 pairs, basal pair both touching sides of short sinus-membrane or meeting just below it without fusing, next pair to edge; hairs on *lower surface* of costae and costules erect, as on rachis but shorter, surface between veins bearing many short erect hairs and glands; hairs on *upper surface* of costae 1 mm long, similar hairs scattered on costules and veins, surface between veins bearing suberect hairs 0.2 mm long. *Sori* inframedial, basal ones not divergent; indusia bearing hairs 0.4 mm long; sporangia bearing glands.

Distr. *Malesia*: Philippines (W. Samar), only known from the type.

Ecol. In forest on limestone soils.

75. Sphaerostephanos unitus (L.) HOLTTUM, J. S. Afr. Bot. 40 (1974) 165; Kalikasan 4 (1975) 63. — *Polypodium unitum* L. Syst. Nat. ed. 10. 2 (1759) 1326, *excl. syn.* — *Aspidium unitum* (L.) SW. in Schrad. J. Bot. 1800, 2 (1801) 32, *nomen tantum*; WILLD. Sp. Pl. ed. 4, 5 (1810) 241. — *Dryopteris unita* (L.) O. KTZE, Rev. Gen. Pl. 2 (1891) 811; BACKER & POSTH. Varenfl. Java (1939) 51. —

Cyclosorus unitus (L.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 192; HOLTTUM, Rev. Fl. Mal. 2 (1955) 260, f. 147; COPEL. Fern Fl. Philip. (1960) 360. — *Thelypteris unita* (L.) MORTON, Amer. Fern J. 49 (1959) 113. — Type: without locality (LINN).

Tectaria serrata CAV. Descr. (1802) 251; C. CHR. Dansk Bot. Ark. 9, *n.* 3 (1937) 16, t. 1, f. 10–11. — *Nephrodium serratum* (CAV.) PRESL, Rel. Haenk. (1825) 34. — Type: NÉE, Marianas (MA).

Nephrodium insculptum DESV. Mém. Soc. Linn. Paris 6 (1827) 254. — Type: Réunion, no collector named (P).

Aspidium cucullatum BL. En. Pl. Jav. (1828) 151. — *Nephrodium cucullatum* (BL.) BAK. Syn. Fil. (1867) 290; BEDD. Handb. (1883) 270; RACIB. Fl. Btzg I (1898) 184. — *Dryopteris cucullata* (BL.) CHRIST, Philip. J. Sci. 2 (1907) Bot. 194; v.A.v.R. Handb. (1908) 213. — Type: BLUME, Java (L, *n.* 908, 337–5).

Nephrodium haenkeanum PRESL, Epim. Bot. (1851) 46; HOLTTUM, Novit. Bot. Univ. Carol. Prag. 1968 (1969) 17. — *Thelypteris haenkeana* (PRESL) REED, Phytologia 17 (1968) 281. — Type: HAENKE, Marianas (PRC).

KEY TO THE VARIETIES

1. Glands present on some part of lower surface of pinnae.
   2. Rather large glossy brownish glands present on and between veins on lower surface **a.** *var.* **unitus**
   2. Smaller dull yellow glands present on costules and veins only . . . . **b.** *var.* **mucronatus**
1. Glands lacking on lower surface; cells between veins all papilliform . . **c.** *var.* **papilliferus**

a. *var.* **unitus**

Rhizome long-creeping, commonly to 5 mm diameter; *stipe* 10–20 cm long, base of stipe to first normal pinna 30–60 cm; *reduced pinnae* 6–12 pairs, lower ones very small, upper ones triangular with symmetric base, to 10 mm long. *Lamina* 30–60 cm long; pinnae closely placed, lowest not or little narrowed at base, aerophores not elongate. Hairs on both sides of *rachis* less than 1 mm long. *Largest pinnae* 10–15 × 0.8–1.5 cm; base broadly cuneate; apex rather evenly attenuate; edges lobed 1/3 towards costa; lobes rounded with a slight point at falcate end of costule; costules 3–4 mm apart; veins 8–10 pairs, 1½ pairs anastomosing, next 2–4 pairs passing to sides of sinus-membrane which forms a ridge on the lower surface; hairs on *lower surface* of costae *c.* 0.5 mm long, slender, always antrorse but not closely appressed, similar hairs on costules; rather large brownish glossy glands present on costules and veins, and between veins; *upper surface* of pinnae hairy on costae only. *Sori* supramedial; indusia firm, glabrous or with a few short hairs, sometimes also glands; sporangia bearing glands near annulus, also copious glands at the ends of hairs on sporangium-stalks.

Distr. E. Africa; Mascarene Islands; Ceylon & S. India; N.E. India, Burma & Thailand (few specimens); *Malesia* (Malaya, Sumatra, Java, S.W. Celebes, Lesser Sunda Is., few specimens from Luzon and Mindanao, 1 from W. New Guinea); Guam, N. Queensland.

Ecol. At low altitudes, in open places, in moist (not swampy) ground.

Notes. The identity of this species is fixed by the type. LINNAEUS's description is not adequate, and his references to plants from Asia all indicate the species here named *Cyclosorus interruptus* (WILLD.) CHING. ROBERT BROWN and others interpreted *Polypodium unitum* according to the references, and BEDDOME followed this usage. It is now customary to accept the type as fixing the application of a name in such cases; it is to be noted that the specimen in the Willdenow Herbarium agrees with the Linnaean type.

The next name, *Tectaria serrata* CAV., was based on a specimen collected by NÉE in Guam. Specimens of the same species were also collected there by HAENKE, and PRESL at first (1825) identified them with *T. serrata*, but later (1851) thought this was wrong and published the new name *Nephrodium haenkeanum* for them. There is no doubt that the two collections were identical.

b. *var.* **mucronatus** (CHRIST) HOLTTUM, *comb. nov.* — *Dryopteris cucullata var. mucronata* CHRIST, Philip. J. Sci. 2 (1907) Bot. 195; v.A.v.R. Handb. (1908) 819. — Type: CUMING 182, Luzon (CHRIST's specimen not seen; isotypes FI-W, K, LE).

Aspidium multilineatum METT. Farngatt. IV (1858) 108. — Syntypes: CUMING 182, 278, Luzon (duplicates of 278 at FI-W, G, K, LE, PRC).

Nephrodium haenkeanum sensu BAK. Syn. Fil. (1867) 290.

Pinnae 15–20 × 1.0-2.0 cm; veins 10–14 pairs; glands present only on costules and veins of lower surface, small, dull, yellow; indusia always hairy.

Distr. Polynesia (Samoa, Fiji, Tonga), Micronesia (Palau), and *Malesia*: New Guinea, Moluccas, Lesser Sunda Is. (Sumba, Wetar, Timor), Celebes, Philippines and Borneo.

Notes. The characteristic glands on the lower surface of costules and veins were described by METTENIUS but ignored by all others. METTENIUS however made a confusion by adopting the name *multilineatum* from WALLICH and citing WALLICH 353 from Penang, which represents the species here named *S. penniger*, very different from the CUMING specimens which were clearly the basis of METTENIUS's description. BEDDOME later adopted the WALLICH epithet for *S. penniger*.

BAKER wrongly referred CUMING 182 to *Nephrodium haenkeanum*. FOURNIER also adopted this name in his work on the ferns of New Caledonia, but his citation of specimens shows that he confused it with other species. The New Caledonia specimens which he so named are *S. invisus*.

The varietal name *mucronatus* was first published by J. SMITH in 1843, as a *nomen nudum* under which he cited specimens of three species; it was not validated until CHRIST's description of 1907. Both *var. unitus* and *var. mucronatus* occur in the Lesser Sunda Islands; they may occupy different habitats; records are inadequate.

c. *var.* **papilliferus** HOLTTUM, *var. nov.*

A typo speciei differt: costulis venisque subtus eglandulosis; pagina subtus inter venas omnino minute papillifera. — Type: HOOGLAND 9084, N.E. New Guinea, Huon Peninsula, 1320 m (K).

Distr. *Malesia*: New Guinea, many specimens, at 1300–2000 m.

Note. All cells on the lower surface of pinnae have small papilliform colourless outgrowths. Stomata presumably occur, but they are not detectable. The condition is probably an adaptation to extreme exposure.

76. Sphaerostephanos sessilipinna (COPEL.) HOLTTUM, Kalikasan 4 (1975) 53. — *Dryopteris sessilipinna* COPEL. Philip. J. Sci. 6 (1911) Bot. 145. — *Cyclosorus sessilipinna* (COPEL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 249; COPEL. Fern Fl. Philip. (1960) 353. — *Thelypteris sessilipinna* REED, Phytologia 17 (1968) 313. — Type: MERRILL 6934, Negros, Mt Canlaon (MICH).

Dryopteris canlaonensis COPEL. Philip. J. Sci. 40 (1929) 300. — *Thelypteris canlaonensis* (COPEL.) REED, Phytologia 17 (1968) 266. — Type: MERRILL 6934, Negros (MICH).

Dryopteris austrophilippina COPEL. Philip. J. Sci. 40 (1929) 300. — *Cyclosorus austrophilippinus* (COPEL.) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 354. — *Thelypteris austrophilippina* (COPEL.) REED, Phytologia 17 (1968) 262. — Type: COPELAND 1705, Mindanao, San Ramon (MICH).

Caudex short, creeping. *Stipe* 5 cm long; base of stipe to first large pinna 15–20 cm. *Reduced pinnae* 4–6 pairs, all less than 2 mm long. *Lamina* to 20 cm long; apical section 10–12 cm long, deeply lobed, tapering very gradually to tip, at base with gradual transition to pinnae; free pinnae 10–12 pairs, very close; basal pinnae deflexed and narrowed towards their bases; aerophores not elongate. *Rachis* with thick curved brown hairs both sides. *Middle pinnae* 2.3 × 0.8 cm, lobed about 1/3 to costa, apex obtuse; costules 2 mm apart; veins 2–4 pairs, basal pair anastomosing in basal half of pinna, free near its tip; hairs on *lower surface* of costae pale, antrorsely curved; glands present on surface between veins; *upper surface* of type bearing rather sparse appressed hairs between veins, of other specimens many. *Sori* medial or inframedial; indusia glabrous or with a few short hairs; sporangia bearing glands.

Distr. *Malesia*: Philippines (Negros, Mindanao).

Notes. The type of *D. austrophilippina* has a less tapering apical lamina than the other type, and paler hairs on lower surface of rachis. In 1975 I included *D. urdanetensis* COPEL. also as a synonym of the present species, but it lacks very small basal reduced pinnae. Apart from size, there is little to distinguish this from *S. lobatus*.

77. Sphaerostephanos lobangensis (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris lobangensis* C. CHR. Gard. Bull. Str. Settl. 7 (1934) 245. — *Thelypteris lobangensis* (C. CHR.) REED, Phytologia 17 (1968) 289. — Type: CLEMENS 10728, Mt Kinabalu, Pakka Cave to Lobang (MICH; BO).

Caudex short, suberect. *Stipe* 12 cm long; base of stipe to first large pinna 50 cm. *Reduced pinnae* 10 pairs, upper ones 3 mm long. *Lamina* to 40 cm long; pinnae to 20 pairs; basal pinnae a little reduced and deflexed, narrowed towards their bases; aerophores not elongate. Lower surface of *rachis* glabrous. *Largest pinnae* 6 × 1.4 cm; base truncate; apex short-acuminate; edges lobed 1/3 to costa; costules 3 mm apart, at 60°; veins to 6 pairs, 1 pair anastomosing, next acroscopic vein to side of sinus-membrane; *lower surface* of pinnae quite glabrous, with yellow glands throughout; hairs on *upper surface* of costae short, on costules shorter, few on veins, no others. *Sori* inframedial, basal ones not divergent; indusia small, glandular; sporangia bearing glands.

Distr. *Malesia*: Sabah (Mt Kinabalu), in forest at 1500–2000 m; two collections, the second being an unnumbered CLEMENS specimen from Marei Parei spur "on rocks in stream" (BO).

Notes. The above description is prepared from the Bogor isotype; the type at MICH is somewhat smaller. CHRISTENSEN described the rhizome as creeping with widely-spaced stipes, but this is not true of the Bogor specimen.

78. Sphaerostephanos gymnorachis HOLTTUM, *sp nov.*

Caudex erectus; pinnae redactae usque 8–10-jugatae, superiores 3 mm longae; pinnae normales fertiles usque 16 × 1.9 cm, 1/2–5/8 costam versus lobatae; rachis subtus glabra, costae costulaeque pilis brevibus antrorsis vestitae, pagina inter venas glandulosa; indusia glabra; sporangia glandulifera. — Type: HOLTTUM 34, Mt Kinabalu, Pinosok area, Nov. 1972 (K).

Caudex erect, at least to 10 cm tall. *Stipe* 10 cm long, dull reddish; base of stipe to first large pinna

of largest fronds 50 cm. *Reduced pinnae* 4–5 cm apart, 8–10 pairs, uppermost 3 mm long, lowest with no evident blade. *Lamina* to 70 cm long; pinnae more than 20 pairs, in most cases all opposite; basal pinnae gradually narrowed towards base in basal 4 cm, next 2–3 pairs less narrowed; aerophores not elongate. Lower surface of *rachis* glabrous; hairs on upper surface 0.5 mm long, brown. *Largest fertile pinnae* 16 × 1.9 cm (sterile to 2.3 cm wide); base broadly cuneate; apex acuminate with cauda 1–1.5 cm; edges lobed a little more than ½ way to costa (about ½ way on upper pinnae or those of small fronds); lobes falcate, distinctly tapered to a blunt tip; costules 3.5–4 mm apart (to 5 mm in sterile fronds); veins to 12 pairs, basal pair anastomosing with long excurrent vein to sinus, second pair both to sides of sinus-membrane; *lower surface* of costae near base covered with hairs 0.1–0.2 mm long, near apex 0.3–0.4 mm, antrorse but not closely appressed, on costules similar, sparser and shorter on veins, many glands on surface between veins (hairs on lower surface of sterile pinnae somewhat longer, distal ones on costae 0.5 mm); hairs on *upper surface* of costae brown, 0.7 mm long, on costules 0.2 mm, pale, rarely with a solitary longer hair; surface between veins glabrous or with a few pale appressed hairs. *Sori* medial, basal ones somewhat divergent; indusia large, glabrous; sporangia bearing glands.

Distr. *Malesia*: Sabah (Mt Kinabalu), in forest at 1500 m.

Notes. In addition to the type collection, CLEMENS 28233 and 28382 (from Tenompok, 1500 m) have pinnae not opposite and upper surface between veins covered with many appressed hairs; CLEMENS 29050 (Silau Basin,.2100 m) is a smaller plant (pinnae to 9 × 1.5 cm) with almost sterile fronds, differing in scattered pale hairs 1 mm long on lower surface of rachis. *S. gymnorachis* may be a fully developed form of *S. lobangensis*.

79. Sphaerostephanos pullenii HOLTTUM, *sp. nov.*

Pinnae redactae 6-jugatae vel ultra, omnes parvae; pinnae normales 26 × 3.0 cm, 3/4–4/5 costam versus lobatae; rachis costaeque subtus glabra vel pilis minutis paucis praedita; pagina subtus inter venas glandulosa, supra pilis erectis brevibus praedita; indusia parva, glandulifera, sporangia nec glandulis nec setis instructa. — Type: R. PULLEN 672, N.E. New Guinea, Eastern Highlands (BM; L, LAE).

Caudex erect. *Stipe* 30 cm long, glandular; base of stipe to first long pinna 85 cm. *Reduced pinnae* 6 cm apart, at least 6 pairs, all very small. *Lamina* 85 cm or more long; pinnae to 30 pairs; basal pinnae narrowed towards their bases, basal lobes 6–10 mm long; aerophores not elongate. Lower surface of *rachis* glabrous or with sparse minute erect hairs; upper surface with pale hairs less than 1 mm long. *Largest pinnae* 26 × 2.0 cm; base truncate; apex caudate-acuminate (cauda to 3 cm); edges lobed to 3–3.5 mm from costa, lobes slightly falcate; costules 5–7 mm apart, at more than 60°; veins to 12 pairs, basal pair at a wide angle to costule meeting to form a long excurrent vein, one or both of next pair passing to sinus-membrane; *lower surface* of costae near base with sparse minute hairs, somewhat longer hairs distally, costules similar; copious glands between veins; hairs on *upper surface* of costae 0.5 mm long, shorter on costules with a few long ones near apices of lobes, surface between veins bearing very short suberect hairs. *Sori* medial, lower ones divergent, lowest somewhat elongate; indusia small, thin, with marginal glands; sporangia bearing neither glands nor setae.

Distr. *Malesia*: Papua New Guinea.

Ecol. In *Nothofagus* forest at 2000 m.

80. Sphaerostephanos gregarius (COPEL.) HOLTTUM, *comb. nov.* — *Cyclosorus gregarius* COPEL. J. Arn. Arb. 24 (1943) 440; Philip. J. Sci. 78 (1951) 451, pl. 31. — *Thelypteris gregaria* (COPEL.) REED, Phytologia 17 (1968) 280. — Type: BRASS 6759, Papua, Fly River (MICH; BM, BO, L).

Caudex short; erect or suberect. *Stipe* 25–30 cm long, dull reddish; base of stipe to first large pinna 60 cm. *Reduced pinnae* 7 pairs, lowest 3–4 mm long, uppermost 2.2 cm long, broadly triangular, subentire, base slightly asymmetric. *Lamina* 60 cm long; apex on type pinna-like, on isotype at L not pinna-like; pinnae 16 pairs, lower ones 4 cm apart, subopposite, not narrowed towards their bases, upper ones close and alternate; aerophores not elongate. *Rachis* glabrous on lower surface or with minute appressed hairs; hairs on upper surface not over 1 mm long. *Largest pinnae* 15 × 1.5 cm; base subequally broadly cuneate and a little dilated both sides; apex acuminate; edges lobed to a depth of 2–2.5 mm (on BM and BO isotypes little more than 1 mm); costules 3.5–4 mm apart, at 60° or more; veins 6–7 pairs, 2–3 pairs anastomosing, 1 pair to short sinus-membrane; *lower surface* of costa glabrous or with minute appressed hairs, no other hairs on lower surface, sparse glands present on costules and on surface between veins; hairs on *upper surface* of costae 1 mm long, rest of upper surface glabrous apart from short hairs on margin. *Sori* medial or inframedial, lowest not divergent; indusia very small, thin, bearing a few very short hairs; sporangia bearing glands.

Distr. *Malesia*: Eastern New Guinea, at altitudes to 1000 m, in forest.

81. Sphaerostephanos tephrophyllus (COPEL.) HOLTTUM, Kalikasan 4 (1975) 58. — *Dryopteris tephrophylla* COPEL. Philip. J. Sci. 40 (1929) 296. — *Cyclosorus tephrophyllus* (COPEL.) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip.

(1960) 350. — *Thelypteris tephrophylla* (COPEL.) REED, Phytologia 17 (1968) 319. — Type: COPELAND *s.n.* 18 April 1905, Mindanao, Zamboanga, San Ramon (MICH).

Caudex suberect, short. *Stipe* 3–4 cm long; base of stipe to first large pinna 12–15 cm. *Reduced pinnae* 3–5 pairs, lowest 3–5 mm long, uppermost to 1.5 × 0.8 cm, entire, deflexed, auricled on acroscopic base; transition to normal pinnae not abrupt. *Lamina* to 25 cm long; apical section to 12 cm, deeply lobed and grading to upper pinnae; free pinnae 5–6 pairs, lower ones slightly reduced and sometimes a little auricled on acroscopic base; aerophores not elongate. Hairs on lower surface of *rachis* short, with sparse longer ones, on upper surface similar but thicker, the long ones more than 1 mm. *Largest pinnae* 4.5 × 1.4 cm (sterile), 3.5 × 1.2 cm (fertile); base truncate; apex short-pointed; edges crenate to a depth of less than 1 mm; costules 3–3.5 mm apart; veins to 4 pairs, 1 pair anastomosing, next pair to sides of sinus-membrane; hairs on *lower surface* of costae and costules short, with a few longer ones, between veins short hairs and glands; short hairs on *upper surface* of costae, between veins very short suberect hairs. *Sori* medial; indusia large, with a few hairs; sporangia sometimes with a gland.

Distr. *Malesia*: Philippines (Mindanao), 3 collections.

Note. Allied to *S. spenceri*, differing in little but much smaller size.

82. Sphaerostephanos pilososquamatus (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris pilososquamata* v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 21 (1908) 4; Handb. (1908) 222; Handb. Suppl. (1917) 181, *excl. var. obtusata.* — *Thelypteris pilososquamata* (v.A.v.R.) REED, Phytologia 17 (1968) 304. — Type: cult. Hort. Bog., origin W. New Guinea (BO; BM, L).

Dryopteris paraphysata COPEL. Philip. J. Sci. 6 (1911) Bot. 74. — *Thelypteris paraphysata* REED, Phytologia 17 (1968) 301. — Type: C. KING 306, Papua (MICH; NSW, P).

Dryopteris megaphylloides ROSENST. Fedde Repert. 12 (1913) 174. — *Thelypteris megaphylloides* (ROSENST.) REED, Phytologia 17 (1968) 292. — Type: KEYSSER 120, N.E. New Guinea, Sattelberg (orig.?; UC). — **Fig. 12i–k.**

Caudex short, creeping. *Stipe* on a well-grown plant 30-40 cm long; base of stipe to first large pinna 45–55 cm (sterile) 60–70 cm (fertile). *Reduced pinnae* 2–3(–4) pairs, largest 5 mm long; an intermediate pair sometimes present. *Lamina* dimorphous; pinnae to 15 pairs, sometimes with stalks 1–2 mm long; basal pinnae narrowed towards their bases; apical lamina almost pinna-like; aerophores not elongate. Hairs on *rachis* of sterile fronds to 1 mm long both sides, rather sparse on lower surface. *Largest sterile pinnae* 20–27 × 3.5–4 cm; base broadly cuneate; apex acuminate with cauda to 2 cm; edges lobed 1/4–2/5 to costa, lobes falcate, narrowed to tips in more deeply lobed pinnae; costules 5–5.5 mm apart, at 60° or rather less; veins 12–15 pairs, 2½–3½ pairs anastomosing, 2–3 pairs to sides of sinus-membrane; hairs on *lower surface* of costae spreading, 0.5–1 mm long, not dense, on costules and veins similar but fewer, glands usually present on costules and veins and between veins, not abundant; scattered hairs on *upper surface* of costules and veins like those on costae, appressed hairs between veins sometimes present. *Fertile pinnae* commonly to 18 × 2 cm, less deeply lobed than sterile and with closer costules, hairs on all parts shorter and more sparse; veins 7–9 pairs; *sori* medial, lower ones not or little divergent; indusia bearing glands and hairs; sporangia usually with a seta, sometimes also a gland, near annulus, and a gland at end of hair on stalk.

Distr. *Malesia*: New Guinea, Bismarck Archipelago, in forest, 0–1400 m.

Note. One specimen assigned to this species appears to be quite eglandular. Another (NAKAIKE 73) is small, lacks reduced pinnae and has no glands on sporangia.

83. Sphaerostephanos angustifolius (PRESL) HOLTTUM, Kalikasan 4 (1975) 66. — *Nephrodium angustifolium* PRESL, Epim. Bot. (1851) 48; HOOK. Spec. Fil. 4 (1862) 69. — *Cyclosorus angustifolius* (PRESL) COPEL. Fern Fl. Philip. (1960) 349. — *Thelypteris setulosa* REED, Phytologia 17 (1968) 313, *nom. nov.* — Type: CUMING 268, Luzon (PRC; B, BM, E, FI-W, G, K, LE, US).

Dryopteris hispidula sensu C. CHR. Ind. Fil (1905) 271, *p.p.*; v.A.v.R. Handb. (1908) 228.

Caudex short, erect. *Stipe* 4–6 cm long, dark reddish, densely short-hairy; base of stipe to first large pinna 15 cm or more. *Reduced pinnae* to 5 pairs, highest 3 mm long. *Lamina* to 35 cm long; pinnae *c.* 17 pairs; lower 2–3 pairs somewhat narrowed towards their bases with basal acroscopic lobe a little elongate; aerophores not elongate. Lower surface of *rachis* covered with short erect hairs and scattered longer ones (some of them dark red), upper surface covered with pale hairs 0.5 mm long. *Largest pinnae* 9.5 × 0.8 cm; base truncate and not dilated; apex a subentire cauda 1.5–2.0 cm long; edges lobed ½ way to costa, lobes oblique; costules 3 mm apart, at 60°; veins 4–5 pairs, 1 pair anastomosing, next pair to margin; hairs on *lower surface* of costae not dense, very short, with scattered hairs to 0.8 mm long, on costules similar but more sparse, minute erect hairs present between veins, glands throughout lower surfaces; hairs on *upper surface* of costae 0.5 mm long, similar hairs scattered on costules and veins, suberect hairs 0.1–0.2 mm long between veins. *Sori* medial; indusia short-hairy; sporangia bearing glands.

Distr. *Malesia*: Philippines (Luzon); a second collection is M. G. PRICE 2553, Zambales Prov., from exposed place by stream (small plants).

Note. *S. angustifolius* is very near *S. heterocarpus*; it is peculiar in its very narrow pinnae.

84. Sphaerostephanos efogensis HOLTTUM, *sp. nov.*

S. conferto (Brause) affinis, differt: membranis sinuum brevibus; costis subtus pilis usque 1 mm longis vestitis; costulis subtus glanduliferis; soris supramedialibus, sporangiis glanduliferis. — Type: J. R. CROFT LAE 61873, Papua, Central Distr., Port Moresby Subdistr. Efogi (K).

Caudex short, decumbent (collector). *Stipe* 12–20 cm long, basal scales short and thick, apparently 1.5 × 1 mm; base of stipe to first large pinna 40–60 cm. *Reduced pinnae* 12 pairs, lowest 2–4 mm long, middle ones 10 × 10 mm, uppermost 1.7 cm long, 1.3 cm wide at truncate base, triangular, crenate. *Lamina* 43 cm long; apex broadly deltoid and deeply lobed; pinnae 20 pairs, basal ones not narrowed at base; aerophores not elongate. Hairs on lower surface of *rachis* not dense, mostly 0.1–0.3 mm long with some more than 1 mm, on upper surface long hairs more numerous, to 1.5 mm long. *Largest pinnae* 8.5 × 1.7 cm; base subtruncate, almost symmetric; apex short-acuminate; edges lobed to a depth of 2 mm, lobes oblique, subtriangular; costules to 3.5 mm apart; veins 7–8 pairs, all except basal ones very oblique, 2–2½ pairs anastomosing to form a zig-zag excurrent vein, 1 pair to short sinus-membrane; hairs on *lower surface* of costae as on rachis, on costules shorter, glands present on costules and veins, between veins sparse short erect hairs and sometimes a few glands; hairs on *upper surface* of costae mostly 0.3 mm long with scattered long ones which occur also on costules and veins, surface between veins bearing appressed hairs 0.2–0.3 mm long. *Sori* a little supramedial; indusia thin, with a few hairs 0.5 mm long; sporangia bearing glands.

Distr. *Malesia*: Papua New Guinea.

Ecol. At 1500 m in riverine hill forest.

85. Sphaerostephanos dichrotrichoides (v.A.v.R.) HOLTTUM, Kalikasan 4 (1975) 65. — *Dryopteris dichrotricha* COPEL. Philip. J. Sci. 7 (1912) Bot. 54, *non* COPEL. 1911. — *Dryopteris dichrotrichoides* v.A.v.R. Handb. Suppl. (1917) Corr. 48, *nom. nov.* — *D. weberi* COPEL. Philip. J. Sci. 38 (1929) 135, *nom. nov. superfl.* — *Lastrea dichrotrichoides* (v.A.v.R.) COPEL. Fern Fl. Philip. (1960) 329. — *Thelypteris dichrotrichoides* (v.A.v.R.) REED, Phytologia 17 (1968) 272. — Type: WEBER 1173, Mindanao, Mt Hilong-Hilong (MICH; E, G, K, NSW, P, US).

Caudex short, creeping. *Stipe* 15 cm long, pale, short-hairy; base of stipe to first large pinna 30 cm. *Reduced pinnae* to 5 pairs, upper ones 4 mm long, auricled, lowest very small. *Lamina* 35 cm long; pinnae 18 pairs, basal pinnae a little narrowed towards their bases, strongly auricled on acroscopic base; aerophores swollen. Hairs on both surfaces of *rachis* 1 mm long, pale. *Largest pinnae* 7–12 cm long, 1.5 cm wide at broadly cuneate base from which they are gradually attenuate to apex; edges lobed to 2 mm from costa, lobes oblique, slightly falcate; costules to 3 mm apart; veins 8–9 pairs, basal pair anastomosing near base of pinna, passing to sides of a short sinus-membrane towards apex of pinna; coarse rather sparse hairs 1 mm long on *lower surface* of costae and costules, shorter hairs on veins and surface between them, glands present on costules and veins, few between veins; hairs on *upper surface* of costae 1 mm long, similar hairs scattered on costules and veins, whole upper surface covered with fine appressed hairs nearly 0.5 mm long. *Sori* medial, basal ones not divergent; indusia with copious hairs 0.5 mm long; sporangia often with 2–3 glands.

Distr. *Malesia*: Philippines (Mindanao; Panay?).

86. Sphaerostephanos nakaikei HOLTTUM, *sp. nov.*

Pinnae redactae 5-jugatae, superiores 10 mm longae, valde auriculatae; pinnae normales usque 14 × 2.3 cm, 2/3–3/4 costam versus lobatae; venae infimae anastomosantes vel ad basin sinus conniventes; costae subtus pilis erectis brevibus vestitae; pagina inter venas subtus glandulifera, supra pilis appressis vestita; indusia glandulifera, sporangia non glandulifera. — Type: T. NAKAIKE 358, E. New Guinea, Mt Wilhelm 2500–3500 m (K; TNS).

Caudex "massive or ascending" (NAKAIKE). *Stipe* 20 cm long, shôrt-hairy, basal scales broad and thin; base of stipe to first large pinna 45 cm. *Reduced pinnae* 5 pairs, lowest 2 mm long, uppermost 10 mm with basal acroscopic auricle 5 mm long; 1–2 pairs pinnae of intermediate length sometimes present. *Lamina* 60–70 cm long; pinnae 25 pairs; basal large pinnae not narrowed at base, slightly auricled; aerophores slightly elongate. Hairs on lower surface of *rachis* dense, brownish, erect, 0.3–0.5 mm long, on upper surface a little longer. *Largest pinnae* 13–14 cm long, 1.8–2.3 cm wide; base truncate; apex acuminate; edges lobed 2/3–3/4 to costa, lobes falcate, separated by distinct sinuses; costules 5 mm apart; veins 8–10 pairs, basal pair anastomosing with a short excurrent vein to sinus, less commonly both touching sides of short sinus-membrane; *lower surface* of costae densely covered with erect hairs 0.2 mm long, hairs on costules sparse, glands present on costules and veins and on surface between veins; hairs on *upper surface* of costae 0.7 mm long, similar hairs scattered on costules and veins, surface between veins rather sparsely covered with

appressed hairs. *Sori* medial; indusia bearing glands; sporangia with neither setae nor glands.

Distr. *Malesia*: Papua New Guinea (Mt Wilhelm and Mt Giluwe: PARRIS & CROXALL 5900, at 2950 m).

87. Sphaerostephanos woitapensis HOLTTUM, *sp nov.*

S. nakaikeo affinis, differt: pinnis minoribus, brevi-stipitatis, inferioribus sensim decrescentibus; lobis pinnarum distaliter dentatis; venis infimis semper anastomosantibus. — Type: NAKAIKE 576, Papua, Central Distr., Woitape (TNS; K).

Caudex thick, short-creeping or ascending. *Stipe* 25 cm long, copiously short-hairy. *Lamina* to 75 cm long; pinnae to more than 20 pairs, distinctly stalked; 5–6 lower pairs gradually decrescent and more widely spaced, lowest 8 mm long; aerophores slightly swollen. Hairs on lower surface of *rachis* suberect, 0.2–0.4 mm long, on upper surface 0.7 mm long. *Largest pinnae* 9.5 × 2.0 cm; base truncate and in some cases slightly dilated both sides; apex short-acuminate; edges lobed *c.* 3/5 to costa, lobes oblique, slightly falcate, with distinct teeth at ends of some distal veins; costules 4–4.5 mm apart at 60°; veins 6–7 pairs, pale and prominent both sides, basal pair always anastomosing, second pair both to margin; hairs on *lower surface* of costae near base 0.1 mm, distally 0.3 mm long, on costules and veins sparse and very short, glands present on surface between veins; *upper surface* of costae hairy as rachis, scattered similar hairs on costules and veins, appressed hairs 0.2 mm long between veins. *Sori* medial; indusia with short hairs and many glands; sporangia lacking glands and setae.

Distr. *Malesia*: Eastern New Guinea at 2500–2800 m.

Note. Other collections have smaller pinnae than the type, on smallest fronds 5.0 × 1.2 cm, rather rigid; these do not show teeth at ends of distal veins.

88. Sphaerostephanos ekutiensis HOLTTUM, *sp. nov.*

Pinnae redactae 8-jugatae, usque 10 mm longae; pinnae normales usque 7.0 × 1.8 cm, c. 3/5 costam versus lobatae; venae 7-jugatae, infimae solum anastomosantes; costae subtus pilis paucis praedita, pagina inferior pinnarum cetera glabra, glandulifera, glandulis inter venas paucis; sori inframediales; indusia tenuia, glandulis multis ornata; sporangia nec setis nec glandulis praedita. — Type: B. S. PARRIS & J. P. CROXALL 6022, N.E. New Guinea, Morobe Distr., Ekuti Range (CGE; K).

Caudex not known; *stipe* 7 cm long, glabrous on abaxial surface, scales at base 7 × 1.5 mm; base of stipe to first normal pinna 30 cm; *reduced pinnae* 8 pairs, uppermost 10 × 4 mm with an auricle 8 mm long, lowest 5 mm long, deflexed, narrowly triangular with acroscopic auricle 3 mm long; two pairs of pinnae of intermediate length present between reduced and normal pinnae. *Lamina* excluding reduced pinnae 37 cm long; pinnae 18 pairs, all opposite, texture firm; basal pinnae not narrowed at their bases. Both surfaces of *rachis* bearing thick curved pale brown hairs 1 mm long. *Largest pinnae* 7.0 × 1.8 cm, sessile; aerophores slightly swollen; base subtruncate, not auricled; apex abruptly short-caudate; edges lobed 3/5 towards costa, lobes slightly falcate with rounded tips; costules 4 mm apart, at more than 60° to costa; veins to 7 pairs, basal pair anastomosing, next pair to margin; *lower surface* of costae bearing rather sparse thick pale hairs 0.3 mm long and glands, rather large glands and no hairs on costules and veins, rather sparse glands between veins; *upper surface* of costae covered with pale hairs less than 1 mm long, shorter hairs scattered on costules and veins, no other hairs. *Sori* inframedial; indusia thin, with many glands; sporangia bearing neither setae nor glands.

Distr. *Malesia*: Papua New Guinea; only known from the type.

Ecol. In *Nothofagus* forest at 2250 m.

89. Sphaerostephanos omatianus HOLTTUM, *sp. nov.*

Stipes 2.5 cm longus; lamina 7–8 cm longa, pars apicalis profunde lobata 5.5 cm longa, pinnae liberae 3–4-jugatae, crenatae, infimae leviter redactae; venae liberae; costae costulaeque subtus pilis longis glandulisque praeditae; sori exindusiati, sporangia nuda. — Type: WOMERSLEY & SIMMONDS 5076A, Papua, Gulf Div., Omati (BRI).

Caudex apparently short-creeping. *Stipe* 2.5 cm long, covered with pale spreading hairs 1 mm long. *Lamina* 7–8 cm long, apical 5.5 cm deeply lobed, grading to pinnae; free pinnae 3–4 pairs, lowest only reduced, 6–7 mm long, deflexed and a little narrowed on basiscopic side. *Largest pinnae* 1.1 × 0.45 cm, almost sessile; base broadly cuneate; apex obtusely pointed; edges crenate near base, entire distally; costules near base of pinnae hardly 2 mm apart, twice forked, distal ones forked or simple, all veins free; *lower surface* of rachis, costae and costules bearing hairs 1 mm long and some shorter ones, slender erect hairs on surface between veins, glands present on costae and costules; slender hairs 1 mm long on *upper surface* of costae and costules, appressed hairs on surface generally. *Sori* in an uneven row on each side of costa, on acroscopic branches of forked costules; no indusia; neither glands nor setae on sporangia; spores minutely papillose.

Distr. *Malesia*: Papua, known only from type collection.

Ecol. At an altitude of 30 m, in shallow soil over pinnacle limestone, in dense rain-forest.

90. Sphaerostephanos alticola HOLTTUM, *sp. nov.*

Caudex brevis, crassus; *stipes* 12 *cm longus*; *lamina* 45–55 *cm longa*; *pinnae* 40-*jugatae*, 12–14-*jugatae inferiores sensim decrescentes, maximae* 3.3 *cm longae*, 7–8 *mm latae, leviter lobatae, rigidae, lobis cucullatis*; *costae costulaeque subtus patenti-pilosae paulo glandulosae*; *indusia parva, glandulis pilisque praedita*; *sporangia setifera*. — Type: HOOGLAND 9762, N.E. New Guinea, Huon Peninsula, Salawaket Range (LAE; L).

Caudex "thick, ± horizontal". *Stipe* 12 cm long, base covered with glossy scales 10 × 1.3–3 mm. *Lamina* 45–55 cm long; pinnae to 40 pairs, rigidly coriaceous, lower 12–14 pairs gradually smaller and more widely spaced, lowest 5 mm long, 6 mm wide at truncate base, 3-lobed, upper ones triangular, crenate; aerophores not elongate. *Rachis* covered with dense pale spreading hairs 0.7 mm long. *Largest pinnae* 3.3 cm long, 7–8 mm wide above base, base truncate and a little dilated; apex shortly obtuse; edges lobed to a depth of 1 mm or a little more deeply; lobes rounded, their edges much deflexed so that the lower surface is concave; costules little more than 2 mm apart; veins 3–5 pairs, pale, prominent both sides, 1 pair anastomosing, next pair to short sinus-membrane; *lower surface* of costae covered with erect thick pale hairs to 1 mm long, similar hairs sparse on costules; sparse glands present on costules and veins; *upper surface* of costae densely hairy, similar hairs more sparse on costules and veins, some erect hairs between veins. *Sori* medial; indusia small, bearing glands and short hairs; sporangia setiferous; spores with many small wings.

Distr. *Malesia*: Papua New Guinea (Salawaket Range); 2 collections.

Ecol. "In low open forest on landslide, limestone". 2500–3200 m.

91. Sphaerostephanos rigidus (RIDL.) HOLTTUM, *comb. nov.* — *Goniopteris rigida* RIDL. Trans. Linn. Soc. Bot. 9 (1916) 258. — *Phegopteris wollastonii* v.A.v.R. Handb. Suppl. (1917) 515, *nom. nov.*, not *P. rigida* (HOOK. & GREV.) METT. — *Thelypteris rigida* (RIDL.) REED, Phytologia 17 (1968) 309. — Type: C. B. KLOSS *s.n.* 18 Feb. 1913, W. New Guinea, Mt Carstensz, Camp VIc, 1680 m (BM; K).

Caudex lacking from type and *stipe* incomplete. *Lamina* to 40 cm long; pinnae to 30 pairs; basal 3–4 pairs pinnae gradually decrescent, lowest 2.2 × 0.6 cm, below them 3 pairs reduced pinnae 3–4 mm long; aerophores *c.* 0.5 mm long. *Rachis* bearing throughout stiff spreading brown hairs to 1.2 mm long. *Largest pinnae* 6.0 × 1.3 cm; base truncate and slightly dilated both sides; apex narrowed to a short obtuse or rounded tip; edges lobed 1/4–1/3 to costa, lobes rounded with edges strongly reflexed (lower surface thus concave); costules 2.5 mm apart, pale and prominent on lower surface, grooved above; veins 4–5 pairs, prominent beneath, one pair anastomosing, next acroscopic vein to sinus-membrane; stiff brown hairs to 0.7 mm long on *lower surface* of costae, more sparse on costules, veins and edge, glands present on costae and costules; *upper surface* of pinnae glabrous apart from sparse short hairs on costae. *Sori* medial; indusia very small with a few stiff hairs (sometimes absent?); sporangia with neither glands nor hairs on body, yellow glands sometimes on their stalks.

Distr. *Malesia*: Western New Guinea; 2 collections at 1700 m; on limestone?

Note. The second collection, EYMA 4986 from Wissel Lake region, is small, with lamina of fronds 15 cm long, pinnae to 2 cm long, 3–4 pairs lower ones gradually reduced, lowest 8 mm long; the caudex is short-creeping. It seems probable that the type was found on limestone.

92. Sphaerostephanos arfakianus (BAK.) HOLTTUM, *comb. nov.* — *Polypodium arfakianum* BAK. in Beccari, Malesia 3 (1880) 45. — *Dryopteris arfakianus* (BAK.) C. CHR. Ind. Fil. (1905) 253; Dansk Bot. Ark. 9, *n.* 3 (1937) 50. — *Phegopteris arfakiana* (BAK.) v.A.v.R. Handb. (1908) 502. — *Cyclosorus arfakianus* (BAK.) COPEL. Gen. Fil. (1947) 142; Philip. J. Sci. 78 (1951) 451. — *Thelypteris arfakiana* (BAK.) REED, Phytologia 17 (1968) 260. — Type: BECCARI *s.n.* 1872, W. New Guinea, Mt Arfak at Putat (FI; K).

Dryopteris sepikensis BRAUSE, Bot. Jahrb. 56 (1920) 101; COPEL. Philip. J. Sci. 78 (1951) 443. — Type: LEDERMANN 12053, N.E. New Guinea, Schraderberg (B).

Dryopteris arborea v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 24, *non* BRAUSE 1914. — *Dryopteris rosenburghii* C. CHR. Ind. Fil. Suppl. III (1934) 96. — Type: RUTTEN 161, Ceram (BO).

Caudex slender, erect, to at least 100 cm tall. *Stipe* 10–20 cm long, dark, short-hairy. *Lamina* to 80 cm long, ± dimorphous, thin; pinnae to 40 pairs, lowest 6–10 pairs gradually smaller, lower ones broadly triangular with slightly asymmetric base, entire; aerophores not elongate. Hairs on both sides of *rachis* less than 0.5 mm long, brownish, ± appressed. *Largest sterile pinnae* 12–17 × 2.2–4 cm, *fertile* commonly to 10 × 1.5 cm, sometimes larger; base broadly cuneate to truncate, sometimes a little dilated both sides; apex acuminate; edges shallowly crenate or sinuous; costules to 4.5 mm apart on large pinnae; veins 5–7 pairs, slender, concolorous, slightly prominent both sides, almost all anastomosing to form zigzag excurrent veins between costules; hairs on *lower surface* of costae 0.1–0.2 mm long, slender, appressed, similar hairs on costules and veins, also sometimes a few glands; hairs on *upper surface* of costae 0.3–0.4 mm long, on costules shorter and sparse, usually a few slender appressed hairs on surface between veins at least near mar-

gin. *Sori* inframedial; indusia small, thin, usually with a few hairs; sporangia bearing glands.

Distr. *Malesia*: Moluccas (Ceram;? Amboina, BROOKS 18102) and widely in New Guinea.

Ecol. In forest at altitudes to 2000 m.

Note. The type of *D. sepikensis* and some others from an altitude of about 2000 m are smaller than BECCARI's type and other lowland specimens, with fewer reduced pinnae and distinctly lobed sterile ones, but agree in details of pubescence and sori.

93. Sphaerostephanos archboldii (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris archboldii* C. CHR. Brittonia 2 (1937) 297. — *Thelypteris archboldii* (C. CHR.) REED, Phytologia 17 (1968) 260. — Type: BRASS 4873, Papua, Mt Tafa, valley forest, 2400 m (BM; BRI).

Dryopteris protecta COPEL. Univ. Cal. Publ. Bot. 18 (1942) 221. — *Cyclosorus protectus* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 453, pl. 33. — *Thelypteris protecta* (COPEL.) REED, Phytologia 17 (1968) 306. — Type: BRASS 10933, New Guinea, 9 km N.E. of Lake Habbema, 2800 m (MICH; BM, L). — **Fig. 13d–e.**

Caudex slender, erect, to 100 cm or more tall. *Stipe* 5–15 cm long, minutely hairy, when young covered with rather firm brown scales 7 × 1 mm. *Lamina* to 65 cm long, texture very firm; lower 8–15 pairs pinnae gradually smaller, lowest 3–6 pairs of these more widely spaced with asymmetric base, lowest *c.* 1 mm long; aerophores not elongate. Hairs on lower surface of *rachis* erect, to 0.5 mm long, on upper surface a little longer, also spreading. *Largest pinnae* of type to 6 × 1.0 cm (type of *D. protecta* 9 × 1.5 cm); base truncate; apex evenly attenuate; edges lobed about 1/3 to costa; costules to 3 mm apart; veins 4–6 pairs, prominent on lower surface, 1–1½ pairs anastomosing, next acroscopic vein or pair to short sinus-membrane; hairs on *lower surface* of costae 0.1–0.3 mm long, antrorse distally, sparse glands and hairs on costules and veins (glands best seen on sterile fronds); hairs on *upper surface* of costae short, sparse on costules, veins and between veins. *Sori* near costules; indusia bearing hairs and glands; sporangia sometimes with a seta.

Distr. *Malesia*: Eastern New Guinea at 1800–2800 m, many collections.

94. Sphaerostephanos tibangensis (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris tibangensis* C. CHR. Dansk Bot. Ark. 9, *n.* 3 (1937) 66. — *Pronephrium tibangense* (C. CHR.) HOLTTUM, Blumea 20 (1972) 118. — Type: MJÖBERG *s.n.* Oct.–Dec. 1925, E. Kalimantan, Mt Tibang, 1400–1700 m (BM; S-PA).

Caudex short, suberect; *stipe* to 20 cm long, short-hairy. *Lamina* to 20 cm long; no reduced basal pinnae; normal pinnae 8–10 pairs, lower ones with stalks to 2 mm long; basal pinnae slightly shorter than next pair, with 3 pairs of basal basiscopic lobes slightly reduced. *Largest pinnae* 3.5 × 1.4 cm; base truncate and slightly auricled on the acroscopic side, narrowed rather evenly from base to acute apex; edges lobed 2/5 towards costa or rather more deeply; lobes subfalcate, acute; costules 3 mm apart, at more than 60° to costa; veins 6 pairs, basal pair anastomosing, second pair to sides of sinus-membrane, rest to margin; *lower surface* of costae and costules bearing pale spreading hairs 0.2–0.6 mm long, short erect hairs present between veins, many glands on costules and veins; *upper surface* of costae copiously short-hairy, rest of surface bearing short suberect hairs. *Sori* supramedial; indusia small, densely short-hairy; sporangia not setiferous.

Distr. *Malesia*: East Borneo (Mt Tibang), 1400–1700 m.

Note. This is certainly very near *S. norrisii*. The type consists of one fertile and one sterile frond, the latter not quite fully expanded, with immature sori. The fertile frond is smaller than any specimen undoubtedly referable to *S. norrisii*, and the pinnae are of a different shape; mature sori might show further differences.

95. Sphaerostephanos norrisii (ROSENST.) HOLTTUM, *comb. nov.* — *Dryopteris norrisii* ROSENST. Med. Rijksherb. *n.* 31 (1917) 8. — Type: W. NORRIS, Malaya (L; K).

Nephrodium pennigerum var. malayense BEDD. Handb. Suppl. (1892) 74, excl. Parish, Tenasserim. — *Dryopteris indica var. malayensis* (BEDD.) v.A.v.R. Handb. (1908) 224. — Lectotype (selected here): KUNSTLER 2360, Perak (K).

Dryopteris subfalcinella v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 151. — *Thelypteris subfalcinella* (v.A.v.R.) REED, Phytologia 17 (1968) 317. — Lectotype (selected here): LÖRZING 5338, Sumatra, Bandar-baroe (BO; L).

Dryopteris elmerorum COPEL. Philip. J. Sci. 40 (1929) 295, pl. 2. — *Cyclosorus elmerorum* (COPEL.) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 351. — *Thelypteris elmerorum* (COPEL.) REED, Phytologia 17 (1968) 274. — *S. elmerorum* (COPEL.) HOLTTUM, Kalikasan 4 (1975) 53. — Type: COPELAND *s.n.* Nov. 1911, Mindanao, San Ramon (MICH).

Nephrodium indicum sensu RIDL. J. Mal. Br. R As. Soc. 4 (1926) 73.

Dryopteris toppingii sensu C. CHR. Gard. Bull. Str. Settl. 4 (1929) 391. — *Cyclosorus toppingii sensu* HOLTTUM, Rev. Fl. Mal. 2 (1955) 280, f. 161.

Cyclosorus ellipticus sensu COPEL. Fern Fl. Philip. (1960) 351. — **Fig. 12f–h.**

Caudex short-creeping. *Stipe* 30–90 cm long, dull reddish, minutely hairy; *reduced pinnae* 0–3 pairs, present only on largest fronds, irregularly spaced and very small. *Lamina* to 100 cm long

(type), on type of *D. elmerorum* 30 cm long; pinnae 10–18 pairs, several pairs distinctly stalked; basal pinnae often somewhat reduced if small reduced pinnae absent, with stalks 1–3 mm long, narrowed towards their bases, not auricled; aerophores not elongate. Hairs on lower surface of *rachis* dense, short, stiff, erect; on upper surface copious, appressed, less than 0.5 mm long. *Largest pinnae* of type 24 × 3.4 cm, of type of *D. elmerorum* 6.5 × 1.8 cm; base subtruncate on large fronds, subcordate on small ones; apex rather abruptly short-acuminate; edges lobed *c.* 2/5 towards costa (less deeply on small fronds), lobes falcate with broadly pointed or rounded forward-pointing tips; costules 5–6 mm apart (3.5–4 mm in type of *D. elmerorum*); veins to 12 pairs, 1–1½ pairs anastomosing, 2–2½ pairs passing to sides of sinus-membrane; hairs on *lower surface* of costae and costules dense, short, erect, some short hairs also between veins, glands present on costules at least near apex of pinna-lobes; hairs on *upper surface* of costae and costules short, some short appressed or suberect hairs on surface between veins. *Sori* supramedial, somewhat elongate, especially the lower ones; indusia large, densely short-hairy, sometimes with a few glands; sporangia sometimes with a gland or a short seta.

Distr. *Malesia*: Malaya, Sumatra, Borneo, Philippines (Mindanao).

Ecol. In forest at 1000–1500 m; apparently not common anywhere.

Note. Though the type of *D. elmerorum* is small, other specimens from Mindanao have pinnae to 15 × 3 cm. No small fertile fronds have been found on plants in Sumatra and Malaya. Some specimens have very few glands on the lower surface of costules. Specimens from Sumatra and Malaya have appressed hairs between the veins on the upper surface, specimens from Borneo and Mindanao have shorter suberect hairs.

96. Sphaerostephanos semimetralis HOLTTUM *sp. nov.*

S. arfakiano affinis, differt: frondibus minoribus; pinnis redactis 2–3-jugatis, minutis; pinnis fertilibus usque 5 × 1.2 cm; costis costulisque subtus pilis sparsis suberectis instructis. — Type: PULLE 518, W. New Guinea, Perameles Mts, 1100 m, on limestone (L).

Caudex erect, slender, 50 cm tall. *Stipe* 15 cm long, basal scales *c.* 8 × 1 mm; base of stipe to first large pinna 25–30 cm. *Reduced pinnae* 2–3 pairs, all very small, with above them an apparently much larger intermediate pair (incomplete). *Lamina* 35 cm long; pinnae 10–12 pairs, very firm, dimorphous; basal pinnae not narrowed at base; aerophores less than 0.5 mm long. Hairs on lower surface of *rachis* thick, brown, 0.5 mm long, on upper surface similar, to 1 mm long. *Largest sterile pinnae* 9 × 2.2 cm; base truncate with a winged stalk 1 mm long; apex abruptly short-acuminate; edges crenate to a depth of 1–2 mm; costules 3.5–4 mm apart, at 60°; veins 6–8 pairs, very oblique except basal ones, prominent both sides, 2 pairs anastomosing to form a zig-zag excurrent vein, 1 pair to short sinus-membrane; *lower surface* of costae bearing sparse erect hairs 0.1 mm long, similar hairs very sparse on costules and veins with a few glands, sparse erect hairs between veins; hairs on *upper surface* of costae pale, 0.5 mm long, rest of surface glabrous. *Fertile pinnae* to 5 × 1.2 cm; veins 5 pairs; pubescence as sterile; sori near costules; indusia small with a few short hairs and glands; sporangia sometimes with a gland.

Distr. *Malesia*: New Guinea. A specimen from N.E. New Guinea, Western Highlands, at Kompiai in the Jimmi valley at 1900 m (MANNER & STREET 454), probably not from limestone, is similar to the type.

Note. This differs from the mountain form of *S. arfakianus* in the very small reduced pinnae, and in pubescence of lower surface; but better specimens are needed to characterize it clearly.

97. Sphaerostephanos semicordatus HOLTTUM, *sp. nov.*

Pinnae redactae 8-jugatae, omnes minutae; lamina 35 cm longa; pinnae 10–12-jugatae, omnes oppositae, subintegrae; costulae subtus glabrae, glanduliferae; sori exindusiati; sporangia setifera; sporae alatae. — Type: PULLEN 1476, N.E. New Guinea, Sepik Distr., Prince Alexander Range, 900 m (CANB).

Caudex short, creeping. *Stipe* 8 cm long, reddish, glabrescent, basal scales 3 × 1.5 mm; base of stipe to first large pinna 60 cm. *Reduced pinnae* 8 pairs or more, 5–6 cm apart, all very small. *Lamina* 35 cm long; pinnae 10–12 pairs, all opposite, basal pinnae not narrowed at their bases; aerophores slender, to 1 mm long. Hairs on *rachis* both sides 0.5 mm long, on upper surface brown. *Largest sterile pinnae* 14 × 2.5 cm, *fertile* to 10 × 2.0 cm; basiscopic base cordate and overlapping rachis, acroscopic truncate or slightly cordate; apex acuminate; edges irregularly sinuous to slightly crenate; costules 4.5 mm (sterile) 3.5 mm (fertile) apart, at more than 60°; veins 6–7 pairs, 3½ pairs anastomosing, one vein to short sinus-membrane; *lower surface* of costae minutely hairy, rest of lower surface glabrous, glands present on costules; on *upper surface* base of costae covered with brown hairs as rachis, above base spare short hairs, rest of upper surface glabrous. *Sori* on distal veins medial, on lower ones supramedial, those on veins from adjacent costules often coalescent; no indusia; sporangia with 4–6 setae; spores with a ± continuous translucent wing and a few irregular other wings.

Distr. *Malesia*: Papua New Guinea (Sepik).

98. Sphaerostephanos pterosporus (v.A.v.R.)

HOLTTUM, *comb. nov.* — *Dryopteris pterospora* v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 148. — *Thelypteris pterospora* (v.A.v.R.) REED, Phytologia 17 (1968) 307. — Type: BROOKS 447, Sumatra, Benkoelen, Tambang Sawah (BO; BM).

Dryopteris bungoensis C. CHR. Dansk Bot. Ark. 9, *n.* 3 (1937) 59. — Type: BROOKS 10, April 1909, Sarawak, Bungo Range (BM).

KEY TO THE VARIETIES

1. Pinnae lobed at least 1/3 towards costa.
   2. Pinnae lobed less than 1/2 towards costa; basal pair of veins often anastomosing **a.** *var.* **pterosporus**
   2. Pinnae lobed 3/5–2/3 towards costa; basal veins rarely anastomosing . . . **b.** *var.* **altilobus**
1. Pinnae crenate . . . . . **c.** *var.* **crenatus**

a. *var.* **pterosporus**

Caudex short, erect. *Stipe* 3–10 cm long, basal scales 8 × 1 mm; base of stipe to first normal pinna 20–30 cm (sterile fronds) 30–45 cm (fertile fronds). *Reduced pinnae* 6–8 pairs, all less than 2 mm long. *Lamina c.* 40 cm long; pinnae to 18 pairs, basal pinnae narrowed to a width of 6–8 mm or less at base; aerophores less than 1 mm long. Hairs on lower surface of *rachis* of sterile fronds thick, brown, curved, to 1 mm long, on fertile paler and shorter; hairs on upper surfaces as on lower surface of sterile. *Largest sterile pinnae* to 12 × 2 cm; base truncate; apex rather abruptly caudate-acuminate; edges lobed less than 1/2 towards costa, lobes falcate with forward-pointing tips; costules 4.5–5 mm apart, at 60° to costa; veins 5–7 pairs, all very oblique, basal pair uniting to form an excurrent vein to sinus or touching just below sinus, next acroscopic vein to side of sinus-membrane or to margin; hairs on *lower surface* of costae 0.3 mm long, pale, closely appressed, on costules and veins similar, sometimes also a few glands, on surface between veins some fine appressed hairs may be present but not glands; hairs on *upper surface* of costae 0.5 mm long with some to 1 mm, on costules and veins short and sparse, sometimes a few appressed hairs between veins. *Fertile pinnae* to 7 × 1.4 cm, lobed a little more deeply than sterile; costules 3.5 mm apart; basal veins more often connivent at the sinus without joining. *Sori* medial; indusia firm with short hairs; sporangia bearing glands; spores with many small separate wings.

Distr. *Malesia*: Southern Malaya (several localities), S. Sumatra, W. Sarawak, in forest at 0–700 m.

b. *var.* **altilobus** HOLTTUM, *var. nov.*

A typo speciei differt: pinnis maximis sterilibus usque 14 × 2.6 *cm, fertilibus* 10 × 1.8 *cm,* 3/5–2/3 *costam versus lobatis; venis infimis plerisque ad sinum conniventibus, raro anastomosantibus.* — Type: MOLESWORTH ALLEN 2736, Perak, Maxwell's Hill, 730 m, in forest, "deep green fronds, brown rachis, quite distinct" (K). Also from Taiping Hills: KUNSTLER 6345, at 750–900 m, "pinnae dark green".

Distr. *Malesia*: Malaya.

c. *var.* **crenatus** HOLTTUM, *var. nov.*

A typo speciei differt: pinnis crenatis; venis 1½*-jugatis anastomosantibus, vena sequente acroscopica ad membranam sinus terminata; pinnis fertilibus usque* 10 × 1.5 *cm.* — Type: JERMY 13870, Sarawak, G. Mulu National Park, by Tapin River (BM). Also M. HOTTA 13809, Brunei, along Sungei Lacquan, 50–300 m (L).

Distr. *Malesia*: Borneo (Sarawak; Brunei).

99. Sphaerostephanos sagittifolius (BL.) HOLTTUM, *comb. nov.* — *Aspidium sagittifolium* BL. Enum. Pl. Jav. (1828) 153; MIQUEL, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 150. — *Nephrodium sagittifolium* (BL.) MOORE, Ind. Fil. (1858) 103; RACIB. Fl. Btzg 1 (1898) 191. — *Dryopteris sagittifolia* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 222; BACKER & POSTH. Varenfl. Java (1939) 52. — *Thelypteris sagittifolia* (BL.) REED, Phytologia 17 (1968) 311. — Type: BLUME, Java (L, *n.* 908, 336–24).

Caudex short, massive, decumbent or suberect; young fronds covered with slime. *Stipe* 15 cm long; scales (*fide* RACIBORSKI) 4 × 3 mm; base of stipe to first large pinna 50–80 cm. *Reduced pinnae* more than 30 pairs, 1.5–2 cm apart, deflexed, upper ones 2.5–3.0 cm long with basal auricle to 1.5 cm, apex acuminate, edges crenate; lowest 1 cm long. *Lamina* 100 cm or more long; several pairs lower pinnae with elongate basal acroscopic auricle in which veins are forked; aerophores thick but hardly 1 mm long. *Rachis* covered with thick spreading hairs more than 1 mm long, both sides. *Largest pinnae* to 20 × 2.3 cm; base truncate, basal acroscopic lobe somewhat elongate; apex caudate-acuminate; edges lobed 2/5 to costa, lobes with falcate tips; costules 5–5.5 mm apart at more than 60°; veins to 10 pairs, pale and prominent on lower surface, 1½–2 pairs anastomosing, 2–2½ pairs to sides of sinus-membrane; hairs on *lower surface* of costae stiff, spreading, of varying length to 1 mm, on costules similar but sparse, a few glands on costules and veins; hairs on *upper surface* of costae 1 mm long, scattered similar hairs on costules and veins, no others. *Sori* medial, basal ones divergent; indusia small with stiff hairs 0.3 mm long; sporangia bearing glands or setae; spores with many small wings.

Distr. *Malesia*: Sumatra, Java, and Lesser Sunda Is. (Lombok).

Ecol. In forest at 1000–1500 m.

Note. v.A.v.R. (Handb. Suppl. 182) reported specimens from New Guinea; I did not find these in Herb. Bog.

100. Sphaerostephanos foliolosus HOLTTUM, *sp. nov.* — *Aspidium hirsutum* and *A. cucullatum sensu* CHRIST, Ann Jard. Bot. Btzg 15 (1898) 134, *quoad Sarasin 745 tantum.*

S. polyoti affinis, differt: pinnis c. 2/5 costam versus lobatis; venis inferioribus 2½–3-jugatis vel anastomosantibus vel ad membranam sinus conniventibus; aerophoris usque 1 mm longis; pinnis redactis superioribus minoribus. — Type: P. & F. SARASIN 745, N. Celebes, G. Matinang 350 m (BAS).

Stipe to 15 cm long; scales broad, thin; base of stipe to first large pinna 60 cm. *Reduced pinnae c.* 30 pairs, 1–1.5 cm apart, upper ones to 12 × 6 mm, lowest 4–8 mm long, shape as in *S. polyotis*, covered with mucilage when young. *Lamina* 65–70 cm long; pinnae 30 pairs, lower ones not narrowed at base; aerophores slender, to 1 mm long. Lower surface of *rachis* densely short-hairy (sometimes with longer hairs?); brown hairs to 1 mm long on upper surface. *Largest pinnae* 15 × 1.8 cm, base subtruncate, symmetric (more cuneate and less symmetric on upper pinnae); apex gradually attenuate, not caudate; edges lobed *c.* 2/5 to costa, lobes falcate with obtusely pointed tips; costules 3 mm apart, at 60° or more; veins 8–10 pairs, 1½ pairs anastomosing, 1½–2 pairs passing to sides of sinus-membrane; hairs on *lower surface* of costae short, dense, mixed with long ones on sterile fronds, sparse hairs with glands on costules and veins, short erect hairs between veins; *upper surface* of costae bearing pale hairs 1 mm long, rest of surface ± closely covered with slender appressed hairs. *Sori* medial; indusia small, pilose; sporangia usually with 1–2 glands, sometimes a seta.

Distr. *Malesia*: N. Celebes, Moluccas (Talaud Islands: LAM 2786, 2788, on river bank at 80–350 m).

Note. LAM's sterile specimens differ from the type (which is fertile) in the presence of hairs 1 mm long on lower surface of rachis and costae.

101. Sphaerostephanos alpinus HOLTTUM, *sp nov.*

Pinnae redactae 6–7-jugatae, superiores 12 mm longae; lamina 45 cm longa; pinnae maximae 9.5 × 1.8 cm, 3/4 costam versus lobatae; costae, costulae venaeque subtus glandulosae, pagina inter venas pilosa; pagina superior pilis appressis vestita; indusia glandulis et pilis brevibus praedita; sporangia nec glandulis nec setis praedita. — Type: A. C. JERMY 5248, N.E. New Guinea, Western Highlands, Keglsugl (BM).

Caudex short, creeping. *Stipe* 15–20 cm long, minutely hairy, basal scales broad, thin; base of stipe to first large pinna 45–50 cm. *Reduced pinnae* 6–7 pairs, 3–4 cm apart, lowest 5–7 mm long, uppermost 12 mm long, somewhat deflexed, narrowly triangular, with auricle 6–8 mm long on acroscopic base. *Lamina* 45 cm long; pinnae to 24 pairs; basal pinnae not or little narrowed at their bases; aerophores thick, hardly 1 mm long. Hairs on lower surface of *rachis* dense, short, spreading, on upper surface 1 mm long. *Largest pinnae* 9.5 cm long, 1.8 cm wide above slightly dilated base; apex acuminate with cauda 1.5 cm; edges lobed almost or quite 3/4 to costa, lobes slightly falcate; costules 3.5–4 mm apart, their bases almost at right angles to costa; veins 9 pairs, at a wide angle, pale and prominent both sides, basal pair anastomosing, next pair usually both to margin; *lower surface* of costae densely covered with short spreading hairs, hairs less dense, with glands, on costules, surface between veins with short erect hairs; hairs 1 mm long on *upper surface* of costae, similar hairs scattered on costules and veins, whole upper surface covered with appressed hairs. *Sori* medial; indusia bearing glands and short hairs; sporangia with neither glands nor setae; spores with many small wings.

Distr. *Malesia*: Papua New Guinea.

Ecol. Type locality at 2500–2750 m, and Mt Wilhelm at 3300–3500 m (NAKAIKE 274).

102. Sphaerostephanos polisianus HOLTTUM, Kalikasan 4 (1975) 65. — Type: M. G. PRICE 431, Luzon, Mountain Prov. Mt Polis (CAHUP; K).

Caudex creeping, 5–6 mm diameter, bearing a close series of fronds. *Stipe* 4–5 cm long, minutely hairy, basal scales short and firm; base of stipe to first large pinna 25–30 cm. *Reduced pinnae* 3–4 cm apart, all very small. *Lamina* to 28 cm long; pinnae 14 pairs, lowest narrowed at their bases; aerophores 1 mm long. Lower surface of *rachis* covered with very short erect reddish hairs, upper surface with thick curved dark red hairs 0.5 mm long. *Largest pinnae* 6.5 × 1.3 cm; base subtruncate; apex short-acuminate; edges lobed ½ way to costa, lobes oblique with forward-pointing obtuse tips; costules 3–3.5 mm apart at 60°; veins 6–7 pairs, slender and prominent on lower surface, basal pair anastomosing, next acroscopic vein to side of short sinus-membrane; *lower surface* of costae covered with hairs 0.1 mm long or a little more, antrorse at least distally, few similar hairs on costules, glands on costules and veins; hairs on *upper surface* of costae 0.3 mm long, rest of upper surface glabrous. *Sori* medial; indusia small, glabrous; sporangia sometimes with a gland.

Distr. *Malesia*: Philippines (Luzon); only known from the type.

Note. This should perhaps be regarded as a form of *S. lobatus.*

103 Sphaerostephanos hoalensis HOLTTUM, *sp. nov.* — *Dryopteris ceramica* ROSENST. MS, *non* v.A.v.R.

Pinnae redactae c. 13-jugatae, superiores 15 × 8 mm, infimae 10 mm longae; aerophora elongata; pinnae maximae 11 × 2 cm, dimidio costam versus lobatae; costae subtus pilis erectis usque

1 mm *longis vestitae, costulae pilis brevioribus glandulisque praeditae; pagina superior pilis appressis vestita; indusia pilifera; sporangia glandulifera.* — Type: STRESEMANN 110, Ceram, Central Mts, G. Hoale, 1000 m (L).

Stipe lacking. *Reduced pinnae* 2.5 cm apart, *c.* 13 pairs, one near the base 10 mm long, uppermost 15 × 8 mm, deflexed, slightly auricled on acroscopic base, edges crenate, apex obtuse to rounded. *Lamina c.* 60 cm long; lowest pinnae not narrowed at base; aerophores elongate. Lower surface of *rachis* covered with erect hairs 0.2–0.3 mm long and some longer ones, hairs on upper surface 1 mm long. *Largest pinnae* 11 × 2 cm; base truncate; apex abruptly short-acuminate; edges lobed *c.* ½ way to costa, lobes oblique, slightly falcate; costules 3 mm apart, at more than 60°; veins 9 pairs, 1½ pairs anastomosing, next acroscopic vein to sinus-membrane; *lower surface* of costae hairy as rachis, costules and veins less densely covered with shorter hairs and some glands, surface between veins bearing short erect hairs; hairs on *upper surface* of costae 1 mm long, shorter ones on costules, appressed hairs all over surface. *Sori* small, medial to supramedial, lower ones a little divergent; indusia with many rather long hairs; sporangia bearing 1 or 2 glands.

Distr. *Malesia*: Moluccas (Central Ceram, 2 collections, second one *n.* 57).

Ecol. In the mountains, 1000 m.

104. Sphaerostephanos larutensis (BEDD.) C. CHR. Ind. Fil. Suppl. III (1934) 172. — *Nephrodium larutense* BEDD. Handb. Suppl. (1892) 73. — *Mesochlaena larutensis* (BEDD.) v.A.v.R. Handb. (1908) 232, *incl. var. borneensis.* — *Cyclosorus larutensis* (BEDD.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 245; HOLTTUM, Rev. Fl. Mal. (1955) 284, f. 165. — *Thelypteris larutensis* (BEDD.) REED, Phytologia 17 (1968) 286. — Lectotype (here selected): KUNSTLER 2398, Perak, Larut (K).

Mesochlaena sumatrensis v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 160. — *S. sumatrensis* (v.A.v.R.) C. CHR. Ind. Fil. Suppl. III (1934) 172. — Type: BROOKS 391, Sumatra, Benkoelen, Lebong Tandai (BO; BM). — **Fig. 12d–e.**

Caudex short, creeping. *Stipe* 20–30 cm long, above base covered with spreading hairs to 1 mm long; base of stipe to first large pinna 40–70 cm. *Reduced pinnae* 6–12 pairs, lower ones less than 1 cm long, upper ones *c.* 1.5 × 1.2 cm, spreading, triangular, edges crenate, apex acute; an intermediate pair sometimes present. *Lamina* 50–70 cm long; apex pinna-like; pinnae *c.* 12 pairs, well spaced; lower pinnae narrowed towards their bases; middle pinnae with truncate bases, upper ones broadly cuneate; aerophores not elongate. *Rachis* covered throughout with slender light brown hairs 1–1.5 mm long. *Largest pinnae* 20–30 cm long, 2.5–3.8 cm wide, acuminate with cauda 1–3 cm long; edges lobed 1/4–1/3 to costa, lobes falcate with forward-pointing obtuse tips; costules 4.5–6 mm apart; veins to 11 pairs, 1½–2 pairs anastomosing, next 2 pairs to sides of long sinus-membrane; *lower surface* of costae covered with erect hairs 0.5–1 mm long, shorter hairs on costules, veins and between veins, some glands with the hairs on costules and veins; *upper surface* of costae covered with fine pale antrorse hairs, on costules and veins much shorter hairs with scattered long ones, surface between veins glabrous or with suberect hairs. *Sori* medial, about twice as long as wide; indusia large, thin, bearing slender hairs and glands; sporangia bearing neither glands nor setae on body, hair on stalk of several cells, terminal one acicular and thick-walled; spores with many small wings.

Distr. *Malesia*: Malaya, Sumatra, Borneo.

Ecol. In forest at 50–1000 m.

Note. v.A.v.R. distinguished *var. borneensis* which has many glands and no hairs on indusia. His *M. sumatrensis* was based on a rather small specimen. Glands are apparently sometimes lacking on lower surface of costules.

105. Sphaerostephanos loherianus (CHRIST) HOLTTUM, Kalikasan 4 (1975) 61. — *Aspidium loherianum* CHRIST, Bull. Herb. Boiss. 6 (1893) 191. — *Dryopteris loheriana* (CHRIST) C. CHR. Ind. Fil. (1905) 275; CHRIST, Philip. J. Sci. 2 (1907) Bot. 207; v.A.v.R. Handb. (1908) 221, 820. — *Cyclosorus loherianus* (CHRIST) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 342. — *Thelypteris loheriana* (CHRIST) REED, Phytologia 17 (1968) 289. — Type: LOHER 900, Luzon, Montalban, Oct. 1890 (P; K).

Caudex creeping, sometimes with well-spaced fronds. *Stipe* 5–30 cm long, reddish, glabrescent; base of stipe to first large pinna 40–50 cm. *Reduced pinnae* 5–15 pairs, deflexed, strongly auricled, uppermost 6–10 mm long, lowest 2–5 mm. *Lamina* to 60 cm or more long; pinnae well spaced, several lower pairs narrowed towards their bases; aerophores slightly swollen. Lower surface of *rachis* densely covered with short erect hairs, those on upper surface to 1 mm long. *Suprabasal pinnae* of type 11 × 1.8 cm, of largest specimen 30 × 3.2 cm; basal lobes somewhat reduced; apex acuminate, sometimes with cauda to 2 cm; edges lobed to 2 mm from costa, lobes slightly falcate, narrowed gradually from base; costules 4–4.5 mm apart, almost at right angles to costa; veins of type to 14 pairs, of largest specimen 24 pairs, basal veins near base of pinna often anastomosing to form a short excurrent vein, those near apex of pinna connivent at the sinus without uniting; *lower surface* of costae densely covered with erect hairs 0.3–0.5 mm long, on some specimens to 1 mm, on costules and veins shorter hairs and some glands, short erect hairs between veins; hairs on *upper surface* of costae to 1 mm

long, scattered similar hairs on costules and veins, between veins a variable number of short hairs. *Sori* all close to margin; indusia small, covered with short hairs and sometimes a few glands; sporangia setiferous, rarely with a gland.

Distr. *Malesia*: Philippines (N. Luzon).

Ecol. In mountain forest, 1500–2000 m; smaller specimens apparently from streamsides in open places.

106. Sphaerostephanos erectus (COPEL.) HOLTTUM, Kalikasan 4 (1975) 64. — *Cyclosorus erectus* COPEL. Philip. J. Sci. 81 (1952) 30, t. 22; Fern Fl. Philip. (1960) 346. — *Thelypteris erecta* (COPEL.) REED, Phytologia 17 (1968) 275. — Type: RAMOS BS 41550, Leyte, Cabalian (US; B).

Caudex slender, erect, to 100 cm tall. *Stipe* 10 cm long, reddish, minutely hairy; base of stipe to first large pinna 45 cm. *Reduced pinnae* to at least 6 pairs, uppermost 5 mm long. *Lamina* to 50 cm long; pinnae 15 pairs, lower ones narrowed on basiscopic side near base; apex of frond narrowly triangular and deeply lobed with abrupt transition to pinnae; aerophores not elongate. Hairs on *rachis*, both sides, to 1 mm long, thick, brown. *Suprabasal pinnae* to 14 × 2.8 cm; base truncate; apex rather abruptly caudate-acuminate; edges lobed 3/5–2/3 to costa, lobes falcate; costules 4–5.5 mm apart, at more than 60°; veins 10–12 pairs, prominent on lower surface, basal pair anastomosing, second pair touching sides of sinus-membrane; hairs on *lower surface* of costae spreading, of varied length to 1 mm, on costules shorter with glands; hairs on *upper surface* of costae 1 mm long, on costules short, sometimes with a few glands, rest of upper surface glabrous. *Sori* medial; indusium firm, large, short-hairy; sporangia bearing glands.

Distr. *Malesia*: Philippines (Leyte, 2 collections; Biliran).

Ecol. In mossy forest at 1000 m (M. G. PRICE 3278).

Note. M. G. PRICE informs me that SULIT PNH 20306 from Biliran, which he identifies with this species, has a few glands on upper surface of costules; I have seen none in this position on the specimens from Leyte.

107. Sphaerostephanos stresemannii HOLTTUM, *sp. nov.*

Basis frondis imperfecta; *pinnae infimae* 12 *cm longae, medio* 3.2 *cm latae, basin versus angustatae*; *pinnae suprabasales usque* 10 × 2.7 *cm, oppositae*, 3/4 *costam versus lobatae*; *costae subtus pilis erectis usque* 0.5 *mm longis vestitae, costulae venaeque pilis sparsis glandulisque praeditae*; *pagina superior inter venas pilis brevibus suberectis instructa*; *sori exindusiati*; *sporangia setifera*. — Type: STRESEMANN 416, Moluccas, Buru, G. Fogha 1400 m (L).

Caudex and *stipe* lacking. *Reduced pinnae* at least 2 pairs, 3–4 mm long; above them are an intermediate unequal pair 1.0 and 2.0 cm long. *Lamina* 42 cm long; apex narrowly deltoid with gradual transition to upper pinnae; pinnae 15 pairs, almost opposite; basal pinnae largest, 12 × 3.2 cm, widest in middle and narrowed to base both sides, basiscopic lobes longer than acroscopic; aerophores swollen, not elongate. Hairs on lower surface of *rachis* dense, short, erect, with scattered longer ones to 0.7 mm, hairs on upper surface longer and appressed. *Suprabasal pinnae* to 10 × 3.0 cm; base truncate; apex short-acuminate; edges lobed fully 3/4 to costa, lobes hardly falcate, slightly tapered; costules 4.5 mm apart at more than 60°; veins 10 pairs, slender, pale both sides, 1 pair anastomosing, next acroscopic veins to side of short sinus-membrane; hairs on *lower surface* of costae as on rachis, on costules and veins more sparse and shorter spreading hairs with glands; short erect hairs on surface between veins; hairs on *upper surface* of costae more than 0.5 mm long, similar hairs scattered on costules and veins, between veins short suberect hairs. Sori medial; indusia lacking; sporangia copiously setose; spores with many small wings.

Distr. *Malesia*: Moluccas (Buru), 1400 m.

108. Sphaerostephanos simplicifolius (J. SM. *ex* HOOK.) HOLTTUM, Kalikasan 4 (1975) 61. — *Aspidium simplicifolium* J. SM, *ex* HOOK. Ic. Pl. 10 (1854) t. 919. — *Polypodium simplicifolium* (J. SM.) HOOK. Sp. Fil. 5 (1863) 2, excl. SEEMANN 736 (Fiji). — *Dryopteris canescens var.* C. CHR. Ind. Fil. (1905) 256. — *Dryopteris simplicifolia* (J. SM.) CHRIST, Philip. J. Sci. 2 (1907) Bot. 206. — *Phegopteris simplicifolia* (J. SM.) v.A.v.R. Handb. (1908) 500. — *Cyclosorus simplicifolius* (J. SM.) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 371. — *Thelypteris simplicifolia* (J. SM.) REED, Phytologia 17 (1968) 314. — Type: CUMING 315, Samar (K; E, G, L).

Caudex short-creeping; *stipe* to 20 cm long, pale; basal scales 7 × 1 mm; base of stipe to first normal pinna 40–50 cm; *reduced pinnae* to 6–7 pairs, lowest 3 mm long, uppermost 10 mm, triangular with asymmetric base. *Lamina* to 50 cm long; apex pinna-like, pinnae to 8 pairs, lowest somewhat narrowed at base; aerophores not elongate. Hairs on both sides of *rachis* pale, longest more than 1 mm rather sparse, with shorter ones. *Largest pinnae* to 16 × 4 cm; base broadly cuneate, not auricled; apex abruptly short-acuminate; edges crenate to subentire; costules 4–4.5 mm apart, at 60°; veins to 10 pairs, pale and prominent on lower surface, almost all anastomosing to produce a zig-zag excurrent vein; copious stiff short erect hairs on *lower surface* of costae with scattered long ones, on costules and veins fewer short hairs and also glands; hairs on *upper surface* of costae and costules short with scattered long ones. *Sori* near apices of veins,

basal ones on veins from adjacent costules sometimes confluent; indusia with many short hairs; sporangia with many glands; spores with many broad translucent wings which anastomose.

Distr. *Malesia*: Philippines (Samar, Leyte, Biliran).

Note. The original description was based on a partially fertile small plant with apical lamina much larger than the pinnae. The above description is based on fully grown plants from other collections. Both the type and larger specimens have glands on sporangia, not setae as stated by COPELAND. In Sp. Fil. vol. 5 HOOKER misidentified a specimen of the exindusiate *Pronephrium beccarianum* (from Fiji) with the present species, for which reason he transferred the latter to *Polypodium*.

109. Sphaerostephanos spenceri (CHRIST) HOLTTUM, Kalikasan 4 (1975) 58. — *Dryopteris spenceri* CHRIST, Philip. J. Sci. 2 (1907) Bot. 206; v.A.v.R. Handb. Suppl. (1917) 188. — *Phegopteris spenceri* (CHRIST) v.A.v.R. Handb. (1908) 508. — *Cyclosorus spenceri* (CHRIST) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 350. — *Thelypteris spenceri* (CHRIST) REED, Phytologia 17 (1968) 314. — Type: COPELAND 1464, Mindanao, Davao Distr., Todaya (P; B, US).

Caudex short, suberect or creeping. *Stipe* 5–10 cm long, densely short-hairy; base of stipe to first large pinna 35 cm. *Reduced pinnae* to at least 10 pairs, lowest 5–10 mm long, uppermost to 2 cm long, 1.5 cm wide above auricled acroscopic base, triangular, crenate. *Lamina* 45 cm long; apex narrowly triangular, deeply lobed at base; pinnae to at least 10 pairs; basal pinnae not narrowed at base; aerophores not elongate. Hairs on both sides of *rachis* dense, c. 0.3 mm long, with some less abundant 1 mm or more long. *Largest pinnae* 8.5 × 2.0 cm; base broadly rounded to subcordate on basiscopic side, truncate to broadly cuneate on acroscopic; apex short-acuminate; edges crenate to a depth of 1 mm or a little more; costules 4½–5 mm apart, at 60°; veins 7–8 pairs, prominent on lower surface, 2–2½ pairs anastomosing to form a zig-zag excurrent vein, 2–2½ pairs passing to sides of sinus-membrane; *lower surface* of costae hairy as rachis, hairs on costules shorter with some glands, short erect hairs on surface between veins; hairs on *upper surface* of costae 0.3–0.4 mm long, on costules shorter. *Sori* medial, distinctly elongate; indusia with short hairs; sporangia bearing glands.

Distr. *Malesia*: Philippines (E. & S.E. Mindanao).

Note. CHRIST failed to see the indusia and thus at first misled v.A.v.R. The short stipe and deeply lobed apical lamina appear to be distinctive and are shown by M. G. PRICE 2790 from Agusan del Sur Province, which is a rather small sterile plant differing from the type in scattered long hairs on the upper surface of costules and veins and in abundant glands on lower surface of costules and veins.

110. Sphaerostephanos mengenianus HOLTTUM, *sp. nov.*

Caudex 40 *cm longus, erectus*; *pinnae omnes oppositae, basi late cuneatae*; *pinnae redactae* 8-*jugatae, maximae* 2 × 2 *cm*; *pinnae normales* 13.5 × 2.0 *cm, crenatae*; *pili paginae inferioris omnes breves*; *costulae subtus glanduliferae*; *indusia pilifera*; *sporangia glandulifera*? (*non setifera*). — Type: STEVENS & LELEAN LAE 58680, E. New Britain, in *Castanopsis* forest, 900 m (K; L).

Caudex erect, 50 cm tall (collectors). *Stipe* 15 cm long, minutely hairy, dull reddish; base of stipe to first large pinna 60 cm. *Reduced pinnae* opposite, 5–6 cm apart, lowest 7 mm long, uppermost 2 × 2 cm, almost symmetrically rhombic with basal angle more than 90°, apical angle less than 90°, subentire; one pair intermediate pinnae 4 cm long also present. *Lamina* 55 cm long; apex not pinna-like; pinnae 20 pairs, all opposite; basal pinnae not narrowed at base; aerophores not elongate. Hairs on lower surface of *rachis* 0.2 mm long, slender, appressed, on upper surface thicker, antrorsely curved, 0.5 mm long. *Largest pinnae* 13.5 × 2.0 cm; base broadly cuneate and slightly dilated both sides; apex acuminate, not caudate; edges crenate to a depth of 1.5 mm or little more; costules 4.5–5 mm apart, at less than 60°; veins 7–8 pairs, 2–2½ pairs anastomosing to form a zig-zag excurrent vein, 1½–2 pairs passing to rather long sinus-membrane; *lower surface* of costae covered with slender appressed hairs 0.2 mm long, similar sparse hairs with glands on costules, surface between veins glabrous, eglandular; hairs on *upper surface* of costae 0.5 mm long, rest of upper surface glabrous. *Sori* medial; indusia rather small, thin, with short hairs; sporangia probably with glands, not setiferous.

Distr. *Malesia*: Papua New Guinea (New Britain), only the type.

Ecol. In *Castanopsis* forest, 900 m.

111. Sphaerostephanos confertus (BRAUSE) HOLTTUM, Webbia 30 (1976) 194. — *Dryopteris conferta* BRAUSE, Bot. Jahrb. 49 (1912) 22, f. 1F; v.A.v.R. Handb. Suppl. (1917) 175. — *Cyclosorus confertus* (BRAUSE) COPEL. Gen. Fil. (1947) 142; HOLTTUM & ROY, Blumea 13 (1965) 134. — *Thelypteris conferta* (BRAUSE) REED, Phytologia 17 (1968) 268. — Type: SCHLECHTER 17864, N.E. New Guinea, Rani Mts 700 m (B; K, L, P, UC).

Dryopteris terrestris COPEL. Univ. Cal. Publ. Bot. 18 (1942) 221. — *Cyclosorus terrestris* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 454, pl. 34. — *Thelypteris terrestris* (COPEL.) REED, Phytologia 17 (1968) 319. —

Type: BRASS 13660, New Guinea, Idenburg River, in forest at 700 m (MICH; BO, L).

Caudex short, creeping, branched, apices of branches with tufts of fronds. *Stipe* 5–15 cm long, minutely hairy; basal scales narrow, firm; base of stipe to first large pinna 15–30 cm. *Reduced pinnae* 5–6 pairs, uppermost 6–12 mm long and wide, broadly triangular, lowest 3–5 mm long. *Lamina* 30–40 cm long; apex deltoid, deeply lobed; pinnae to 15 pairs, basal ones slightly narrowed at base which in some cases is slightly auricled; aerophores not elongate. Lower surface of *rachis* covered with short erect pale hairs; upper surface with long curved brown hairs and shorter ones in the groove. *Largest pinnae* 5–10 cm long, 1.5–2.0 cm wide, in some cases widest 1/3 from apex; base truncate, in some cases a little dilated both sides or only on acroscopic side; apex abruptly short-acuminate, with or without a short cauda; edges crenate throughout (near apex only in small pinnae) to a depth of 1–2 mm; costules commonly 4 mm apart, at 60°; veins 5–6 pairs, 2 pairs anastomosing to form a zig-zag excurrent vein, 1–2 pairs to rather long sinus-membrane; *lower surface* of costae covered with antrorse (not closely appressed) hairs 0.1–0.3 mm long, hairs on costules and veins sparse, sometimes with a few glands, short erect hairs on surface between veins; hairs on *upper surface* of costae 0.3–0.4 mm long, a few minute hairs on costules, between veins a variable number of short appressed hairs. *Sori* medial; indusia with many short stiff hairs; sporangia bearing several setae, sometimes also a gland; spores minutely papillose.

Distr. *Malesia*: New Guinea and Waigeo; at low altitudes in forest.

Note. Many collections from eastern New Guinea, none from west except Waigeo.

112. Sphaerostephanos multiauriculatus (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris multiauriculata* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 221. — *Cyclosorus multiauriculatus* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 453, pl. 32. — *Thelypteris multiauriculata* (COPEL.) REED, Phytologia 17 (1968) 294. — Type: BRASS 12850, New Guinea, Idenburg River, 1150 m, in gullies in forest (MICH; BM, L).

Caudex erect, to 40 cm tall, 1.5 cm diameter. *Stipe* 5–10 cm long, reddish, minutely hairy, with many narrow scales 10 mm long. *Lamina* 150 cm long, somewhat dimorphous; pinnae to 45 pairs, lower 12–15 pairs gradually reduced, lowest 1 cm long, suprabasal ones spreading, broadly triangular with symmetric base; aerophores elongate barely to 1 mm. Lower surface of *rachis* of fertile frond densely covered with short appressed hairs, hairs on upper surface similar but with some thick brown hairs 1.5 mm long; similar long thick hairs sometimes present on lower surface of sterile fronds. *Largest sterile pinnae* to 15 × 1.8 cm; base subtruncate; apex short-acuminate, not caudate; edges crenate to a depth of 1 mm; costules 3 mm apart, at 60°; veins to 7 pairs, slender and prominent both sides, 3–3½ pairs anastomosing to form a zig-zag excurrent vein, 1 pair to very short sinus-membrane; *lower surface* of costae, costules and veins covered with appressed hairs 0.1–0.3 mm long, a few similar hairs on surface between veins, glands lacking; *upper surface* of costae covered with hairs less than 0.5 mm long, rest of surface glabrous. *Fertile pinnae* to 9× 1.0 cm; sori medial, often spreading a little along veins; no indusia; sporangia sometimes bearing a few glands, not setae.

Distr. *Malesia*: Eastern New Guinea at 750–1220 m.

113. Sphaerostephanos stipellatus (BL.) HOLTTUM, *comb. nov.* — *Aspidium stipellatum* BL. Enum. Pl. Jav. (1828) 152; MIQUEL, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 160. — *Nephrodium stipellatum* (BL.) MOORE, Ind. Fil. (1858) 105; RACIB. Fl. Btzg 1 (1898) 188. — *Dryopteris stipellata* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 227; BACKER & POSTH. Varenfl. Java (1939) 49. — *Thelypteris stipellata* (BL.) K. IWATS. Acta Phytotax. Geobot. 21 (1965) 168. — Type: BLUME, Java (L, *n.* 908, 337–123).

Caudex thick, short-creeping, apex and very young fronds covered with slime. *Stipe* 10 cm long, glabrescent; scales very thin; base of stipe to first large pinna 65 cm. *Reduced pinnae* 2–3 cm apart, to 15 pairs or more, lowest 6 mm long, uppermost 12 mm long, deflexed, narrowly triangular and strongly auricled. *Lamina* to 70 cm long; pinnae to 30 pairs, lower ones not narrowed at their bases; aerophores thick, to 2 mm long. Hairs on lower surface of *rachis* of fertile fronds 0.3 mm long, closely appressed, on sterile ones sparse longer hairs also; on upper surface pale, spreading, 1 mm long. *Largest pinnae* commonly 12 × 1.8 cm; base subtruncate; apex acuminate, apical 1.5 cm entire; edges lobed *c.* 1/3 to costa (always less than ½), lobes of fertile fronds distinctly falcate; costules 3.5–4.5 mm apart, at a wide angle; veins 6–8 pairs, 1 pair anastomosing, next acroscopic vein to side of short sinus-membrane; hairs on *lower surface* of costae and costules short, closely appressed, with a few longer ones distally on costae, few or none on veins and surface between them, no glands; hairs on *upper surface* of costae 1 mm long, scattered similar hairs on costules and veins. *Sori* medial; indusia firm, with a few glands; sporangia bearing glands; spores finely spinulose.

Distr. *Malesia*: Java, Sumatra.

Ecol. In forest at 1000–1700 m.

114. Sphaerostephanos plurifolius (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris plurifolia*

v.A.v.R. Bull. Jard. Bot. Btzg III, 5 (1922) 201. — *Thelypteris plurifolia* (v.A.v.R.) REED, Phytologia 17 (1968) 305. — Type: LÖRZING 6393, Sumatra, Deli, Bandar-baroe, 800 m (BO).

Caudex erect, 20–30 cm tall, apex and young fronds covered with mucilage; *stipe* 10–15 cm long; base of stipe to first normal pinna 40–50 cm; *reduced pinnae c.* 4 cm apart, to 8 pairs, lowest very small, upper ones 6 mm long. *Lamina* 70 cm or more long; pinnae to 25 pairs, 3 or more pairs of lower ones distinctly narrowed towards their bases, basal ones much narrowed; aerophores to 2 mm long. Hairs on lower surface of *rachis* very short, erect, on upper surface 0.5 mm long, or to 1 mm on sterile fronds. *Largest suprabasal pinnae* commonly 15 × 2 cm (sterile to 25 × 3.2 cm); base truncate; apex acuminate; edges lobed 2/3–3/4 towards costa, lobes falcate; costules 3.5–5 mm apart, at more than 60° to costa; veins 10–13 pairs, basal pair anastomosing, next pair both passing to margin or the acroscopic vein to sinus-membrane; *lower surface* of costae, costules and veins covered with short pale appressed hairs, without glands, area between veins glabrous; hairs on *upper surface* of costae short, with some longer ones, similar long hairs scattered on costules and veins. *Sori* medial; indusia large, firm, with a few hairs; sporangia usually bearing glands.

Distr. *Malesia*: Sumatra.

Note. The type has distinctly dimorphous fronds, but a specimen from Gunong Kerinci (ROBINSON & KLOSS *s.n.* at BM) has fertile pinnae to 3.2 cm wide.

115. Sphaerostephanos hendersonii HOLTTUM, *sp. nov.*

Pinnae redactae c. 8-jugatae, usque 6 mm longae; pinnae normales usque 14 × 2.3 *cm, 3/5 costam versus lobatae, basi aerophoris longis praeditae, subtus eglandulosae; venae 10-jugatae, infimae solum anastomosantes; rachis, costae costulaeque subtus pilis adpressis vestitae; sori mediales; indusia parva, tenuia, sparsim pilosa; sporangia glandulifera.* — Type: HENDERSON 23352, Malaya, Cameron Highlands, 1500 m (K; SING).

Caudex short, erect or suberect; *stipe* 10–15 cm long; base of stipe to first normal pinna 40–50 cm; *reduced pinnae c.* 4 cm apart, *c.* 8 pairs, uppermost 6 mm long, rest very small. *Lamina* excluding reduced pinnae 70 cm long; pinnae more than 20 pairs; basal pinnae narrowed towards their bases which are 1.2 cm wide; aerophores to almost 2 mm long. *Largest pinnae* (fertile) 14 × 2.3 cm; base truncate; apex abruptly short-acuminate with narrow entire cauda 1–2 cm long; edges lobed to 4 mm from costa; costules 4–5 mm apart, at more than 60°; veins to 10 pairs, basal pair anastomosing, next acroscopic vein passing to the sinus-membrane, sometimes a basiscopic vein also; *lower surface* of rachis bearing slender appressed pale hairs 0.2 mm long (sometimes sparse), costae and costules bearing many appressed hairs 0.3–0.4 mm long, on and between veins neither hairs nor glands; *upper surface* of rachis bearing pale curved hairs 0.5 mm long, hairs on costae to 1 mm or more, similar hairs rare on costules and veins, surface between veins bearing a variable number of appressed hairs. *Sori* medial, basal ones not divergent; indusia small, thin, with a few hairs; sporangia bearing glands.

Distr. *Malesia*: Malaya (Cameron Highlands, 3 collections); N. Sumatra at 1700 m.

Note. The Sumatran specimens (SURBECK 747, 1201) are somewhat smaller than those from Malaya, with pinnae lobed a little less deeply, and have a seta on some sporangia.

116. Sphaerostephanos posthumii HOLTTUM, *sp. nov.*

Pinnae redactae c. 10-jugatae, usque 4 mm longae; pinnae normales usque 12.5 × 1.5 *cm, basi aerophoris 1 mm longis praeditae, profunde lobatae; venae infimae prope sinum conniventes, vel liberae vel anastomosantes; pagina inferior pinnarum eglandulosa, pagina superior pilis adpressis vestita; indusia parva, brevi-pilosa; sporangia glandulifera.* — Type: POSTHUMUS 3157, Flores, near Sita, 600–700 m (BO).

Caudex not known; *stipe* 24 cm long, basal scales broad, thin, with rather long superficial hairs; base of stipe to first normal pinna 80 cm; *reduced pinnae c.* 5 cm apart, uppermost 4 mm long. *Lamina* 60 cm long, excluding reduced pinnae; pinnae 20 pairs; lowest large pinnae much narrowed towards their bases, several successive pairs gradually less narrowed; aerophores 1 mm long. *Rachis* on both surfaces covered with pale appressed hairs *c.* 0.6 mm long. *Largest pinnae* (fertile) 12.5 × 1.5 cm, sessile; apex gradually attenuate, not caudate; edges lobed to 1.5–2 mm from costa, lobes slightly falcate; costules 3–3½ mm apart, at 60°; veins 10–12 pairs, basal pair either both touching sides of a short sinus-membrane or meeting just below it to form a short excurrent vein; *lower surface* of costae and costules closely covered with pale appressed hairs, between veins some shorter appressed hairs, glands lacking; *upper surface* throughout covered with pale appressed hairs 0.3–0.4 mm long. *Sori* a little inframedial, basal ones not much divergent; indusia rather small, thin, with many hairs 0.2 mm long; sporangia often with a gland.

Distr. *Malesia*: Lesser Sunda Is. (Flores), only known from type.

117. Sphaerostephanos inconspicuus (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris inconspicua* COPEL. Philip. J. Sci. 12 (1917) Bot. 55; C. CHR Gard. Bull. Str. Settl. 7 (1934) 242. — *Thelypteris inconspicua* (COPEL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 252. — Type: TOPPING

1543, Sabah, Mt Kinabalu, Kiau (isotype NY). — **Fig. 12n–p.**

Caudex short, creeping. *Stipe* 4–8 cm long, minutely hairy; base of stipe to first large pinna 15–30 cm. *Reduced pinnae* 4–7 pairs, all very small, not opposite. *Lamina* cm long; pinnae to 25 pairs, basal pinnae narrowed at base; aerophores not elongate. Hairs on lower surface of *rachis* variable, sometimes very few on fertile fronds, on sterile often many, thick, curved, 0.5 mm or more long; hairs on upper surface 0.8–1.0 mm long. *Largest pinnae* 3.5 × 0.8 to 6.0 × 1.3 cm; base subtruncate; basal acroscopic lobe sometimes elongate; apex acuminate, sometimes caudate; edges lobed to 1–1.5 mm from costa, lobes oblique; costules 3–3.5 mm apart, usually at less than 60°; veins 4–5 pairs, slender, basal acroscopic vein touching short sinus-membrane, basal basiscopic vein to edge above base of sinus; hairs on *lower surface* of costae 0.2–0.3 mm long, pale, appressed, fewer on costules, sometimes with rudimentary scales which have a glandular tip, sessile spherical glands usually lacking; hairs on *upper surface* of costae less than 0.5 mm long, no others. *Sori* medial; indusia rather large with a few short hairs or glabrous; sporangia bearing a gland or a seta; spores not seen.

Distr. *Malesia*: Borneo; several localities, in forest at 1200–1800 m.

118. Sphaerostephanos subulifolius (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris subulifolia* v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 22. — *Thelypteris subulifolia* CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 254. — Type: BROOKS 334 *partim*, Sumatra, Benkoelen, Lebong Simpang (BO; BM).

Closely allied to *S. inconspicuus*, differing as follows: reduced pinnae 2–3 pairs, all very small; normal pinnae to 30 or more pairs; pinnae abruptly short-acuminate, lobed to 1 mm from costa; hairs on lower surface of costae 0.5 mm long, not closely appressed.

Distr. *Malesia*: Southern Sumatra, 3 collections.

Notes. The differences between this and *S. inconspicuus* need checking from further collections from Sumatra. BROOKS 334 at BM includes specimens of *Coryphopteris hirsutipes* (CLARKE) HOLTTUM.

119. Sphaerostephanos mjobergii HOLTTUM, *sp. nov.*

S. inconspicuo (Copel.) Holttum affinis, differt: pinnis evolutis 27-jugatis, usque 3.6 × 1.0 cm metientibus, ad alam 0.5 mm latam lobatis; venis infimis omnibus ad marginem supra basin sinuum terminatis; costis subtus pilis patentibus vestitis. — Type: E. MJÖBERG *s.n.* Sarawak, Mt Poi, 1370–1520 m (BM).

Caudex and stipe missing. *Reduced pinnae* all very small, 2–3 pairs on specimen. *Lamina* 30 cm long; pinnae 27 pairs; basal pinnae apparently narrowed on basiscopic side only; aerophores not elongate. Hairs on lower surface of *rachis* 0.2–0.3 mm long, copious. *Largest pinnae* 3.6 × 1.0 cm; base symmetric, subtruncate; apex rather abruptly acute; edges lobed to 0.5 mm from costa, lobes hardly falcate; costules to 2.5 mm apart; veins 3–4 pairs, basal ones both passing to margin above base of sinus; *lower surface* of costae covered with somewhat antrorse hairs 0.2–0.3 mm long, longer hairs scattered on costules; hairs on *upper surface* of costae short, with longer ones scattered on distal parts of costae and on costules. *Sori* inframedial; indusia sparsely hairy; sporangia bearing glands; spores with a narrow erose wing, surface otherwise bearing scattered small wings or papillae.

Distr. *Malesia*: Borneo (Sarawak), only known from the type.

120. Sphaerostephanos mutabilis (BRAUSE) HOLTTUM, *comb. nov.* — *Dryopteris mutabilis* BRAUSE, Bot. Jahrb. 56 (1920) 97. — *Cyclosorus mutabilis* (BRAUSE) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 443. — *Thelypteris mutabilis* (BRAUSE) REED, Phytologia 17 (1968) 295. — Type: LEDERMANN 9745, N.E. New Guinea, Sepik Distr., on rocks, 200–400 m (B; UC).

Caudex short, erect. *Stipe* 5–8 cm long, reddish, glabrous; scales *c.* 2 × 1 mm. *Lamina* to 20 cm long; apex pinna-like; pinnae 10 pairs, lower 3–4 pairs gradually smaller, lowest 5–10 mm long; aerophores not elongate. *Largest pinnae* commonly 6 × 0.3 cm (to 8.5 × 0.5 cm, *fide* BRAUSE); base and apex narrowly attenuate, edges entire; costules 1.5 mm apart, very oblique, forked or simple, without anastomosis; *lower surface* quite glabrous; *upper surface* hairy in groove of rachis only. *Sori* in one row on each side of costa, often on both branches of a costule; indusia large, firm, with a few glands; sporangia sometimes bearing glands; spores minutely spinulose.

Distr. *Malesia*: New Guinea. Known only from type and BRASS 13047 from Idenburg River.

Ecol. In forest, "massed in semi-shade on steep flood-swept bank of river" (BRASS), 200–850 m.

121. Sphaerostephanos uaniensis HOLTTUM, *sp. nov.*

Stipes 5 cm longus; pinnae redactae 3–4-jugatae; lamina 33 cm longa, pinnae normales 12-jugatae, superiores plures non liberae; pinnae liberae subintegrae, basi auriculatae; costae subtus pilis erectis 0.1–0.2 mm longis vestita, pagina inferior cetera pilis brevioribus praedita, eglandulosa; sori elongati; indusia parva (vel nulla?); sporangia interdum glandula una praedita. — Type: T. G. WALKER 10132, cult. Kew, origin New Britain, Uani River (BM).

Stipe 5 cm long; *lamina* in all 33 cm long, consisting of 3 pairs of reduced pinnae (basal one 7 × 5 mm with stalk 1.5 mm, uppermost 1.2 × 0.6 cm with auricled base), 1 intermediate pair (unequal) 2.0 and 2.7 cm long, and 12 pairs normal pinnae of which several upper ones are adnate to the rachis. *Largest pinnae* 4.2 cm long, 1.4 cm wide at the auricled base, 1.1 cm wide above base; apex rather abruptly obtuse; edges irregularly sinuous; costules 2.5–3 mm apart, at *c.* 45°; veins 3 pairs, 2 pairs anastomosing, slender, concolorous; *lower surface* of rachis bearing sparse stiff curved pale hairs 0.2–0.3 mm long, costal hairs 0.1–0.2 mm, erect, very short hairs on costules and on surface between veins, no glands; *upper surface* hairy only on costae and rachis. *Sori* all considerably elongate, those on basal veins of adjacent costules almost meeting, distal ones shorter and near costules; indusia very small with 2 or 3 short hairs, apparently sometimes lacking; sporangia not setiferous, sometimes with a gland.

Distr. *Malesia*: New Guinea (New Britain), only known from type.

122. Sphaerostephanos echinosporus (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris echinospora* v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 149. — *Thelypteris echinospora* (v.A.v.R.) REED, Phytologia 17 (1968) 274. — Type: BROOKS 451, Sumatra, Seblat River, Benkoelen (BO; BM).

Caudex not known; *stipe* 5 cm long; base of stipe to largest pinna 80 cm; *reduced pinnae c.* 15 pairs, uppermost (v.A.v.R.) 6 × 1 cm, a middle one seen 4.5 cm long, 7 mm wide in the middle and gradually narrowed towards auricled base, lobed half-way to costa, one near base 1.8 cm long, 2 mm wide apart from a narrow basal auricle. *Lamina* excluding reduced pinnae 100 cm long; basal pinnae narrowed towards their bases which have a narrow auricle 6 mm long, upper pinnae truncate to full width at base; aerophores to 2 mm long. *Largest pinnae* 16 × 2.1 cm; apex narrowly caudate and entire; edges lobed to 2 mm from costa; lobes slightly falcate, separated by wide sinuses; costules 3.5–4 mm apart; veins to 11 pairs, basal pair, at a wide angle to costule, anastomosing to form a short excurrent vein, next pair both to margin above base of sinus; *lower surface* of costae densely covered with hairs 0.2–0.3 mm long, hairs on costules more sparse and somewhat antrorse, sparse minute erect hairs present between veins, no glands; *upper surface* of costae covered with antrorse hairs 0.6 mm long, rest of surface covered with slender appressed hairs 0.3 mm long. *Sori* medial, covering lower surface of pinna-lobes at maturity; indusia large, firm, with sparse short hairs; a small proportion of sporangia bearing a single seta or (less commonly?) a gland.

Distr. *Malesia*: South Sumatra. Known only from the type; "common" at the type locality.

123. Sphaerostephanos peltochlamys (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris peltochlamys* C. CHR. Dansk Bot. Ark. 9, 3 (1937) 65; BACKER & POSTH. Varenfl. Java (1939) 338, *excl. syn.* — *Abacopteris peltochlamys* (C. CHR.) HOLTTUM, Rev. Fl. Mal. 2 (1955) 295, f. 171. — *Thelypteris peltochlamys* (C. CHR.) REED, Phytologia 17 (1968) 303. — Type: C. W. FRANCK *s.n.* E. Java, Tanggore (BM).

Nephrodium urophyllum sensu RACIB. Fl. Btzg 1 (1898) 184.

Caudex a short or long-creeping rhizome. *Stipe* 20–30 cm long, glabrous, stramineous; scales broad, thin; base of stipe to first large pinna 30–60 cm (longest on fertile fronds). *Reduced pinnae* 2–4 pairs (lacking on young plants), less than 5 mm long: *Lamina* to 60 cm long; apex pinna-like or with one basal lobe; pinnae 6–10 pairs, lower ones sometimes a little reduced, always with a narrowed base; aerophores not swollen. Lower surface of *rachis* glabrous; upper surface with short hairs in groove. *Largest pinnae* of type 21 × 3.5 cm; sterile pinnae to 4.5 cm wide, fertile ones on small plants 14 × 2.8 cm; suprabasal pinnae widest at or above the middle, slightly and gradually narrowed to an abruptly contracted broadly cuneate base; apex abruptly short caudate-acuminate; edges entire to crenate; costules 4 mm apart, at 60°; veins 7–10 pairs, almost all anastomosing to form a zig-zag excurrent vein; sinus-membrane only distinct where margin is crenate; *lower surface* quite glabrous; between veins ± verrucose when dry; *upper surface* of costae with slender hairs 0.3 mm long. *Sori* medial or somewhat inframedial; indusia large, thin, glabrous, rarely with hairs or a few glands; sporangia often bearing glands; spores with a continuous translucent wing and several other separate small wings.

Distr. Burma, in *Malesia*: Malaya (one collection in Kelantan), Sumatra and Java (many localities), in lowland forest.

Note. Apart from the reduced pinnae, this is very similar to *Pronephrium lineatum* (BL.) PRESL. It seems uniform over a wide area, and may be a tetraploid of hybrid origin.

124. Sphaerostephanos irayensis (COPEL.) HOLTTUM, *comb. nov.* — *Cyclosorus irayensis* COPEL. Philip. J. Sci. 81 (1952) 28; Fern Fl. Philip. (1960) 340. — *Thelypteris irayensis* (COPEL.) REED, Phytologia 17 (1968) 285. — *Plesioneuron irayense* (COPEL.) HOLTTUM, Blumea 22 (1975) 239. — Type: RAMOS BS 80344, Batanes Islands, Mt Iraya (MICH; SING).

Sphaerostephanos fenixii HOLTTUM, Kalikasan 4 (1975) 55. — Type: FENIX BS 3780, Batanes Islands (P; US).

Caudex short-creeping; *stipe* 35–70 cm long,

glabrescent, reddish. *Lamina* 35–40 cm long; pinnae to 15 pairs, of firm texture; 1 pair reduced basal pinnae 1.5 cm long sometimes present; lowest pinnae variably narrowed towards base with stalk 1 mm long, to 2.5 cm wide at the middle; aerophores not elongate. Lower surface of *rachis* densely short-hairy. *Suprabasal fertile pinnae* to 12 × 2.2 cm (sterile to 2.8 cm wide); base broadly cuneate to full width; apex acuminate; edges lobed more than 1/2 way to costa, in basal sterile pinnae to more than 2/3; lobes falcate, those of basal pinnae attenuate; costules 5 mm apart, at 60° or more; veins 10–12 pairs, pale and prominent on both surfaces, basal pair always connivent below sinus, either anastomosing or touching sides of sinus-membrane without fusing; *lower surface* of costae hairy as rachis but less densely, of costules and veins sparsely, hairs longer on sterile than on fertile pinnae; *upper surface* densely short-hairy on costae, sparsely on costules. *Sori* medial, impressed on upper surface when dry, lower ones distinctly elongate; indusia small, thin, with short hairs; sporangia bearing 2–3 spherical yellow glands; spores with a narrow erose translucent wing and a few cross-wings.

Distr. *Malesia*: Philippines (Batanes Islands, 3 collections).

Note. This very interesting and isolated species needs further study. The type of *C. irayensis* resembles species of *Plesioneuron* in aspect and texture, but its glands (on sporangia), and venation and sinus-characters are unlike that genus.

125. Sphaerostephanos lithophyllus (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris lithophylla* COPEL. Philip. J. Sci. 12 (1917) Bot. 57; C. CHR. Gard. Bull. Str. Settl. 7 (1934) 206, 245. — *Thelypteris lithophylla* (COPEL.) REED, Phytologia 17 (1968) 289. — Type: TOPPING 1850, Sabah, Mt Kinabalu (AFS; US).

Caudex short, suberect; apex covered with slime. *Stipe* 1–2 cm long, dark; base of stipe to first large pinna 20–35 cm. *Reduced pinnae* near base 1 cm apart, distally 2–3 cm, in all to at least 10 pairs, all with rigid aerophore, lower ones without a perceptible blade, upper ones 2 mm long and wide. *Lamina* to 30 cm long, red when young; pinnae 12–18 pairs, fleshy when living, thick and rigid when dried, 2–3 basal pairs slightly narrowed at base; aerophores elongate. *Rachis* flushed with red; both surfaces bearing a varied number of short pale to dark red erect hairs; upper surface deeply grooved. *Largest pinnae* 5–6.5 × 1.1 cm; base truncate; apex short-acuminate; edges lobed about 1/3 to costa, lobes rounded, their margins revolute on drying; costules to 3 mm apart; each with a small swelling at the base; veins to 8 pairs, prominent on the upper surface and not below, basal pair anastomosing, 2 pairs to sinus-membrane which is very prominent on the lower surface; *lower surface* of costae almost glabrous or with pale short spreading hairs, some short hairs present on surface between veins; sparse hairs present on edges of groove of costa on *upper surface*, no others. *Sori* supramedial; indusia with a few short hairs and glands; sporangia bearing glands, often several; spores copiously minutely spinulose.

Distr. *Malesia*: Sabah (Mt Kinabalu).

Ecol. In wet ground in fully exposed places, often among rocks, at 1500–2000 m.

126. Sphaerostephanos hamiferus (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris hamifera* v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 12; Handb. Suppl. (1917) 181. — *Thelypteris hamifera* (v.A.v.R.) REED, Phytologia 17 (1968) 281. — Type: MATTHEW *s.n.* Sumatra, G. Singgalang (BO).

Caudex erect. *Stipe* 12 cm long; basal scales thin, narrow; base of stipe to first large pinna 50 cm. *Reduced pinnae* at least 10 pairs, lowest 5 mm long, upper ones 1.0–1.5 cm long, spreading, narrowly triangular with auricle 5 mm long on acroscopic side, short on basiscopic; on type 1 pair intermediate pinnae also present. *Lamina* 70 cm long; pinnae 30 pairs; lowest pinnae slightly narrowed and slightly auricled at base; aerophores 1–2 mm long (at least on reduced pinnae). Hairs on lower surface of *rachis* dense, erect, to 0.5 mm long on fertile frond, mixed with many hairs 1 mm long on sterile; hairs on upper surface 0.5–1 mm long, less difference between fertile and sterile. *Largest fertile pinnae* of type 10 × 1.5 cm; base truncate; apex acuminate, not caudate; edges lobed more than ½ way to costa (on a larger specimen to 2/3), lobes slightly falcate; costules 3.5–4 mm apart, at more than 60°; veins 7–8(–10) pairs, basal pair anastomosing, next pair both to margin or acroscopic one to the short sinus-membrane; *lower surface* of costae hairy as rachis but hairs a little shorter, hairs on costules sparse, on fertile fronds antrorse but not closely appressed, glands absent or rare; hairs on *upper surface* of costae to 1 mm long, scattered similar hairs on costules and veins, surface between veins ± closely covered with slender appressed hairs. *Sori* medial; indusia large, firm, with short hairs; sporangia sometimes with a gland, not setiferous.

Distr. *Malesia*: Central Sumatra, at 1500 m or less.

Note. There is variability in size of fertile pinnae from 6.4 × 0.9 cm to 12 × 2.0 cm, the latter lobed fully 2/3.

127. Sphaerostephanos plurivenosus HOLTTUM, *sp. nov.*

Caudex brevis, repens; pinnae redactae 20–30-jugatae, aerophoris 3 mm longis constitutis; pinnae 10-jugatae, fertiles usque 30 × 5.5 cm; venae 18–20-jugatae; pagina inferior pinnarum glabra; sori exindusiati; sporangia nec setis nec glandulis praedita. — Type: JERMY 4038, N.E. New

Guinea, Madang Distr., gorge below Moro (BM).

Caudex massive, prostrate. *Stipe* c. 5 cm long; base of stipe to first true pinna 30–50 cm. *Reduced pinnae* consisting of aerophores 3 mm long with no evident blade, 10–15 mm apart, 20–30 pairs. *Lamina* 100 cm or more long; apex pinna-like; pinnae c. 10 pairs, opposite, basal ones not or little reduced, lower ones 10 cm apart. *Rachis* reddish, glossy, quite glabrous apart from small hairs in groove of upper surface. *Largest fertile pinna* 30 × 3.5 cm (sterile to 35 × 6.5 cm) with stalk 2 mm long and stiff aerophores 1 mm; base rounded to broadly cuneate; apex acuminate with slender cauda to 3 cm long; edges parallel for most of their length, entire or slightly crenate; costules 4–4.5 mm apart, at almost 90°, falcate distally; veins 18–20 pairs, close, at a wide angle to costules (more oblique in sterile pinnae), excurrent veins mostly free, 2–3 veins from each costule passing to margin; *both surfaces* quite glabrous, eglandular. *Sori* supramedial, those on veins from adjacent costules touching or fusing, exindusiate, lower ones elongate; sporangia bearing neither glands nor setae; spores with a continuous wing of irregular width and some smaller wings. *Chromosomes*: n = 36 (T. G. WALKER).

Distr. *Malesia*: Papua New Guinea; Madang and Morobe Districts at 1300–1700 m; additional specimens are CLEMENS 4841, Sattelberg; HOOGLAND 9094, Mt Rawlinson.

Ecol. HOOGLAND's specimen was from a shaded vertical limestone cliff near a creek.

128. Sphaerostephanos squamatellus HOLTTUM, *sp. nov.*

Pinnae redactae 8-jugatae, superiores 3 mm longae; pinnae normales 2/5 costam versus lobatae; aerophora elongata; costae costulaeque subtus pilis appressis vestitae, eglandulosae; pagina superior pinnarum pilis appressis vestita; indusia pilosa; sporangia setifera. — Type: HOLTTUM 56, Sabah, Mt Kinabalu, near waterfall in forest, 1900 m (K).

Caudex not preserved. *Stipe* 12 cm long, minutely hairy with many small scales; base of stipe to first large pinna 35 cm. *Reduced pinnae* 8 pairs, uppermost 3 mm long, with elongate aerophores. *Lamina* 40 cm long; pinnae 16 pairs, all almost opposite; basal pair of pinnae somewhat shortened and a little narrowed at base which is 0.8 cm wide. *Rachis* stramineous; lower surface covered at base with very short erect hairs and small appressed scales, distally with longer hairs and few scales; upper surface bearing brown hairs 1 mm long. *Largest pinnae* 10.5 × 1.7 cm; base broadly cuneate; apex rather abruptly short-acuminate; edges lobed about 2/5 to costa, lobes slightly falcate; costules 4–4.5 mm apart, at 60° or more; veins 7 pairs, basal pair anastomosing, 1–1½ pairs passing to sinus-membrane which is not prominent on the lower surface; *lower surface* of costae covered with slender appressed hairs 0.3 mm long, costules and veins the same with minute uniseriate scales, appressed hairs 0.3 mm long scattered on surface between veins; hairs on *upper surface* of costae 0.7 mm long, rest of upper surface bearing slender appressed hairs 0.3 mm long. *Sori* medial; indusia firm with a few short hairs; sporangia all with 2–4 short setae.

Distr. *Malesia*: Sabah (Mt Kinabalu) (also CLEMENS 32548A at 2450 m, BO, L).

129. Sphaerostephanos canescens (BL.) HOLTTUM, *comb. nov.* — *Polypodium canescens* BL. Enum. Pl. Jav. (1828) 133. — *Gymnogramme canescens* (BL.) BL. Fl. Jav. Fil. (1829) 93, t. 40. — *Phegopteris canescens* (BL.) METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 223 (*non* METT. 1858); v.A.v.R. Handb. (1908) 507, *excl. var. omn.* — *Dryopteris canescens* (BL.) C. CHR. Ind. Fil. (1905) 250, *quoad typus tantum*; BACKER & POSTH. Varenfl. Java (1939) 56. — *Haplodictyum canescens* (BL.) CHING, Sunyatsenia 5 (1940) 251. — Type: REINWARDT, Moluccas, Tidore (L, *n.* 908, 300–133).

Caudex short, creeping. *Stipe* 9–12 cm long, densely short-hairy in groove; base of stipe to first large pinna 19–24 cm. *Reduced pinnae* to 5 pairs, 2–3 mm long, 3 cm apart. *Lamina* 27 cm long consisting of a deeply lobed apical section 18 cm long, 2.7 cm wide at base, with gradual transition to pinnae, and 5 pairs free pinnae, lowest longest, all widest near their apices; aerophores elongate. *Rachis* bearing hairs 1 mm long both sides, less abundant on lower surface with many shorter hairs. *Largest pinnae* 4–4.5 cm long, 1.6 cm wide at 1/3 from apex; base truncate; apex very abruptly short-pointed; edges lobed 1/3 to costa; costules to 3 mm apart at more than 60°; veins 7–8 pairs, 1 pair anastomosing and 2–2½ pairs passing to long sinus-membrane which is prominent on the lower surface; hairs on *lower surface* of costae pale, spreading, 0.4–0.7 mm long, on costules similar, erect veins present on surface between veins; hairs on *upper surface* of costae more than 0.5 mm long, similar hairs scattered on costules and veins, whole surface covered with fine pale appressed hairs. *Sori* medial, exindusiate; sporangia bearing several setae; spores with many small wings.

Distr. *Malesia*: West Java (Mt Gedeh), N Celebes, Moluccas (Tidore, Halmahera).

Notes. BLUME (1829) stated that the name was given by REINWARDT to the specimen collected by REINWARDT in Tidore, which may have been the model for BLUME's plate; BLUME stated that he had also specimens from G. Gedeh (*n.* 908, 337–391) and these are certainly like REINWARDT's.

This species was construed in a very broad sense by CHRIST to include specimens which are here referred to several other species, and in part

he was copied by v.A.v.R. The veins on some of the lower lobes of the apical lamina are sometimes forked as in *Haplodictyum heterophyllum* PRESL, for which reason CHING transferred this species to *Haplodictyum*.

130. Sphaerostephanos subopposítus HOLTTUM, *sp. nov.* — *Aspidium procurrens sensu* CHRIST, Ann. Jard. Bot. Btzg 15 (1898) 130, *quoad* SARASIN 128. — *Aspidium heterocarpus sensu* CHRIST, *l.c.* 133, *quoad* SARASIN 1326.

Pinnae redactae 9-jugatae, superiores 5 mm longae; pinnae normales usque 11 cm longae, ad basin auriculatam 2.5 cm latae, subopposítae, 3/5–2/3 costam versus lobatae, infimae basi leviter angustatae; costae costulaeque subtus pilis antrorsis non appressis vestitae, eglandulosae; pagina superior pilis appressis vestita; sporangia setifera. — Type: ALSTON 15744, Celebes, Minahassa, G. Lokon (BM).

Caudex short, suberect. *Stipe* 8 cm long, glabrescent; scales thin, 5 × 1.5 mm; base of stipe to first large pinna 30–45 cm. *Reduced pinnae* 9 pairs, subopposite, lowest very small, uppermost 5 mm long. *Lamina* 50–70 cm long; pinnae 18–21 pairs, subopposite in basal half of frond, basal 2–3 pairs somewhat narrowed at base; aerophores slender, to 1 mm long. Hairs on lower surface of *rachis* dense, short, pale; on upper surface pale, less than 0.5 mm long. *Middle pinnae* to 11 cm long, to 2.5 cm wide at auricled base (which is sometimes a little dilated also on basiscopic side), 2.1 cm wide above base; apex acuminate; edges lobed 3/5–2/3 to costa, lobes slightly falcate with obtuse tips; costules 4.5 mm apart, at more than 60°; veins slender, 9–11 pairs, basal pair anastomosing, next acroscopic vein or pair to sinus-membrane; *lower surface* of costae with dense somewhat antrorse short hairs, on sterile fronds scattered long ones also present, hairs on costules and veins short, antrorse, not appressed, short erect hairs on surface between veins; *upper surface* of costae covered with pale hairs more than 0.5 mm long, similar hairs scattered on costules and veins, surface generally covered with pale appressed hairs. *Sori* medial, lower ones a little divergent; indusia small, thin, with a few hairs; sporangia bearing copious short setae; spores short-spinulose.

Distr. *Malesia*: N. Celebes at 1100–1400 m.

131. Sphaerostephanos makassaricus HOLTTUM, *sp. nov.*

Pinnae redactae c. 10-jugatae, usque 2 mm longae; pinnae normales usque 17 × 2.8 cm, profunde lobatae; aerophori elongati; venae 12-jugatae, infimae tantum anastomosantes; costae costulaeque subtus pilis 1 mm longis brevioribus intermixtis vestitae, eglandulosae; indusia parva, tenuia, brevi-pilosa; sporangia setifera. — Type: POSTHUMUS 2727, S.W. Celebes, G. Bonthain, S.W. slope, 1500 m, above Karoenglowe (BO).

Caudex short, prostrate; *stipe* 8 cm long; base of stipe to first normal pinna 50 cm or more; *reduced pinnae c.* 10 pairs, uppermost 2 mm long, lower ones very small. *Lamina* excluding reduced pinnae more than 50 cm long; 3 pairs lower pinnae somewhat narrowed at their bases which are not auricled; upper pinnae with almost symmetric bases. Lower surface of *rachis* bearing copious erect hairs 0.2 mm long and scattered pale hairs 1 mm long; upper surface with slender pale hairs 0.7 mm long. *Largest pinnae* 17 × 2.8 cm, almost sessile; aerophores more than 1 mm long; base broadly cuneate; apex gradually attenuate with cauda to 2 cm long; edges lobed to 3 mm from costa, lobes falcate and somewhat tapered to a blunt apex; costules 4.5–5.5 mm apart, at 60° to costa; veins to 12 pairs, 1 pair anastomosing, next pair both ending at margin; *lower surface* of costae bearing copious erect hairs 0.2–0.4 mm long with many to 1 mm or more, on both sterile and fertile pinnae, hairs on costules similar but fewer, few hairs on veins, no hairs and no glands between veins; *upper surface* of costae with pale hairs 1 mm long, shorter hairs scattered on costules and veins, appressed hairs 0.3–0.4 mm long on surface between veins. *Sori* medial, lower ones not divergent; indusia small, thin, with many short hairs; sporangia bearing 3–4 slender setae.

Distr. *Malesia*: S.W. Celebes; a second specimen is POSTHUMUS 3476, from Patapang.

132. Sphaerostephanos sarasinorum HOLTTUM, *sp. nov.* — *Aspidium longipes sensu* CHRIST, Ann. Jard. Bot. Btzg 15 (1898) 133.

Caudex erectus; stipes 7 cm longus; pinnae redactae c. 9-jugatae, omnes parvae; lamina 100 cm longa; pinnae inferiores plurimae basin versus valde angustatae; pinnae omnes profunde lobatae, apicem versus abrupte caudatae; rachis costaeque subtus pilis brevibus vestitae; pagina inter venas utrinque glabra; sporangia setifera. — Type: JERMY 7458, Central Celebes, Masimbolong River, 1700 m (BM).

Caudex short, erect, *Stipe* 7 cm long; basal scales 10 × 1.5 cm, acuminate; base of stipe to first large pinna 50 cm or more. *Reduced pinnae c.* 9 pairs, all very small with swollen aerophores. *Rachis* short-hairy on both surfaces. *Lamina* to 100 cm long; pinnae in basal half of frond all much narrowed towards their bases which in lower ones are *c.* 5 mm wide; upper pinnae with basal lobes only reduced. *Largest pinnae* of type 16 × 3 cm (of SARASIN 996 21 × 3.5 cm); apex abruptly narrowed to a subentire cauda 3 cm long; edges lobed fully 3/4 towards costa, lobes falcate; costules 4.5–6.5 mm apart; veins 12–16 pairs, basal ones anastomosing with a short excurrent vein to sinus, next acroscopic vein sometimes to sinus-membrane; hairs on *lower surface* of costae short,

distal ones and those on costules appressed, surface between veins glabrous, eglandular; hairs on *upper surface* of costae 1 mm long, similar hairs scattered on costules and veins, surface between veins glabrous or sometimes a few hairs present near tips of pinna-lobes. *Sori* medial, lower ones slightly divergent; indusia sparsely short-hairy; sporangia setiferous.

Distr. *Malesia*: Central Celebes; additional specimens are SARASIN 993, 996.

Ecol. In partial shade on very steep hillside.

Note. The SARASIN specimens lack base of fronds, for which reason JERMY's more perfect specimen is chosen as type. Very young fronds are covered with mucilage (JERMY).

133. Sphaerostephanos muluensis HOLTTUM, *sp. nov.*

Pinnae redactae 8-jugatae, omnes parvae; aerophori leviter elongati; pinnae normales usque 15 × 2.5 cm, profunde lobatae; venae 11–12-jugatae, infimae non anastomosantes; pagina inferior pinnarum eglandulosa; costulae et pagina inter venas subtus pilis adpressis vestita; sori supramediales; indusia pilosa; sporangia interdum setifera. — Type: B. S. PARRIS 6729, Sarawak, Gunong Mulu, 1680 m (CGE).

Caudex short-creeping; *stipe* 15 cm long, basal scales 10 mm long, narrow; base of stipe to first large pinna 50 cm; *reduced pinnae* 8 pairs, all very small. *Lamina* 70 cm long; pinnae 22 pairs, middle ones 3–4 cm apart, basal pair much narrowed towards their bases (several successive ones gradually less narrowed); aerophores (when dried) less than 1 mm long. Lower surface of *rachis* rather densely covered with erect stiff brown hairs 0.3–0.4 mm long; upper surface bearing similar but longer hairs, longest distally. *Largest pinnae* 15 × 2.5 cm, sometimes with a stalk to 1 mm long; apex rather abruptly acuminate with subentire cauda 1.5–2 cm long; edges lobed to 1.5–2 mm from costa; lobes almost at right angles to costa, slightly narrowed distally, their tips obtuse; costules 5 mm apart; veins 11–12 pairs, slender, slightly prominent both sides, basal ones usually both touching sides of the sinus-membrane, less often both ending just above base of sinus; *lower surface* of costae covered with antrorse but not closely appressed pale hairs 0.6 mm long, hairs on costules a little shorter, closely appressed, slender appressed hairs 0.2–0.3 mm long on surface between veins; *upper surface* bearing hairs about the same length as on lower surface but thicker, no long hairs on costules and veins, surface between veins bearing appressed hairs 0.3 mm long. *Sori* distinctly supramedial; indusia rather thin, covered with hairs 0.3 mm long; some sporangia bearing a short seta.

Distr. *Malesia*: Borneo (Sarawak), 3 collections.

Ecol. In forest at 1680–1800 m.

134. Sphaerostephanos telefominicus HOLTTUM, *sp. nov.*

S. roemeriano (*Rosenst.*) *Holttum affinis, ab ea differt: caudice tenue, erecto vel scandente; lamina longiore, pinnis 20-jugatis constata; pinnis distaliter solum crenatis; pagina supra et subtus pilis adpressis vestita.* — Type: W. R. BARKER & J. R. CROFT LAE 67649, N.E. New Guinea, W. Sepik Distr., Telefomin Subdistr. (K; LAE).

Caudex slender, erect, sometimes creeping up small shrubs (collectors); *stipe* 5–12 cm long, copiously scaly, scales 5 mm long, less than 1 mm wide, firm, hairy. *Lamina* to 25 cm long; pinnae more than 20 pairs, isomorphous; basal 2–3 pairs slightly and gradually reduced, smallest 1.2 cm long, subsessile, base unequally cuneate, not auricled; apical lamina not pinna-like. *Largest pinnae* 3.0 × 0.8 cm, with stalk 0.5 mm long; base broadly cuneate to subtruncate, sometimes slightly dilated both sides; apex short-acuminate; edges subentire or slightly crenate distally; costules 2 mm apart or a little more; veins to 4 pairs, 2 pairs anastomosing, next acroscopic vein passing to short sinus-membrane; *lower surface* of rachis and costae bearing copious erect hairs 0.2 mm long (on sterile pinnae 0.3 mm), costules and veins sparsely hairy, surface between veins of sterile pinnae bearing many slender appressed hairs; *upper surface* of rachis bearing hairs 0.5 mm long with scattered ones 1 mm, shorter hairs present on costae and a few on costules and veins, between veins slender appressed hairs 0.3 mm long. *Sori* medial; indusia thin, fairly large, with short hairs; sporangia of type immature, not setiferous, no glands seen on them.

Distr. *Malesia*: Papua New Guinea (Telefomin), only known from the type.

Ecol. In disturbed montane forest near river, at 1500 m.

135. Sphaerostephanos roemerianus (ROSENST.) HOLTTUM, *comb. nov.* — *Dryopteris roemeriana* ROSENST. Nova Guinea 8 (1912) 723; v.A.v.R. Handb. Suppl. (1917) 179. — *Thelypteris roemeriana* (ROSENST.) REED, Phytologia 17 (1968) 310. — Type: VON ROEMER 1023, W. New Guinea, 1350 m (BO).

Caudex short, erect. *Stipe* 3 cm long, covered with short pale hairs; scales narrow. *Lamina* to 12 cm long; apex pinna-like; pinnae 10–12 pairs, lower 2–3 pairs gradually smaller, lowest 3–7 mm long. Lower surface of *rachis* covered with pale spreading hairs 0.3 mm long. *Largest pinnae* to 3.0 × 0.8 cm; base unequally cuneate, sometimes a little auricled on acroscopic side; apex slightly tapered to a rounded tip; edges crenate; costules 2.5 mm apart, at 45°; veins to 3 pairs, basal pair anastomosing; *lower surface* of costae, costules and veins bearing rather sparse short hairs; hairs present on *upper surface* of costae, scattered on costules and veins. *Sori* inframedial; indusia large,

glabrous; sporangia not setose, no glands seen.

Distr. *Malesia*: W. New Guinea, only known from the type.

136. Sphaerostephanos hellwigensis HOLTTUM, *sp nov.*

Caudex erectus, usque 30 *cm altus*; *pinnae redactae* 4–5-*jugatae, usque* 8–9 *mm longae*; *pinnae normales usque* 4.5 × 0.9 *cm, crenatae, eglandulosae, costae costulaeque subtus pilis erectis brunneis* 0.5–0.6 *mm longis vestitae*; *sori mediales, indusia parva, pilis brevibus praedita*; *sporangia non setifera, ut videtur non glandulosa.* — Type: PULLE 884, W. New Guinea, Mt Hellwig, 2600 m (BO).

Caudex erect, to 30 cm tall (collector); stipe 5–10 cm long, scales rather firm, 5 × 1 mm; base of stipe to first normal pinna 20 cm; *reduced pinnae* 4–5 pairs, lowest 1–2 mm long, uppermost 8–9 mm long with an acroscopic auricle 4 mm long, basiscopic base narrower, edges almost entire. *Lamina* excluding reduced pinnae 40 cm long; pinnae to *c.* 30 pairs, texture rigid; basal normal pinnae not narrowed at their bases. *Largest pinnae* 4.5 × 0.9 cm; base truncate and slightly dilated; aerophores *c.* 0.5 mm long; apex short-acute; edges crenate to a depth of 1 mm or a little more deeply; costules 2.5 mm apart; veins to 4 pairs, prominent both sides, 1 pair anastomosing, next acroscopic vein or pair to the sinus-membrane; *lower surface* of rachis bearing thick erect brown hairs 1 mm long, of costae similar hairs 0.5–0.6 mm long, fewer on costules, no hairs between veins, no glands; *upper surface* of rachis covered with antrorse brown hairs, brownish antrorse hairs less than 0.5 mm long on costae, a few short hairs on costules distally. *Sori* medial; indusia small, thin, with a few short hairs; sporangia not setiferous, no glands seen on them.

Distr. *Malesia*: W. New Guinea (Mt Hellwig), 2600 m.

137. Sphaerostephanos benoitianus (GAUD.) HOLTTUM, *comb. nov.* — *Polystichum benoitianum* GAUD. in Freyc. Voy. Uran. Phys. Bot. (1827) 331. — *Aspidium benoitianum* GAUD. *ibid.* t. 11. — *Dryopteris benoitiana* (GAUD.) v.A.v.R. Handb. (1908) 225. — Type: GAUDICHAUD, New Guinea, Rawak Island (G; BM, FI-W).

Caudex short, creeping. *Stipe* 7–9 cm long, short-hairy; basal scales dark, firm, 4 mm long. *Lamina* 27 cm long; apical 10–12 cm narrowly triangular and deeply lobed, grading to upper pinnae; free pinnae 10–12 pairs; basal 1–2 pairs somewhat reduced, narrowed at base on basiscopic side, not on acroscopic, in middle wider on basiscopic than on acroscopic side of costa. Lower surface of *rachis* bearing short erect hairs and scattered pale ones 1 mm long, hairs on its upper surface thick, brown, spreading. *Largest pinnae* 5.5 × 1.4 cm; base subtruncate, symmetric; apex short-acuminate; edges lobed a little more than $\frac{1}{2}$ way to costa (to 2/3 on fertile fronds), lobes slightly falcate; costules 3 mm apart; veins 6–8 pairs, basal pair anastomosing, next acroscopic vein to sinus-membrane or to margin; *lower surface* of costae and costules hairy as rachis; hairs on *upper surface* of costae sparse, short and long, rest of surface usually glabrous. *Sori* submarginal; indusium small, bearing short hairs; sporangia with neither glands nor setae; spores dark, minutely papillose.

Distr. *Malesia*: W. New Guinea (Rawak I.), only known from the type.

Note. This appears to be an isolated species, possibly related to *S. invisus*.

138. Sphaerostephanos neotoppingii HOLTTUM, *nom. nov.* — *Dryopteris toppingii* COPEL. Philip. J. Sci. 12 (1917) Bot. 56; C. CHR. Gard. Bull. Str. Settl. 7 (1934) 246. — *Thelypteris toppingii* (COPEL.) K. IWATS. Acta Phytotax. Geobot. 21 (1965) 168, not *Sphaerostephanos toppingii* (COPEL.) C. CHR. 1934. — Type: TOPPING 1766, Sabah, Mt Kinabalu, Lobang (AFS, not seen).

Caudex short, creeping. *Stipe* 50–90 cm long, dull reddish, minutely hairy; scales narrow, to 10 mm long. *Reduced pinnae* lacking. *Lamina* 50–80 cm long; pinnae 10–15 pairs, lowest not or little reduced; several pairs lower pinnae much narrowed towards their bases and stalked 3–4 mm, distal ones broadly cuneate to subtruncate, almost sessile; aerophores not elongate. *Rachis* densely short-hairy (0.2–0.3 mm) on both surfaces. *Largest pinnae* commonly 15–20 × 2.0–2.5 cm (maximum 24 × 3.5 cm); base cuneate; apex acuminate with subentire cauda 1.5–2.5 cm; edges lobed 1/3–2/5 to costa, lobes distinctly falcate with narrow blunt forward-pointing tips; costules 5–6.5 mm apart at more than 60°; veins to 12 pairs on acroscopic side of costule, to 14 on basiscopic side, prominent on lower surface, $1\frac{1}{2}$–$2\frac{1}{2}$ pairs anastomosing, 1–2 pairs to sides of sinus-membrane; hairs on *lower surface* of costae antrorse but not closely appressed, 0.2–0.3 mm long with some 0.5 mm, similar and more sparse hairs on costules and veins, on surface between veins a variable number of short suberect hairs, glands lacking; hairs on *upper surface* of costae 0.3 mm long, shorter on costules, between veins (especially on young fronds) some short appressed hairs. *Sori* supramedial, those on lowest veins from adjacent costules sometimes touching; indusia firm, glabrous, sometimes a little elongate and asymmetric at base; sporangia lacking glands and setae, hair on sporangia-stalk ending in a red gland.

Distr. *Malesia*: Borneo (Sabah and Kalimantan), in forest at 1200–1500 m.

139. Sphaerostephanos oosorus (BAK.) HOLTTUM, *comb. nov.* — *Nephrodium oosorum* BAK. Kew Bull. (1896) 41. — *Dryopteris oosora* (BAK.) C.

CHR. Ind. Fil. (1905) 280; Gard. Bull. Str. Settl. 7 (1934) 245. — Type: G. F. HOSE 334, Sabah, Pulo Gaya (K).

Caudex short, creeping. *Stipe* 25–40 cm long, minutely hairy; base of stipe to first large pinna 40–55 cm. *Reduced pinnae* 2–4(–6) pairs, uppermost 4 mm long. *Lamina* 60 cm long; pinnae to 20 pairs, sessile; 2–3 pairs lower pinnae narrowed at their bases; aerophores not elongate. Lower surface of *rachis* covered with short erect pale hairs 0.2–0.4 mm long, in some specimens mixed with long ones to 1 mm; upper surface with uniform pale hairs 0.5 mm long. *Largest pinnae* commonly 12–15 × 1.8–2.0 cm (largest seen 21 × 2.4 cm); apex acuminate with cauda to 1.5 cm; edges lobed a little less than ½ way to costa, lobes oblique, narrowed to obtuse tips; costules 4–4.5 mm apart, at 60°; veins to 8 pairs, basal 1½ pairs anastomosing, 1–1½ pairs to sinus-membrane; *lower surface* of costae covered with erect hairs varying from 0.2 to 0.5 mm, hairs on costules and veins similar but shorter, surface between veins bearing many short erect hairs; hairs on *upper surface* of costae 0.5 mm long, shorter on costules, abundant short suberect hairs between veins. *Sori* medial, elongate, 1.5 mm long; indusia large, pale, firm, bearing many short hairs and rarely a gland; neither glands nor setae on sporangia; spores minutely papillose.

Distr. *Malesia*: Borneo (Sabah & P. Balambangan).

Ecol. In forest at low altitudes.

140. Sphaerostephanos rudis (RIDL.) HOLTTUM, *comb. nov.* — *Goniopteris rudis* RIDL. Trans. Linn. Soc. Bot. 9 (1916) 259. — *Phegopteris ridleyana* v.A.v.R. Handb. Suppl. (1917) 515, *nom. nov.* — *Dryopteris rufopilosa* BRAUSE, Bot. Jahrb. 56 (1920) 106, *nom. nov.* (not *D. rudis* (KUNZE) C. CHR. nor *D. ridleyana* BRAUSE). — Type: KLOSS *s.n.* W. New Guinea, Mt Carstensz, Camp I–III, 150–750 m (BM; K).

KEY TO THE VARIETIES

1. Lower surface of rachis and costae bearing thick reddish hairs . . . . . **a. *var.* rudis**
1. Lower surface of rachis and costae glabrous **b. *var.* micans**

a. *var.* rudis

Caudex short-creeping; *stipe* 10 cm long, dark reddish, dark-hairy in groove, scales 7 × 1 mm, thin; base of stipe to first normal pinna 35 cm; *reduced pinnae* 5–6 pairs, all very small, with short aerophores. *Lamina* 50 cm long; apex pinna-like; pinnae 4 pairs, opposite, all widest at or above middle and gradually narrowed to an abruptly cuneate base. Lower surface of *rachis* covered with thick spreading dark red hairs 1 mm long. *Largest pinnae* 20 × 4.5 cm; apex abruptly acuminate with cauda 2–2.5 cm long; edges entire; costules 5 mm apart; veins 8 pairs, most of them united to form a zig-zag excurrent vein; *lower surface* of costae bearing thick erect reddish hairs 0.5 mm long which are more sparse distally, hairs on costules short and sparse, none on surface between veins; *upper surface* glabrous apart from a few hairs in groove of costa. *Sori* medial, exindusiate; sporangia bearing neither glands nor setae.

Distr. *Malesia*: W. New Guinea and Japen Island, at low altitudes.

b. *var.* micans (BRAUSE) HOLTTUM, *stat. nov.* — *Dryopteris micans* BRAUSE, Bot. Jahrb. 56 (1920) 98. — *Cyclosorus micans* (BRAUSE) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 458. — *Thelypteris micans* (BRAUSE) REED, Phytologia 17 (1968) 293. — Type: LEDERMANN 12468, N.E. New Guinea, Sepik Distr. 1400–1500 m (B).

Differs from *var. rudis* in quite glabrous lower surface of rachis and costae; all specimens also are larger, with up to 10 pairs of reduced pinnae and 6 pairs of normal ones which are not opposite, largest 27 × 5.5 cm.

Distr. *Malesia*: New Guinea, from Idenburg River eastwards, at 850–1750.

141. Sphaerostephanos dimorphus (BRAUSE) HOLTTUM, *comb. nov.* — *Dryopteris dimorpha* BRAUSE, Bot. Jahrb. 56 (1920) 100. — *Cyclosorus dimorphus* (BRAUSE) COPEL. Philip. J. Sci. 78 (1951) 442. — *Thelypteris dimorpha* (BRAUSE) REED, Phytologia 17 (1968) 273. — Type: LEDERMANN 12622, N.E. New Guinea, Sepik Distr., 1400–1500 m (B).

Dryopteris morobensis COPEL. Univ. Cal. Publ. Bot. 18 (1942) 221. — *Cyclosorus morobensis* (COPEL.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 459, pl. 38. — *Thelypteris morobensis* (COPEL.) REED, Phytologia 17 (1968) 294. — Type: CLEMENS *s.n.* N.E. New Guinea, Morobe Distr., Finugan, 1400 m (MICH).

Caudex erect, 100–150 cm tall. *Stipe* 10–20 cm long, dull red, glabrous, with many scales to 15 × 2 mm. *Lamina* to 140 cm long; apex pinna-like; pinnae to 40 pairs, dimorphous, lower 10–12 pairs gradually reduced, lower ones narrowly triangular with ± hastate base, lowest 7–15 mm long; aerophores swollen, not or little elongate. *Rachis* glabrous apart from dark red hairs in groove of upper surface, most abundant distally. *Largest sterile pinnae* commonly 20 × 2.0 cm (on type to 36 × 1.8 cm); base asymmetric, rounded on basiscopic side, cuneate on acroscopic; apex narrowly acuminate; edges slightly undulate; costules 4–5 mm apart, at a wide angle to costa; veins 4–6 pairs, all very oblique, pale and prominent on lower surface, 2–2½ pairs anastomosing and 1 pair to sides of sinus-membrane; *both surfaces* of pinnae quite glabrous. *Fertile pinnae* 7–14 cm long,

0.7–1.2 cm wide; edges entire as sterile, or crenate (rather strongly crenate in type of *D. morobensis*); veins 4 pairs; sori confluent at maturity; indusia glabrous or with a few short hairs; sporangia lacking glands and setae; spores minutely papillose.

Distr. *Malesia*: Eastern New Guinea, in forest at 1200–2000 m, many collections.

142. Sphaerostephanos potamios HOLTTUM, *sp. nov.*

Caudex erectus, c. 20 *cm altus*; *frondes dimorphae, omnes pinnis redactis* 6-8-*jugatis praeditae*; *pinnae steriles* 15 × 1.6 *cm, fertiles usque* 8.0 × 0.8 *cm, non ultra* 1/4 *costam versus lobatae, subtus eglandulosae*; *rachis pilis brunneis vestita*; *sori mediales*; *indusia parva, glabra vel pauci-pilosa*; *sporangia nec setis nec glandulis praedita.* — Type: J. CROFT & Y. LELEAN NGF 34913, S.E. New Guinea, Port Moresby Subdistr. near Lake Myola (L).

Caudex erect, 20 cm tall; *stipe* 8 cm long, basal scales 7–8 × 1 mm, covered with many short hairs; base of stipe to first large pinna of sterile frond 25 cm, of fertile 35–42 cm; *reduced pinnae* of fertile frond 6–8 pairs, not opposite, uppermost 1.5 cm long with basal acroscopic auricle 8 mm long, apex acute, lowest reduced pinna 3–4 mm long. *Lamina* 63 cm long (sterile); pinnae 30 pairs, basal pinnae with slightly dilated truncate bases; texture firm; apex of frond not pinna-like; aerophores slightly swollen. *Sterile pinnae* to 15 × 1.6 cm; apex narrowly acuminate; edges lobed to a depth of 1–2.5 mm, lobes with falcate tips and slight projections at ends of veins; costules 3.5–4.5 mm apart; veins 6–7 on basiscopic side, 5–6 on acroscopic, pale and prominent on lower surface, reddish on upper, basal 1–1½ pairs anastomosing, 1½ pairs passing to the rather long sinus-membrane; *lower surface* of rachis bearing rather sparse thick brown hairs 0.7 mm long, hairs on costae sparse, pale, erect, 0.3–0.4 mm long, hairs on costules shorter, ± antrorse, not appressed, surface between veins hairless, slightly pustular; *upper surface* of rachis with brown hairs to 1 mm long, of costae with pale hairs 0.5–0.7 mm, no other hairs. *Fertile pinnae* to 8.0 × 0.8 cm (apparently not quite fully expanded); veins 3–4 pairs; hairs on both surfaces shorter and more sparse than on sterile pinnae; sori medial; indusia small, thin, glabrous or with a few short hairs; sporangia not setiferous, no glands seen on them.

Distr. *Malesia*: S.E. New Guinea; only known from the type.

Ecol. In forest close to stream-bank, at 1900 m.

143. Sphaerostephanos invisus (FORST. *f.*) HOLTTUM, Webbia 30 (1976) 195; Allertonia 1 (1977) 211, f. 7B. — *Polypodium invisum* FORST. *f.* Fl. Ins. Austr. Prodr. (1786) 81. — *Nephrodium invisum* (FORST. *f.*) CARR. in Seem. Fl. Vit. (1873) 362. — *Dryopteris invisa* (FORST. *f.*) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 212; COPEL. Bishop Mus. Bull. 59 (1929) 45; 93 (1932) 38. — *Cyclosorus invisus* (FORST. *f.*) COPEL. Gen. Fil. (1947) 142; BROWNLIE in Aubrév. Fl. Nouv. Cal. 3 (1969) 215, excl. syn. *Nephrodium haenkeanum* PRESL. — *Thelypteris forsteri* MORTON, Contr. U.S. Nat. Herb. 38 (1967) 60, *nom. nov.* (not *T. invisa* (DESV.) PROCTOR). — Type: FORSTER, locality unrecorded (BM; K, LE).

Aspidium dissectum sensu METT. Ann. Mus Bot. Lugd.-Bat. 1 (1864) 232, *excl. synon.*

Caudex a long-creeping rhizome to 7 mm diameter. *Stipe* 25–45 cm or more long. *Lamina* commonly 40–75 cm long (to 120 cm); basal 2 pairs of pinnae gradually smaller and irregularly spaced, lowest sometimes 2 cm long, usually longer; aerophores not elongate. *Largest pinnae* commonly 15 × 1.3 cm (to 24 × 1.8 cm), narrowly acuminate, lobed 1/3–2/5 to costa, lobes falcate, distinctly pointed, oblique; costules commonly 3–3.5 mm apart; veins 7–8 pairs, close, very oblique except basal pair, 1–1½ pairs anastomosing, 1–2 pairs to sinus-membrane; short spreading hairs on all part of *lower surface*, a little antrorse on costules, erect (sometimes lacking) between veins; *upper surface* almost glabrous apart from costae. *Sori* supramedial; indusia thin, hairy; sporangia bearing a variable number of setae; spores dark, with irregular ± continuous brownish wing and a few cross-wings.

Distr. Polynesia (many islands in the Pacific eastward to Tahiti and Hawaii), New Caledonia, Queensland; in *Malesia*: New Guinea (lowlands of north and east) and Moluccas (Kei & Tenimber Is., Amboina).

Ecol. In open or lightly shaded places, sometimes in wet ground, at low altitudes.

144. Sphaerostephanos austerus (BRAUSE) HOLTTUM, *comb. nov.* — *Dryopteris austera* BRAUSE, Bot. Jahrb. 56 (1920) 108. — *Cyclosorus austerus* (BRAUSE) COPEL. Philip. J. Sci. 78 (1951) 446. — *Thelypteris austera* (BRAUSE) REED, Phytologia 17 (1968) 262. — Type: LEDERMANN 11750, N.E. New Guinea, Sepik Distr., 2070 m (B).

Caudex slender, scandent. *Stipe* 11–18 cm long. *Lamina* 65–100 cm long; 5–6 pairs lower pinnae gradually reduced, all with an acroscopic auricle, lowest 1.3 cm long, subtriangular with rounded apex; aerophores not elongate. Hairs on lower surface of *rachis* dense, short; on upper surface a little longer. *Largest pinnae* 9–13 cm long, 2.2–3.0 cm wide; base subtruncate; apex abruptly short-acuminate; edges lobed ½ way to costa or a little more deeply, lobes falcate, blunt-pointed; costules 5–5.5 mm apart, at 60°; veins 7 pairs, slender, basal pair anastomosing, next pair usually both to margin; *lower surface* of costae bearing dense short pale somewhat antrorse hairs of uni-

form length, similar hairs sparse on costules, scattered on surface between veins; hairs on *upper surface* of costae short, scattered longer ones present on costules and veins, surface between veins bearing scattered short appressed hairs. *Sori* slightly inframedial, exindusiate; sporangia with a few setae; spores minutely spinulose.

Distr. *Malesia*: Papua New Guinea (Sepik), only known from type.

145. Sphaerostephanos mundus (ROSENST.) HOLTTUM, *comb. nov.* — *Dryopteris munda* ROSENST. Meded. Rijksherb. *n.* 31 (1917) 5. — *Thelypteris munda* (ROSENST.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 252. — Type: ATASRIP *s.n.* 1903, W. New Guinea (L).

Dryopteris oblonga BRAUSE, Bot. Jahrb. 56 (1920) 109. — *Cyclosorus oblongus* (BRAUSE) COPEL. Philip. J. Sci. 78 (1951) 446. — *Thelypteris oblonga* (BRAUSE) REED, Phytologia 17 (1968) 297. — Type: LEDERMANN 10100, N.E. New Guinea, Sepik Distr., 1000 m (B).

Dryopteris farinosa BRAUSE, Bot. Jahrb. 56 (1920) 111. — *Cyclosorus farinosus* (BRAUSE) COPEL. Philip. J. Sci. 78 (1951) 446. — *Thelypteris farinosa* (BRAUSE) REED, Phytologia 17 (1968) 276. — Type: LEDERMANN 12103, Sepik Distr., 2070 m (B).

Caudex a scandent rhizome 7–10 mm diameter, or sometimes free, slender, erect. *Stipe* 5–10 cm long, dark; base of stipe to first large pinna 25–35 cm. *Reduced pinnae* 5–7 pairs, smallest 3–4 mm long, uppermost 10 mm, spreading, triangular with base auricled both sides (more on acroscopic side). *Lamina* 60–100 cm long; pinnae *c.* 25 pairs, not dimorphous; lower pinnae a little narrowed to symmetric base; aerophores not elongate. Lower surface of *rachis* sparsely short-hairy; upper surface with hairs to 1 mm long. *Largest pinnae* commonly 9–12 cm long, 2.0–2.5 cm wide (on type of *D. oblonga* 18 × 2.6 cm); base broadly cuneate; apex rather abruptly acuminate with cauda 1.5–3 cm long; edges lobed 2/3–3/4 to costa, lobes falcate with blunt forward-pointing tips; costules 4–5 mm apart (to 6.5 mm on type of *D. oblonga*); veins 7–9 pairs, basal pair anastomosing to form a short excurrent vein to sinus, next pair both to margin; *lower surface* of costae bearing rather sparse short erect hairs (dense with some longer ones on type of *D. oblonga*), sparse short hairs on costules, veins and surface between veins; hairs on *upper surface* of costae less than 1 mm long, sparse short hairs on costules and veins, a variable number of fine appressed hairs between veins (in some cases very sparse). *Sori* inframedial, lowest not or little divergent; indusia absent or very small with a few hairs; sporangia setiferous; spores closely papillose.

Distr. *Malesia*: New Guinea, from West to East.

Ecol. Usually climbing on trees in forest, at 1000–2000 m.

Note. BRAUSE distinguished *D. farinosa* by a grey-yellow deposit on the lower surface; this consists of a fungus. In the type of *D. munda* and others from Western New Guinea, basal veins sometimes meet at the sinus without anastomosing.

146. Sphaerostephanos obtusifolius (ROSENST.) HOLTTUM, *comb. nov.* — *Dryopteris obtusifolia* ROSENST. Fedde Repert. 10 (1912) 336. — *Phegopteris obtusifolia* (ROSENST.) v.A.v.R. Handb. Suppl. (1917) 315. — *Cyclosorus obtusifolius* (ROSENST.) COPEL. Gen. Fil. (1947) 143; Philip. J. Sci. 78 (1951) 442. — *Thelypteris obtusifolia* (ROSENST.) REED, Phytologia 17 (1968) 297. — Type: Frau BAMLER 43, N.E. New Guinea, Sattelberg (not seen).

Caudex short, creeping. *Stipe* 2–8 cm long. *Lamina* 8 cm long; apex not pinna-like; pinnae *c.* 8 pairs, 1 or 2 basal pairs reduced, lowest 4–6 × 3–5 mm; aerophores slightly swollen. Hairs on lower surface of *rachis* minute, on upper surface 0.4 mm long, brown. *Largest pinnae* 1.5–2.0 cm long, 0.8–1.0 cm wide; base subtruncate, slightly asymmetric; apex broadly rounded, edges sinuous with very slight development of sinus-membranes; costules 2.5 mm apart; veins 2–3 pairs, 1½ pairs anastomosing; all hairs on *lower surfaces* minute; on *upper surface* short hairs on costae only or a few between veins near margin. *Sori* exindusiate, those on basal veins from adjacent costules sometimes fusing; sporangia setiferous; spores pale, with a moderate number of wings of varying extent.

Distr. *Malesia*: New Guinea (Sattelberg, several collections; Manus Island).

Notes. At BM is a specimen labelled KEYSSER 43, from the type locality, named *D. obtusifolia* by ROSENSTOCK; this is probably an error for BAMLER 43 (ROSENSTOCK was describing specimens from both collectors). Also from Sattelberg is Rosenst. Fil. Novoguin. exsicc. 115, coll. BAMLER (B, BM, W). M. SANDS 2682 (K) from limestone on Manus Island is closely similar to the Sattelberg specimens but less hairy on both surfaces of pinnae.

147. Sphaerostephanos alcasidii HOLTTUM, *sp. nov.*

Pinnae redactae plurimae, 1.5 cm inter se distantes, aerophoris tumidis tantum constitutae; lamina 80 cm longa; pinnae 35-jugatae, maximae 15 × 1.5 cm, 3/5 costam versus lobatae, eglandulosae; pagina utroque latere inter venas pilis adpressis vestita; indusia parva brevi-pilosa; sporangia setifera. — Type: ALCASID PNH 1747, Luzon, Mountain Prov., Mt Data (MICH).

Caudex not known. *Stipe* 10 cm long; base of stipe to first large pinna 50 cm. *Reduced pinnae* many pairs, 1.5 cm apart, all except the very small upper ones consisting of an aerophore without

perceptible blade. *Lamina* 80 cm long; pinnae 35 pairs, lowest narrowed to 8 mm wide at the base. Lower surface of *rachis* near base covered with appressed hairs 0.5 mm long, distally with longer spreading hairs; hairs on upper surface similar. *Largest pinnae* 15 × 1.5 cm; base truncate; apex acuminate with entire cauda 1–2 cm long; edges lobed a little more than ½ way to costa, lobes falcate; costules 3.5 mm apart at more than 60°; veins 8–9 pairs, basal pair anastomosing, next acroscopic vein to sinus-membrane; hairs on *lower surface* of costae near base appressed, 0.5 mm long, stally and on costules longer and spreading, appressed hairs on lower surface between veins; *upper surface* of costae bearing hairs 1 mm long, similar hairs scattered on costules and veins, copious appressed hairs 0.3 mm long on surface between veins. *Sori* medial; indusia small with short hairs; sporangia sometimes with 1–2 setae.

Distr. *Malesia*: Philippines (Luzon: Mt Data), only known from the type.

148. Sphaerostephanos pilosissimus HOLTTUM, *sp nov.*

Pinnae redactae 12-jugatae, infimae 0.7 cm longae, superiores 2.5 cm, anguste triangulares, crenatae; pinnae evolutae usque 16.5 × 2.3 cm, dimidio costam versus lobatae; costae costulaeque subtus pilis erectis vestitae, eglandulosae; indusia pilifera; sporangia setifera. — Type: HOLTTUM 20222, Sumatra, G. Kerinci, 1800–2100 m (SING; BO).

Caudex erect, short. *Stipe* 15 cm long, glabrous; base of stipe to first large pinna 40 cm. *Reduced pinnae* at least 12 pairs, deflexed, basal one 7 mm long, uppermost 2.5 cm long, narrowly triangular with acute apex, crenate edges and slight basal acroscopic auricle. *Lamina* 65 cm long; pinnae 25 pairs; basal pinnae narrowed and less deeply lobed to base which is 1.3 cm wide, basal basiscopic lobes of several successively higher pinnae shortened; aerophores swollen, not elongate. Hairs on lower surface of *rachis* dense, erect, 0.3 mm long, on upper surface more than 0.5 mm long, pale. *Largest pinnae* 16.5 × 2.3 cm; base truncate; apex acuminate with subentire cauda to 2.5 cm long; edges lobed about ½ way to costa, lobes slightly oblique with rounded tips; costules 4.5 mm apart; veins 10–14 pairs, basal 2 pairs anastomosing, 1 pair to sinus-membrane; *lower surface* of costae and costules densely covered with erect hairs of varied length to 0.5 mm, less dense hairs on veins and surface more than 0.5 mm long; hairs on *upper surface* of costae 0.7 mm long, costules, veins and surface between them covered with slender appressed hairs 0.3 mm long. *Sori* a little inframedial, lower ones not divergent; indusia fringed with short hairs and a few on surface; sporangia bearing 2–3 short setae.

Distr. *Malesia*: West Central Sumatra (G. Kerinci), 2 collections (ALSTON 14185, BM), 1800–2100 m.

149. Sphaerostephanos erwinii HOLTTUM, *sp. nov.*

Frondes parvae, lamina apicali 7–8 cm longa, pinnis evolutis 6-jugatis pinnisque redactis 4-jugatis constitutae; pinnae redactae usque 8 mm longae; pinnae evolutae usque 3.2 × 1.3 cm, subintegrae; indusia parva, pilosa; sporangia setifera. — Type: STRESEMANN 43, Ceram, Centralgeb., G. Hoale, 1000 m (L).

Caudex short, suberect. *Stipe* 7 cm long, slender, short-hairy; base of stipe to first large pinna 17 cm. *Reduced pinnae* 4 pairs, ovate, uppermost 8 mm, lowest 3–4 mm long. *Apical lamina* 7–8 cm long, 2.5 cm wide at base, deeply lobed and grading to pinnae; free pinnae 6 pairs. Lower surface of *rachis* bearing thick brown hairs and shorter pale ones. *Largest pinnae* 3.2 × 1.3 cm, widest a little above middle; base truncate, sometimes with a slight acroscopic auricle; apex abruptly narrowed to a rounded or obtuse tip; edges shallowly crenate; costules 3.5 mm apart, at little more than 45°; veins 3 pairs, 1½ pairs anastomosing; hairs on *lower surface* of costae short, erect, with some longer, sparse hairs on costules and veins, short erect hairs on surface between veins; scattered long hairs on *upper surface* of costules and veins like those on costae, appressed hairs on surface between veins. *Sori* medial; indusia small with hairs more than 0.5 mm long; sporangia setiferous.

Distr. *Malesia*: Moluccas (Ceram) and West New Guinea.

Note. The plant from W. New Guinea (KOSTERMANS 2209a, Angi-gita Lake, at 2000 m, BO) is smaller than the type, with pinnae to 2.2 × 0.8 cm, and only 2 pair of reduced basal pinnae.

150. Sphaerostephanos atasripii (ROSENST.) HOLTTUM, Webbia 30 (1976) 194. — *Dryopteris atasripii* ROSENST. Meded. Rijksherb. *n.* 31 (1917) 6; C. CHR. Brittonia 2 (1937) 298. — *Thelypteris atasripii* (ROSENST.) REED, Phytologia 17 (1968) 261. — Type: ATASRIP 211, W. New Guinea (L).

Cyclosorus diminuens HOLTTUM, Blumea 13 (1965) 135. — Type: BRASS 32106, N.E. New Guinea, Eastern Highlands, Arau, 1400 m (K).

Caudex massive, erect. *Stipe* 13 cm long; base of stipe to first large pinna 75 cm. *Reduced pinnae* 15 pairs, spreading, broadly triangular, lowest 6–7 mm long and 10 mm wide at base, uppermost 4–5 × 2.5–3.0 cm. *Lamina* to more than 100 cm long; apex not pinna-like; lower pinnae not narrowed at base; aerophores slightly swollen. Lower surface of *rachis* densely covered with erect hairs 0.1–0.2 mm long; upper surface covered with appressed pale hairs 0.5 mm long with thicker

spreading brown hairs 1 mm long on each side of the groove. *Largest fertile pinnae* 17 × 2.5 cm, *sterile* to 22 × 3.1 cm; base truncate and somewhat dilated both sides; apex short-acuminate; edges lobed to a depth of 2–3 mm; costules 4–4.5 mm (fertile), to 6 mm (sterile) apart; veins 9–11 pairs, 2½–3 pairs anastomosing, 2–3 pairs to sides of sinus-membrane; *lower surface* of costae densely covered with short hairs as rachis, hairs on costules and veins more sparse, on sterile pinnae longer than those on costae, copious short erect hairs on surface between veins; hairs on *upper surface* of costae 0.7 mm long, a few similar hairs on costules and veins, surface between veins ± densely covered with fine appressed hairs. *Sori* medial, lower ones not divergent; indusia covered with hairs 0.3 mm long; sporangia setiferous, sometimes with an acicular hair on the stalk; spores closely and minutely spinulose. *Chromosomes*: n = 36 (T. G. WALKER).

Distr. *Malesia*: throughout New Guinea, in forest at 700–1400 m.

Notes. This species is very similar to *S. confertus* in all characters except the massive erect caudex and much larger fronds which never bear glands. In cultivation the two remain quite distinct in size and habit.

151. Sphaerostephanos albosetosus (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris albosetosa* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 221. — *Cyclosorus albosetosus* (COPEL.) COPEL. Gen. Fil. (1947) 142; Philip. J. Sci. 78 (1951) 455, pl. 35. — *Thelypteris albosetosa* (COPEL.) REED, Phytologia 17 (1968) 259. — Type: BRASS 11435, W. New Guinea, 18 km north of Lake Habbema, on dry face of a limestone wall, in shade (MICH; BM, BO, L).

Caudex short, creeping, 4–5 mm diameter, bearing close but seriate stipes; *stipe* 6 cm long, basal scales ovate, 1 mm long; base of stipe to first normal pinna 12–24 cm; *reduced pinnae* 6 pairs, lowest 4 mm long, others gradually longer; transition to normal pinnae subabrupt, an intermediate pair 1.5 cm long, 6 mm wide above auricled base, apex broadly obtuse. *Lamina* 21 cm long; pinnae 10 pairs, lower ones not auricled at their bases; aerophores not elongate. Lower surface of *rachis* bearing short pale erect hairs with some to 1 mm long; hairs 1 mm long also on upper surface. *Largest pinnae* 4.0 × 1.0 cm; base truncate on acroscopic side, rounded on basiscopic; apex abruptly narrowed to obtuse tip; edges lobed to a depth of 1.5–2 mm, lobes strongly concave beneath (specimen at BO); costules 3.5 mm apart; veins 4–6 pairs, thick and prominent on lower surface, basal pair anastomosing, second pair passing to sinus-membrane or margin; *lower surface* of costae bearing short erect hairs mixed with longer ones to 1 mm, more sparse similar hairs on costules, short slender erect hairs on and between veins; *upper surface* of costae bearing hairs less than 1 mm long, scattered similar hairs on costules and veins, surface between veins covered with fine appressed hairs. *Sori* medial; basal ones much divergent; indusia small with copious long hairs; sporangia setiferous.

Distr. *Malesia*: W. New Guinea (near Lake Habbema), only known from the type.

Ecol. On dry face of limestone wall, in shade.

152. Sphaerostephanos wauensis HOLTTUM, *sp nov.*

Pinnae redactae usque 9-jugatae, infimae 5 × 4 mm, superiores 1.4 × 1.0 cm, triangulares; pinnae evolutae usque 12 × 2.0 cm, 2/5 costam versus lobatae; rachis utrinque pilis patentibus brunneis 1 mm vel ultra longis pilisque brevioribus vestita; costae costulae venaeque subtus pilis pallidis 1 mm longis praeditae, eglandulosae; indusia magna, tenuia, pilis brevibus instructa; sporangia setifera. — Type: T. NAKAIKE 96, N.E. New Guinea, Morobe Distr., Wau, Mt Missim 1300–1600 m (K; TNS).

Caudex massive, suberect. *Stipe* 17 cm long; basal scales narrow, 7 mm or more long; base of stipe to first large pinna 55 cm. *Reduced pinnae* to 9 pairs, alternate; basal ones 5 × 4 mm, uppermost 1.5 × 1.0 cm, triangular with symmetric base, crenate; one pair intermediate pinnae present. *Lamina* 60 cm long; pinnae 21 pairs; lower pinnae slightly narrowed towards base which may be slightly auricled both sides; aerophores not elongate. *Rachis* bearing on both sides spreading thick brown hairs more than 1 mm long (sometimes lacking on lower surface), on lower surface also short erect pale hairs, on upper surface short brown hairs. *Largest pinnae* 12 × 2.0 cm, sessile; base broadly cuneate to subtruncate, not dilated; apex short-acuminate; edges lobed rather less than ½ way to costa; lobes oblique and slightly falcate; costules 4–5 mm apart, at 60° or a little less; veins to 8 pairs, 1½ pairs anastomosing and 1 pair to sinus-membrane; *lower surface* of costae bearing many spreading pale hairs more than 1 mm long with a varied range of shorter ones, hairs on costules and veins sparse, to 1 mm long, short erect hairs between veins; *upper surface* of costae bearing slender pale hairs 1 mm long, similar hairs scattered on costules and veins, short appressed hairs on surface between veins not abundant. *Sori* inframedial, lower ones not divergent; indusia rather large, thin, bearing hairs 0.3 mm long; sporangia setiferous.

Distr. *Malesia*: Papua New Guinea (Morobe District), at 1300–1800 m, several collections.

Note. A smaller plant has fertile pinnae 6.8 × 1.3 cm which are slightly stalked (WOMERSLEY & MILLAR 8309, from 1800 m), otherwise agreeing with the type.

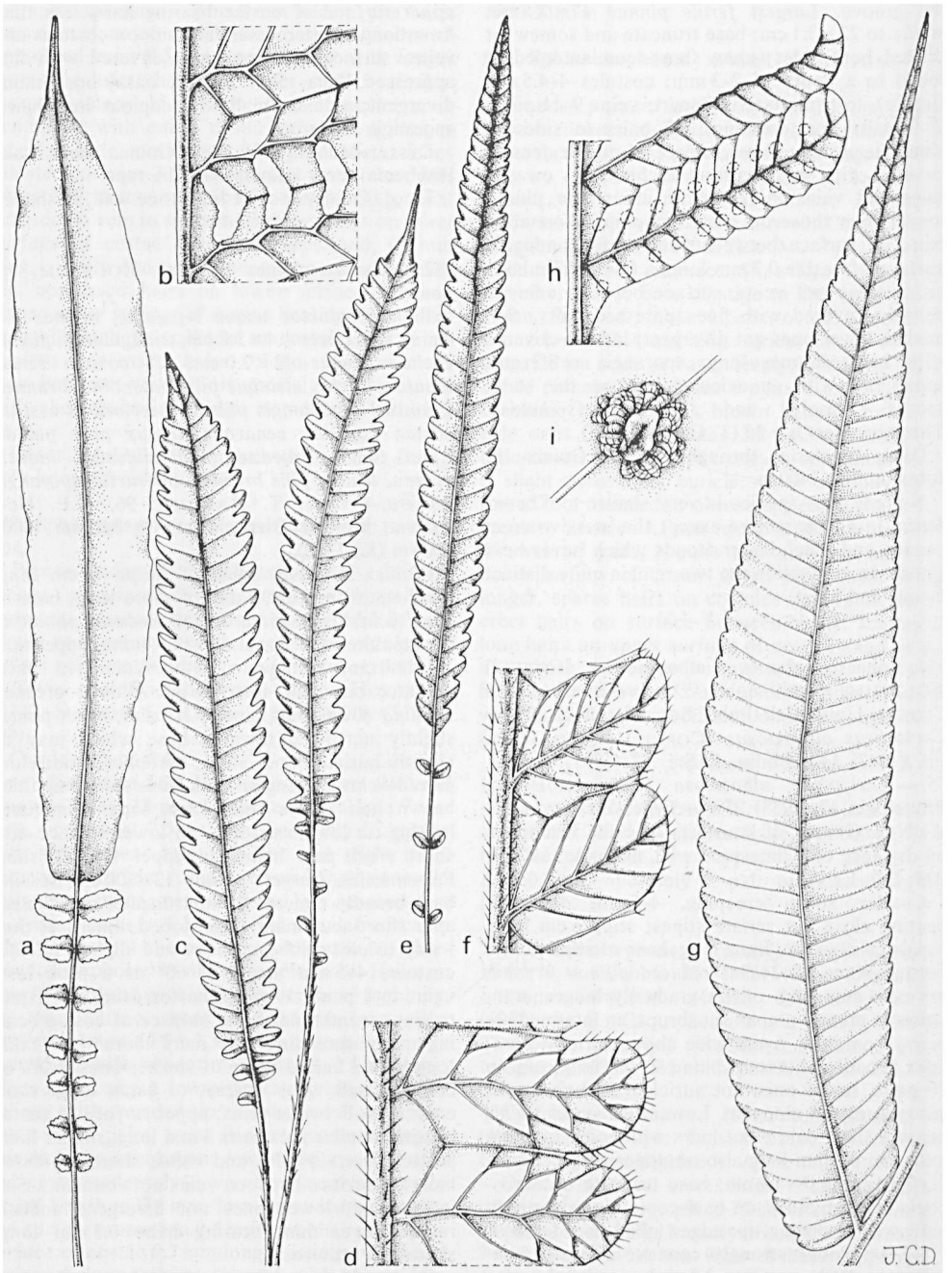

Fig. 14. *Pronephrium womersleyi* HOLTTUM. *a.* Frond, $\times \frac{1}{3}$; *b.* venation and position of sori in apical lamina, $\times 3$. — *P. heterophyllum* (PR.) HOLTTUM. *c.* Fertile and sterile fronds, $\times \frac{1}{3}$; *d.* venation of part of apical lamina, $\times 3$. — *P. micropinnatum* HOLTTUM. *e.* Frond, $\times \frac{2}{3}$; *f.* part of apical lamina, $\times 4$. — *P. asperum* (PR.) HOLTTUM. *g.* One pinna, $\times \frac{2}{3}$; *h.* venation and position of sori, $\times 2$; *i.* one sorus, $\times 16$ (*a* NAKAIKE 69, *b* BRASS 31670, *c–d* PRICE & HERNAEZ 162, *e–f* cult. Kew, *g–i* HENDERSON 21863).

18. PRONEPHRIUM

PRESL, Epim. Bot. (1851) 258, *excl. P. lastreoides* PRESL; HOLTTUM, Novit. Bot. Inst. Bot. Univ. Carol. Prag. 1968 (1969) 48; Blumea 19 (1971) 34; Blumea 20 (1972) 105–126. — Type species: *Pronephrium lineatum* (BL.) PRESL, *l.c.* (designated by HOLTTUM, *l.c.* 1969).

Haplodictyum PRESL, *l.c.* 50; CHING, Sunyatsenia 5 (1940) 251, *p.p.*; COPEL. Fern Fl. Philip. (1960) 377; HOLTTUM, Blumea 19 (1971) 37; Kalikasan 2 (1973) 59, *excl. H. majus.* — *Thelypteris subg. Haplodictyum* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 32. — Type species: *Haplodictyum heterophyllum* PRESL, *l.c.*

Abacopteris FÉE, Gen. Fil. (1852) 309; CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 230; Acta Phytotax. Sinica 8 (1963) 331; HOLTTUM, Rev. Fl. Malaya 2 (1955) 285, *excl. A. peltochlamys* (C. CHR.) HOLTTUM. — *Dryopteris sect. Abacopteris* C. CHR. Gard. Bull. Str. Settl. 7 (1934) 247. — *Thelypteris subg. Abacopteris* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 34. — Type species: *Abacopteris philippinarum* FÉE, *l.c.* (designated by HOLTTUM, *l.c.* 1969) = *Pronephrium asperum* (PRESL) HOLTTUM.

Dimorphopteris TAGAWA & K. IWATS. Acta Phytotax. Geobot. 19 (1961) 8. — Type species: *Dimorphopteris moniliformis* TAGAWA & K. IWATS. *l.c.* — **Fig. 1n–o, 14–16.**

Caudex creeping or suberect (never truly erect); fronds simple or simply pinnate, basal pinnae not reduced but often narrowed at base on basiscopic side, less often on acroscopic; apical lamina pinna-like or widened towards its base and then merging with the upper pinnae; pinnae crenate to entire; veins several pairs (except in a few species with small pinnae), almost all anastomosing, the excurrent veinlets arising from their union in some species free, more often joining to form zig-zag composite veins alternating with the costules; sinus-membranes short or (in species with entire pinnae) lacking; lower surface of old fronds usually pustular when dried; acicular hairs usually present on lower surfaces, hooked in *sect. Grypothrix*; sessile spherical yellow glands present on lower surface, indusia and/or sporangia in some species; sori in some species exindusiate and then often spreading along the veins; sporangia often bearing short setae, less often spherical glands or both glands and setae; spores of most species with a ± continuous longitudinal wing and cross-wings, three species with many small separate wings or papillae.

Distr. India & Ceylon; from S. China southwards throughout *Malesia*; North Queensland; Solomon Islands, New Hebrides, Fiji; *c.* 68 species, of which 12 not Malesian.

Ecol. Most species are terrestrial in forest or on stream-banks in shade (in several cases on rocks only); two are limestone ferns in more exposed positions (*P. simillimum, P. scopulorum*).

Cytol. Chromosome number 36; 10 species investigated, of which *P. pentaphyllum, P. peltatum var. peninsulare, P. womersleyi* and *P. triphyllum* are tetraploid.

Taxon. CHRISTENSEN (Ind. Fil. 1905) accepted *Abacopteris* FÉE (which he included in *Dryopteris*) as published in 1843, but that publication consisted of the generic name only with no description. CHING gave generic status to *Abacopteris*, and cited *Aspidium lineatum* BL. as type, but FÉE did not mention that species when the generic name was validly published by him in 1852; he then listed *Pronephrium* PRESL as a genus not adopted, as he had seen none of the species (p. 358).

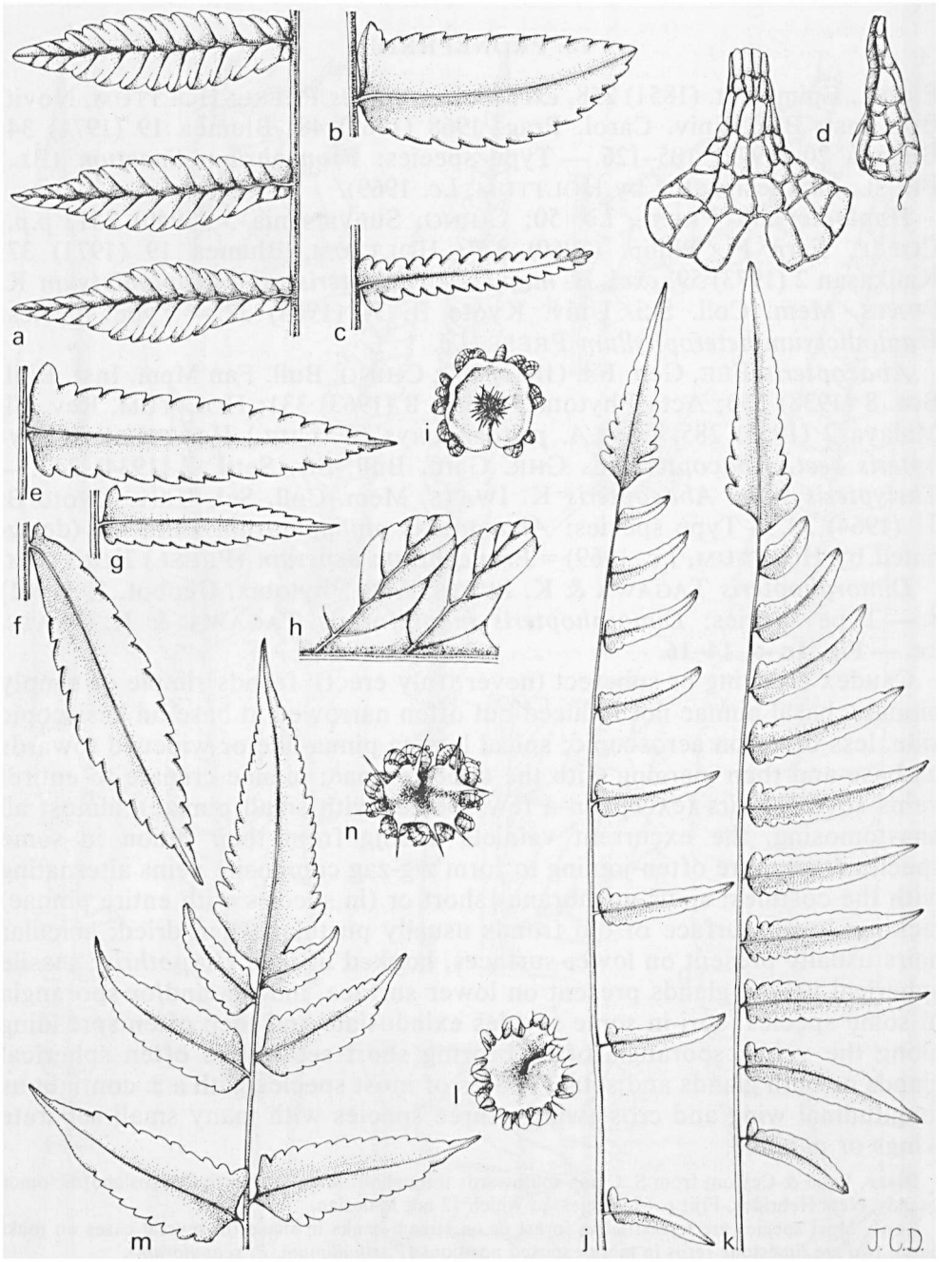

Fig. 15. *Pronephrium amboinense* (WILLD.) HOLTTUM. *a.* Lower pinnae, ×⅔. — *P. celebicum* (BAK.) HOLTTUM. *b.* Sterile pinna, × 1.5; *c.* fertile pinna, × 1.5; *d.* two indusia, × 100. — *P. hewittii* (COPEL.) HOLTTUM. *e.* Middle sterile pinna, × 1.5; *f.* basal sterile pinna, × 1.5; *g.* fertile pinna, × 1.5; *h.* venation of sterile pinna, × 4; *i.* sorus, × 16. — *P. rhombeum* (CHRIST) HOLTTUM. *j.* Fertile frond, ×⅛; *k.* sterile frond, ×⅛; *i.* sorus, × 16. — *P. granulosum* (PR.) HOLTTUM. *m.* Fertile frond, ×⅛; *n.* sorus, × 24 (*a* from photo of type, *b* DRANSFIELD 3776, *c–d* CURTIS 431, *e–i* MOLESWORTH ALLEN 3048, *j–n* cult. Kew).

Pronephrium PRESL (1851) comprised four species, which I discussed in 1969, citing *P. lineatum* (BL.) PRESL as type and accepting the statement by METTENIUS and CHRISTENSEN that the second species *P. affine* (BL.) PRESL was not distinct from the first. Subsequently (HOLTTUM 1971) I examined the types of both of BLUME's species and found them to be quite distinct from each other. The third of PRESL's species is here named *P. rhombeum*; the fourth (*P. lastreoides* PRESL) is here transferred to *Sphaerostephanos*.

PRESL's most distinctive character is dimorphism of fertile and sterile fronds; this is doubtfully true of *P. lineatum* (the fertile frond of the type is not fully expanded) but is true of species 2 and 3. FÉE distinguished *Abacopteris* mainly by subentire pinnae with meniscioid venation but the excurrent veinlets not free, and indusiate sori. CHING (1938) extended it to admit species in mainland Asia with exindusiate sori and typical meniscioid venation; he also cited absence of sinus-membranes as a generic character, but short membranes are often present (the line of distinction is not a sharp one). CHRISTENSEN (1934) had already added species from Malesia as *Dryopteris sect. Abacopteris*. In 1971 and 1972, under the earlier name *Pronephrium*, I accepted the generic concepts of CHING and CHRISTENSEN, adding the character absence of reduced basal pinnae, and divided the whole into three sections: *Pronephrium*, *Dimorphopteris* and *Grypothrix*. But some of the species then placed in *sect. Pronephrium* have resemblances to species in *sect. Dimorphopteris* and some to species in *sect. Grypothrix*. I here attempt to adjust this situation by re-arranging the species in two subgenera *Pronephrium* and *Menisciopsis*. *Haplodictyum* PRESL (which I treated as a separate genus in 1971) is included in *sect. Pronephrium*. But though sections *Dimorphopteris* and *Grypothrix*, as re-arranged, appear to be natural groups, the other two sections are probably not; problems of relationships are discussed under the sections.

KEY TO THE SUBGENERA AND SECTIONS

1. Veins in pinnae less than 10 pairs, or if more than 10, sori indusiate; yellow spherical glands often present, at least on sporangia . . . . . 1. SUBG. PRONEPHRIUM
2. Apical lamina pinna-like or much larger than pinnae; pinnae not auricled on acroscopic base; fronds of young plants simple, in *P. beccarianum* all fronds simple . . . . . **1. *Sect.* Pronephrium**
2. Apical lamina not pinna-like, or if so pinnae auricled on acroscopic base; fronds of young plants rarely simple . . . . . **2. *Sect.* Dimorphopteris**
1. Veins in pinnae 10 pairs or more, or if fewer, excurrent veinlets all free; sori exindusiate; spherical glands never present . . . . . 2. SUBG. MENISCIOPSIS
3. No hooked hairs on any part of plant; sori rarely coalescent . . . . . **3. *Sect.* Menisciopsis**
3. Hooked hairs present on sporangia or on some other part of plant; sori often elongate or coalescent **4. *Sect.* Grypothrix**

1. Subgenus Pronephrium

1. Section Pronephrium

Haplodictyum PRESL, Epim. Bot. (1851) 50.

The following species, included here in 1972, are now transferred to other sections: the non-Malesian *P. lakhimpurense* and allied species, also the Malesian *P. nitidum*, *P. repandum* and *P. acanthocarpum*, to *sect. Menisciopsis*; *P. aquatiloides* and *P. menisciicarpon* to *sect. Dimorphopteris*.

The species here included belong to three groups:

1. Species which appear to be related to the type, *P. lineatum*. Of these, *P. euryphyllum* has glands on the lower surface and appressed hairs on the upper surface as in *P. glandulosum* of *sect. Dimorphopteris*. *P. asperum* and *P. gymnopteridifrons* lack glands but have the same frond-form as the type. None of these have the reddish tinge shown by species of *subg. Menisciopsis*. But they show resemblances to *Sphaerostephanos peltochlamys*, *S. simplicifolius* and *S. spenceri*, which differ only in the presence of several pairs of much-reduced basal pinnae.

2. Species which have an elongate apical lamina and a few much smaller pinnae, and sori which lack indusia. These are specialized forms the relationship of which it is difficult to suggest. Three of them have glands on their sporangia as in *P. lineatum*. The most aberrant species, lacking glands, is *P. micropinnatum*; it may belong elsewhere.

3. Species included in *Haplodictyum* in my arrangement of the genera in 1971, but excluding *H. majus* COPEL. which is now placed in *Sphaerostephanos* because it has much-reduced basal pinnae in addition to normal ones. These species have glands on the lower surface of pinnae and indusiate sori.

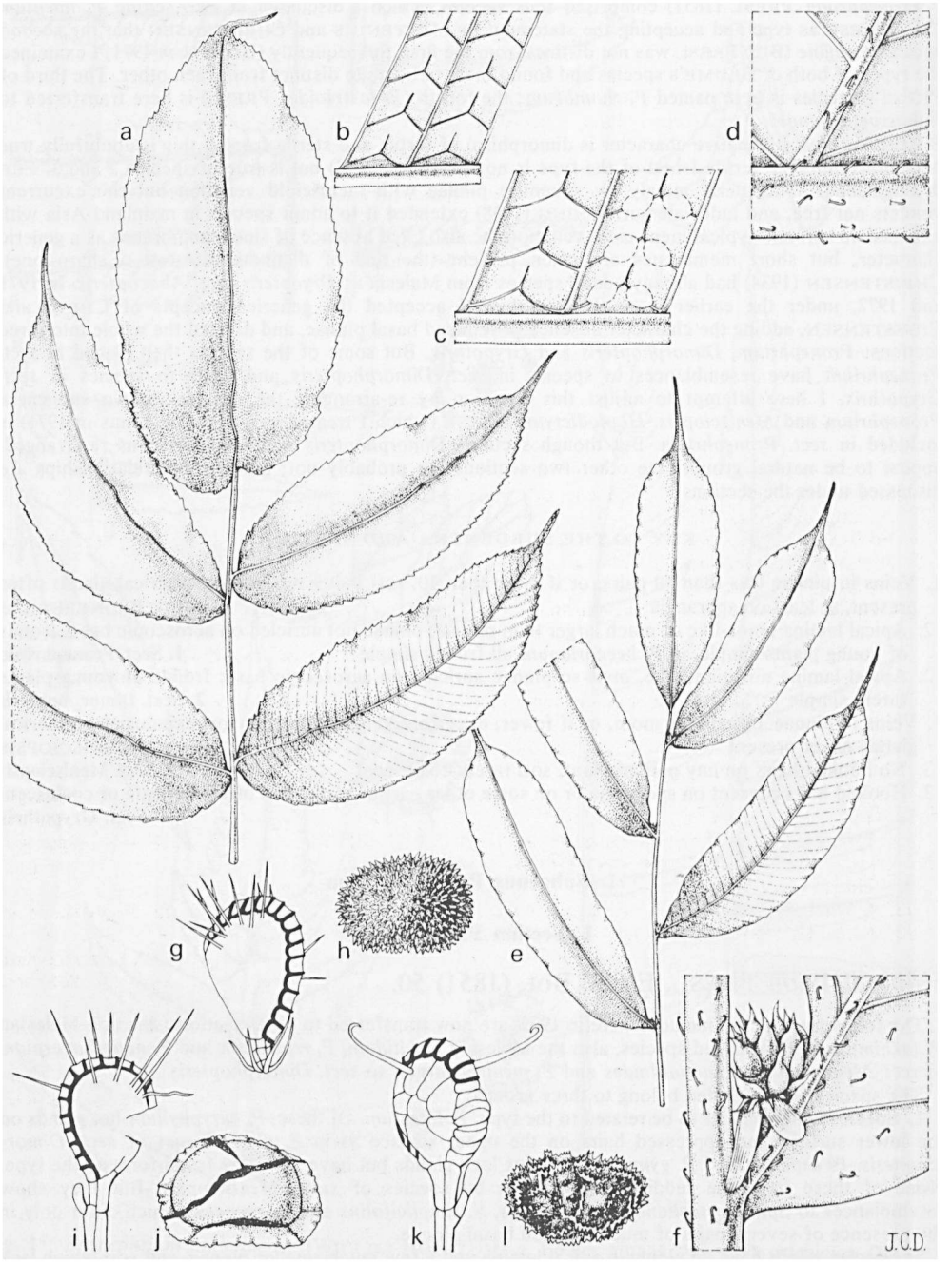

Fig. 16. *Pronephrium rubicundum* (v.A.v.R.) HOLTTUM. *a.* Complete frond, ×½; *b.* venation of sterile frond, ×3; *c.* venation of fertile frond and position of sori, ×4; *d.* costa and costule showing hooked hairs, ×12. — *P. ramosii* (CHRIST) HOLTTUM. *e.* Upper part of frond, ×½; *f.* bud at base of a pinna, ×8. — Sporangia, ×35, and spores, ×235: *g–h. P. nitidum* HOLTTUM; *i–j. P. repandum* (FÉE) HOLTTUM; *k–l. P. triphyllum* (SW.) HOLTTUM (*a–d* MATTHEW *s.n.*, *e–f* ELMER 17851, *g–l* after HOLTTUM, Blumea 19: 24, fig. 8–9 and SEM photos).

Two of them have the peculiar venation in their terminal lamina which caused PRESL to establish the genus *Haplodictyum*: the veins in the lower part of the apical lamina are forked, their branches anastomosing to form a series of areoles along the costules, also sometimes additional areoles below the sinuses. This venation resembles that of *Pleocnemia*, and on that account CHING placed *Haplodictyum* in his family *Aspidiaceae*, though it is unquestionably thelypteroid. But the third species (*P. bakeri*) does not have the veins thus forked, though in every other character it resembles the other two. The *Haplodictyum* type of venation occurs to a small extent at the base of the apical lamina in several species of other genera of *Thelypteridaceae* where the transition from apical lamina to pinnae is not sharply defined. The peculiar venation is like that of pinnae, of which the upper ones are more or less adherent to the base of the apical lamina. There is a North American fossil named *Goniopteris claiborniana* BERRY (Bull. Torr. Bot. Cl. 44, 1917, 331, t. 22) which shows the *Haplodictyum* venation.

KEY TO THE SPECIES

1. Pinnae of fronds of adult plants about equal in size to apical lamina.
 2. Glands present on lower surface of pinnae . . . . . **1. P. euryphyllum**
 2. Glands lacking on lower surface of pinnae.
  3. Pinnae 2–3 pairs; glands present on indusia or sporangia or both . . . . . **2. P. lineatum**
  3. Pinnae to at least 7 pairs; no glands on indusia and sporangia.
   4. Pinnae to 30 × 5 cm; spores with a median wing and cross-wings . . . . . **3. P. asperum**
   4. Pinnae to 15 × 2.5 cm; spores with many separate small wings . . . . **4. P. gymnopteridifrons**
1. Apical lamina much larger than pinnae, or fronds simple.
 5. Sori exindusiate; glands usually lacking on lower surface between veins.
  6. No free pinnae; sometimes one small pair broadly adnate . . . . . **5. P. beccarianum**
  6. Free pinnae present on adult plants.
   7. Sporangia bearing glands near annulus.
    8. Apical lamina to 20 × 3.5 cm; midrib of apical lamina and rachis glabrous on lower surface **6. P. womersleyi**
    8. Apical lamina to 6 × 1.7 cm; hairs present on lower surface of midrib of apical lamina and rachis . . . . . **7. P. melanophlebium**
   7. Sporangia bearing setae, not glands, near annulus.
    9. Terminal lamina lobed 1/4–1/3 towards midrib; pinnae to at least 1 cm long.
     10. Pinnae 4–8 cm long . . . . . **8. P. pentaphyllum**
     10. Pinnae not over 2 cm long.
      11. No glands on lower surface . . . . . **9. P. brauseanum**
      11. Glands present on lower surface . . . . . **10. P. diminutum**
    9. Terminal lamina crenate; pinnae 2–5 mm long . . . . . **11. P. micropinnatum**
 5. Sori indusiate; glands always present on lower surface between veins.
  12. Veins in basal part of apical lamina forked, their branches anastomosing.
   13. Apical lamina widest near its base; pinnae 1 pair . . . . . **12. P. bulusanicum**
   13. Apical lamina not widest near its base; pinnae 3 pairs, decreasing downwards **13. P. heterophyllum**
  12. Veins in apical lamina not forked . . . . . **14. P. bakeri**

1. Pronephrium euryphyllum (ROSENST.) HOLTTUM, Blumea 20 (1972) 112. — *Dryopteris euryphylla* ROSENST. Meded. Rijksherb. *n.* 31 (1917) 7. — *Thelypteris euryphylla* (ROSENST.) REED, Phytologia 17 (1968) 276. — Type: KORTHALS, Sumatra (L; B).

Dryopteris urophylla var. teysmannii v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 24. — Type: TEYSMANN, Sumatra, Loeboe Alang (BO?; not found).

Sterile fronds unknown. *Fertile fronds* consisting of terminal lamina to 21 × 5.5 cm and at least 3 pairs of pinnae. *Pinnae* to 18 × 6 cm, base broadly cuneate, sides parallel for most of their length, crenate to depth of 1–1.5 mm, apex abruptly narrowed to a cusp 1–2 cm long; costules 4–4.5 mm apart, at more than 60° to costa, slightly falcate; veins *c.* 15 pairs, almost all anastomosing, excurrent veinlets not free; *lower surface* of rachis, costae and costules covered densely with short erect hairs, similar shorter hairs with many glands on surface between veins; *upper surface* densely covered throughout with short appressed hairs. *Sori* supramedial, spreading a little along veins; indusia hairy, persistent but shrivelling; sporangia bearing several short setae; spores pale, with continuous wing and cross-wings.

Distr. *Malesia*: Sumatra; the two types cited.

Notes. The KORTHALS collection at L consists of 5 sheets (2 also at B); on one of the smaller fronds the basal pinnae are somewhat reduced and narrowed at their base, but the lowest (of three pairs) on the largest specimen are not, so that there may have been more pairs of pinnae on

the latter. VAN ALDERWERELT's short description of TEYSMANN's specimen is adequate for identification; the number of pairs of pinnae is not specified.

2. Pronephrium lineatum (BL.) PRESL, Epim. Bot. (1851) 259; HOLTTUM, Blumea 19 (1971) 34; 20 (1972) 112. — *Aspidium lineatum* BL. Enum. Pl. Jav. (1828) 144; METT. Farngatt. IV (1858) 264, *p.p.* — *Meniscium lineatum* (BL.) KUNZE, Bot. Zeit. 6 (1848) 259. — *Nephrodium lineatum* (BL.) PRESL, Epim. Bot. (1851) 48; HOOK. Spec. Fil. 4 (1862) 74, *p.p.* — *Cyclosorus lineatus* (BL.) TARD. & C. CHR. Notul. Syst. 7 (1938) 74, *nomen tantum.* — *Abacopteris lineata* (BL.) HOLTTUM, Rev. Fl. Malaya 2 (1955) 292, *nomen tantum.* — *Thelypteris lineata* (BL.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 34. — Type: BLUME, Java (L. *n.* 909, 27–60; isotypes P, PRC).

Alsophila fragilis ZOLL. & MORITZI, Nat. Geneesk. Arch. Ned. Ind. 1 (1844) 400. — *Meniscium sp.* MORITZI, Syst. Verz. (1846) 116. — *Meniscium fragile* (ZOLL. & MOR.) KUNZE, Bot. Zeit. 6 (1848) 259. — Type: ZOLLINGER 1019, Java, Tjikoya river (L; FI).

Dryopteris verruculosa v.A.v.R. Bull. Jard. Bot. Btzg II, 11 (1915) 12; Handb. Suppl. (1917) 177. — *Thelypteris verruculosa* (v.A.v.R.) REED, Phytologia 17 (1968) 323. — Type: BACKER 3954, Java, Pasuruan (BO).

Dryopteris menisciicarpa (BL.) POSTH. in Backer & Posth. Varenfl. Java (1939) 61, *p.p.*

Caudex short-creeping or suberect. *Stipe* of sterile frond 20 cm, of fertile 40 cm long, pale, glabrescent except for hairs in groove. *Sterile frond.* Apical lamina to 15 × 4 cm; pinnae 2–3 pairs, to 9.5 × 3.0 cm, widest 1/3 from apex, gradually narrowed to abruptly broad-cuneate base, apex rather abruptly short-cuspidate, edges crenate distally, sinuous towards base; costules 3 mm apart; veins 7–8 pairs, almost all anastomosing, excurrent veinlets not free; *lower surface* with rather sparse erect hairs on costae, much shorter on costules, surface between veins glabrous and finely pustular, no glands present; *upper surface* hairy on costae only. *Fertile pinnae* of type not fully expanded, largest possibly 3.0 × 1.5 cm, of ZOLLINGER 1019 9 × 2.5 cm, of BACKER 3954 7 × 2.2 cm; sori inframedial; indusia small, bearing a few short hairs and glands; sporangia with glands, or both glands and setae; spores with translucent wing and cross-wings.

Distr. *Malesia*: Central & East Java (3 collections) and Sabah (Bettotan, KLOSS SFN 19083); Sulu Archipelago, Tawi-Tawi (ALCASID & CELESTINO PNH 7507).

Notes. METTENIUS (1858) included *Aspidium affine* BL. as a synonym, and his description is composite; HOOKER (1862) copied him; later authors mostly described *A. affine* under the name *lineatum*, not noticing that BLUME's descriptions of the two species indicate fronds of quite different form.

BLUME gave Noesa Kambangan as type locality, but the only specimen named in his hand is unlocalized; it agrees well with his description. The published description of *Alsophila fragilis* ZOLL. & MOR. is doubtfully valid, but the specimens of ZOLLINGER 1019 certainly agree with BLUME's. The sporangia of the type have both glands and setae; those of ZOLLINGER 1019 glands only.

3. Pronephrium asperum (PRESL) HOLTTUM, Blumea 20 (1972) 112. — *Polypodium asperum* PRESL, Rel. Haenk. (1825) 24, t. 3, f. 4, *non* LINN.; HOLTTUM, Novit. Bot. Inst. Bot. Univ. Carol. Prag. 1968 (1969) 18. — *Goniopteris aspera* PRESL, Tent. Pterid. (1836) 183, *nom. nov.* — *Aspidium asperum* (PRESL) METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 225, *excl. syn. Nephrodium latifolium* PRESL. — *Dryopteris presliana* CHING in C. CHR. Ind. Fil. Suppl. 3 (1934) 95, *nom. nov. superfl.* — *Abacopteris presliana* (CHING) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 248, *p.p.* — *Abacopteris aspera* CHING, Acta Phytotax. Sinica 8 (1963) 332. — *Thelypteris aspera* REED, Phytologia 17 (1968) 261. — Type: HAENKE, Luzon (PRC).

Abacopteris philippinarum FÉE, Gen. Fil. (1852) 310, t. 18C f. 1. — *Cyclosorus philippinarum* (FÉE) COPEL., Fern Fl. Philip. (1960) 372. — *Nephrodium latifolium* PRESL, Epim. Bot. (1851) 45, *p.p.* — Type: CUMING 16, Luzon (isotypes BM, G, K, LE).

Meniscium kennedyi F.v.M. Fragm. 4 (1864) 165. — *Goniopteris kennedyi* (F.v.M.) BAILEY, Handb. Queensl. Ferns (1874) 41, f. 31. — Type: DALLACHY & KENNEDY, Rockingham Bay, Queensland (MEL; K).

Dryopteris urophylla (WALL. *ex* HOOK.) C. CHR. *var. novoguineensis* ROSENST. in Fedde Rep. 10 (1912) 336; v.A.v.R. Handb. Suppl. (1917) 177. — Type: G. Bamler 80, Sattelberg, New Guinea (orig. not seen; probable isotypes BM, L, W, as Rosenst. fil. novoguin. exsic. 174).

Abacopteris multilineata (WALL. *ex* HOOK.) CHING *var. malayensis* HOLTTUM, Rev. Fl. Malaya 2 (1955) 297, f. 173, *nom. illeg.* — *Thelypteris multilineata* (WALL. *ex* HOOK.) CHING *var. malayensis* (HOLTTUM) REED, Phytologia 17 (1968) 294 (type not cited). — Lectotype: HOLTTUM SFN 15303, Trengganu, Kuala Telumong (SING; K).

Aspidium repandum sensu BL. Enum. Pl. Jav. (1828) 144, excl. syn.

Nephrodium glandulosum sensu J. SM. in Hook. J. Bot. 3 (1841) 411 (misidentification of CUMING 16); DIELS in E. & P. Nat. Pfl. Fam. I Abt. 4 fig. 92G "nach Fée" (inaccurate copy of FÉE, Gen. Fil. t. 18C, f. 1). — *Aspidium glandulosum sensu* KUNZE, Bot. Zeit. 6 (1848) 260, *quoad Cuming* 16

tantum; METT. Farngatt. IV (1858) 111, *quoad syn. Abacopteris philippinarum* FÉE *tantum*.

Polypodium urophyllum sensu BENTH. Fl. Austral. 7 (1878) 766, excl. BEDD. Ferns Brit. Ind. t. 3. — *Nephrodium urophyllum sensu* BEDD. Handb. (1883) 274, *p.p.*; *sensu* RACIB. Fl. Btzg 1 (1898) 184. — *Dryopteris urophylla sensu* v.A.v.R. Handb. (1908) 216, *p.p.*; *sensu* BACKER & POSTH. Varenfl. Java (1939) 64, *p.p.* — **Fig. 14g-i.**

Caudex short-creeping. *Stipe* to 70 cm or more long, slightly flushed red, glabrescent, base at first covered with narrow thin scales. *Lamina* to 60 cm or more long; pinnae 6–8 pairs, lower ones ± narrowed at base, lowest sometimes reduced, texture thin; apical lamina more strongly crenate than pinnae. *Largest pinnae* to 37 × 6 cm, sessile, base abruptly broad-cuneate, apex short-acuminate, edges subentire to distinctly crenate, parallel for most of their length; costules 5–5.5 mm apart, at 60° to costa; veins 12–15 pairs, at *c.* 45°, nearly all anastomosing, excurrent veinlets usually not free; sinus-membrane short but distinct; *lower surface* of costae, costules and veins bearing short hairs, surface between veins glabrous or rarely with short erect hairs, finely verrucose when dry; *upper surface* hairy only on costa. *Sori* medial, lowest ones supramedial and ± coalescent; indusia small, with or without short hairs; sporangia of type lacking setae, a hair of 2 cells on the stalk; spores dark with a continuous wing and cross-wings.

Distr. Polynesia (Fiji), Solomon Is. (Bougainville), North Queensland and throughout *Malesia*.

Ecol. In lowland forest.

Notes. Until the work of CHING (1938) this species and others were much confused with *Polypodium urophyllum* WALL. (= *Pronephrium repandum* (FÉE) HOLTTUM), the present species also with *Nephrodium latifolium* PRESL (= *Pronephrium menisciicarpon*) and *Aspidium glandulosum* BL. (*Pronephrium glandulosum*); under the last-named METTENIUS also cited specimens of *Sphaerostephanos peltochlamys* (C. CHR.) HOLTTUM (ZOLLINGER 2608, 2920). Specimens from New Guinea and Queensland often have 1–2 short setae on sporangia.

4. Pronephrium gymnopteridifrons (HAYATA) HOLTTUM, Blumea 20 (1972) 112; C. M. KUO, Fl. Taiwan 1 (1975) 429, pl. 150; EDIE, Ferns Hong Kong (1978) 151, f. 73. — *Dryopteris gymnopteridifrons* HAYATA, Ic. Pl. Formos. 8 (1919) 148, fig. 75, 76. — *Abacopteris gymnopteridifrons* (HAYATA) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 251. — Type: T. SOMA *s.n.* 1912, Taiwan (isotypes TAI).

Polypodium urophyllum var. uniseriale HOOK. Spec. Fil. 5 (1863) 10, new name for *Polypodium granulosum sensu* BENTH. Fl. Hongkong (1861) 459. — Lectotype (HOLTTUM *l.c.* 1972): URQUHART, Hong Kong (K).

Cyclosorus pustulosus COPEL. Philip. J. Sci. 81 (1952) 37; Fern Fl. Philip. (1960) 374. — *Thelypteris pustulosa* (COPEL.) REED, Phytologia 17 (1968) 307. — Type: Copeland 218, Lamao River, Luzon (MICH).

Dryopteris glandulosa sensu CHR. Philip. J. Sci. 2 (1907) Bot. 205, *p.p.*

Abacopteris presliana sensu CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 249, *p.p.*

Differs from *P. asperum* as follows. Caudex (at least in some cases) long-creeping; frond smaller, pinnae commonly to 15 × 2.5 cm (exceptionally to 25 × 4 cm); sori more often coalescent (in some cases many pairs); sporangia often setiferous; spores with many small wings.

Distr. Southern China and *Malesia*: Philippines (Luzon).

5. Pronephrium beccarianum (CESATI) HOLTTUM, Blumea 20 (1972) 107; BROWNLIE, Pterid. Fiji (1977) 256, pl. 26, f. 2. — *Meniscium beccarianum* CESATI, Rendic. Acad. Napoli 16 (1877) 27, 30. — *Dryopteris cesatiana* C. CHR. Ind. Fil. (1905) 257, *nom. nov.* (not *D. beccariana* (CESATI) C. CHR.); COPEL. Bishop Mus. Bull. 59 (1929) 48. — *Phegopteris beccariana* (CESATI) v.A.v.R. Handb. (1908) 509. — *Cyclosorus beccarianus* (CESATI) COPEL. Gen. Fil. (1947) 142; Philip. J. Sci. 78 (1951) 460. — *Thelypteris cesatiana* (C. CHR.) REED, Phytologia 17 (1968) 267 (not *T. beccariana* (CESATI) REED). — Type: *Beccari*, Andai, W. New Guinea (FI, Herb. Becc. 12727).

Goniopteris simplicifolia (J. SM. *ex* HOOK.) CARR. *var. vitiensis* CARR. in Seem. Fl. Vitiensis (1893) 366. — Type: SEEMANN 736, Fiji (K).

Dryopteris oblanceolata COPEL. Philip. J. Sci. 9 (1914) Bot. 3. — *Phegopteris oblanceolata* (COPEL.) v.A.v.R. Handb. Suppl. (1917) 320. — Type: C. KING 394, Taupota, Papua (MICH; SING).

Phegopteris rutteniana v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 36. — Type: KORNASSI 725, Ceram (BO).

Caudex short-creeping. *Stipe* 2–10 cm long, usually longest in fertile fronds, near base minutely hairy, above base hairy in groove. *Lamina* simple, to 35 cm long, sterile to 5 cm wide, fertile usually narrower, widest 1/3 from short-acuminate apex, very gradually narrowed to base, edges entire or sinuous, base sometimes dilated or with a pair of small broadly adnate separate leaflets; main veins 3.5–4 mm apart, at broad angle to midrib, distally upcurved; veins 9–10 pairs, almost all anastomosing, excurrent veinlets mostly not free; *lower surface* between veins pustular, sparse short hairs present on main veins and veins, sometimes also rudimentary scales with red end-cell; *upper surface* short-hairy on midrib, sparsely on main veins. *Sori* exindusiate, spreading along veins, those on connivent veins often joining, sori rarely extending a little along excurrent veinlets; sporangia bearing small

glands and sometimes a short seta; spores pale with rather broad minutely erose translucent wing and a few cross-wings.

Distr. Polynesia (Fiji), Solomon Is., in *Malesia*: New Guinea and Moluccas (Ceram).

Ecol. In forest, usually near streams, to 1000 m or a little higher.

Notes. In Fiji the basal part of the lamina is more often strongly sinuous and there may be 3 pairs of broadly adnate basal leaflets; glands on sporangia are larger than in New Guinea.

6. Pronephrium womersleyi HOLTTUM, Blumea 20 (1972) 108. — *Cyclosorus beccarianus sensu* HOLTTUM & ROY, Blumea 13 (1965) 134. — Type: FLOYD & WOMERSLEY NGF 6308, N.E. New Guinea, Eastern Highlands, Goroka Subdistr. 2200 m (LAE; BM). — **Fig. 14a–b.**

Differs from *P. beccarianum* as follows. Adult plants always with several (to 10) pairs of free ± orbicular pinnae 7–10 mm long, 7–8 mm wide; veins in pinnae forked, the branches joining to form a series of areoles; apical lamina smallest on fronds with most pinnae; lower surface of midrib and veins glabrous or nearly so; sori (on apical lamina only, or rarely on a pinna) on lower 1–3 pairs of veins coalescent, more distal sori on basal part of each vein; sporangia bearing small glands, not setae.

Distr. Solomon Is. (Guadalcanal), in *Malesia*: Papua New Guinea, 1400–2400 m.

Note. A plant cultivated at Kew was found to be tetraploid (HOLTTUM & ROY *l.c.*).

7. Pronephrium melanophlebium (COPEL.) HOLTTUM, Blumea 20 (1972) 108. — *Dryopteris melanophlebia* COPEL. Philip. J. Sci. 6 (1911) Bot. 147. — *Phegopteris melanophlebia* (COPEL.) v.A.v.R. Handb. Suppl. (1917) 319. — *Cyclosorus melanophlebius* (COPEL.) COPEL. Fern Fl. Philip. (1960) 359. — *Thelypteris melanophlebia* (COPEL.) REED, Phytologia 17 (1968) 292. — Type: MERRILL 6959, Canlaon Volcano, Negros (isotypes B, BO, E, K, L, NSW).

Dryopteris canescens var. subsimplicifolia CHRIST, Philip. J. Sci. 2 (1907) Bot. 199. — Type: WHITFORD 784, Luzon (not seen).

In habit similar to *P. womersleyi* but much smaller. *Stipe* 2–3 cm (sterile), to 8 cm (fertile), covered with hairs more than 0.5 mm long. *Apical lamina* of sterile fronds to 5 × 1.8 cm, of fertile to 6 × 1.4 cm; *pinnae* 3 pairs, sterile 6 × 5 mm, fertile 5 × 4 mm and more widely spaced than sterile, oblong-ovate with midrib and 4 pairs of forked veins, the branches anastomosing; *lower surface* of costa with copious spreading pale hairs to 1 mm long, sparse shorter hairs on veins; on *upper surface* a few short appressed hairs between veins, especially near margins; *sori* from base of veins, ± elongate, exindusiate, those on connivent veins sometimes meeting; sporangia bearing glands.

Distr. *Malesia*: Philippines (Negros, Mindanao (ELMER 10784, Mt Apo), (?) Luzon).

Note. ELMER's specimen from Mindanao was distributed under the name *Dryopteris canescens var. subsimplicifolia*; it agrees with CHRIST's brief description of that variety, but ELMER 10278, also so named, is *Pronephrium granulosum*.

8. Pronephrium pentaphyllum (ROSENST.) HOLTTUM, Blumea 20 (1972) 108. — *Dryopteris pentaphylla* ROSENST. in Fedde Rep. 12 (1913) 529. — *Phegopteris pentaphylla* (ROSENST.) v.A.v.R. Handb. Suppl. (1917) 317. — *Thelypteris pentaphylla* (ROSENST.) REED, Phytologia 17 (1968) 303. — Type: KEYSSER 186, N.E. New Guinea, Sattelberg 1400 m (S-PA; B, BM).

Caudex long-creeping, 2–3 mm diameter when dry, with fronds 1–2 cm apart. *Stipe* of sterile frond *c.* 10 cm long, of fertile to 20 cm, bearing pale spreading hairs more than 0.5 mm long; *fronds* consisting of apical lamina and 1–2 pairs of pinnae. *Apical lamina* 10–15 × 1.5–3.0 cm, lobed 1/3 towards midrib, narrowed slightly to ± truncate base, apex acuminate; main veins *c.* 5 mm apart, veins to 10 pairs, 2 pairs anastomosing, 1½–2 pairs passing to long sinus-membrane; *lower surface* of midrib and veins bearing pale spreading hairs 1 mm long, rather sparse slender erect hairs between veins, no glands (but see note below); *upper surface* glabrous except for midrib. *Pinnae* opposite, 4–8 cm long, 1–2.5 cm wide (sterile wider than fertile), widest above middle, lobed 1/4–1/3 towards costa; veins 4–6 pairs; pubescence as apical lamina. *Sori* inframedial, spreading a little along the veins, basal ones only sometimes confluent; sporangia bearing 2–6 setae, on stalk a hair of 2 cells; spores pale, opaque, with rather broad translucent wing and cross-wings. *Chromosomes*: n = 72 (T. G. WALKER).

Distr. *Malesia*: N.E. New Guinea (also New Ireland).

Ecol. In forests, 1200–2000 m.

Notes. One specimen from Mt Oga, Western Highlands (B. S. CROXALL 4362) differs from all others seen in having scattered yellow glands instead of hairs between veins on lower surface of sterile fronds, and a yellow spherical gland at tip of hair on stalk of sporangium; also in the presence of fairly abundant short suberect hairs between veins of upper surface.

9. Pronephrium brauseanum HOLTTUM, Blumea 20 (1972) 107. — *Dryopteris canescens var. novo-guineensis* BRAUSE, Bot. Jahrb. 49 (1912) 22; COPEL. Philip. J. Sci. 78 (1951) 460. — Type: SCHLECHTER 18844, N.E. New Guinea, Bismarck Mts 1100 m (B; K, L, BISH).

Caudex short-creeping; fronds dimorphous. *Sterile fronds. Stipe* 1.5–3 cm long; *frond* consisting of terminal lamina and 1–2 pairs of pinnae close below it; *terminal lamina* 5–6 × 1.7–2.1 cm,

lobed 1/4 towards midrib, main veins 4–4.5 mm apart, veins 5–6 pairs, 1½ pairs anastomosing, 1 pair to sinus-membrane, strongly prominent on *lower surface* and bearing stiff hairs to 1 mm long, a few glands and short erect hairs present on surface between veins; *upper surface* bearing copious appressed hairs 0.3–0.4 mm long between veins; *pinnae* 1.0–2.0 cm long, 0.5–1.1 cm wide, sessile, edges crenate, pubescence as apical lamina. *Fertile frond. Stipe* to 12 cm long; *pinnae* more widely spaced than sterile, not opposite, to 1.2 × 0.6 cm with stalks 1 mm long, subentire with rounded apex, lowest pinna longest; *sori* (mainly on the terminal lamina) a little elongate, exindusiate; sporangia copiously setose.

Distr. *Malesia*: Eastern New Guinea at 1100–1700 m, in forest (5 collections).

10. Pronephrium diminutum (COPEL.) HOLTTUM, Blumea 20 (1972) 115. — *Dryopteris diminuta* COPEL. Philip. J. Sci. 40 (1929) 298. — *Cyclosorus diminutus* (COPEL.) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 359. — Type: COPELAND *s.n.* Nov. 1911, Mindanao, San Ramon 1200 m (MICH).

Caudex creeping, 1 mm diameter; scales 2 mm long. *Stipe* of sterile fronds 1–3 cm long, of fertile to 6 cm, covered with short pale erect hairs; *frond* consisting of apical lamina and 1–2 pairs of pinnae (not opposite). *Sterile fronds. Apical lamina* 2–4 cm long, 1.5 cm wide, lobed 1/4 towards midrib; main veins 4–4.5 mm apart, veins 3–4 pairs, 1–2 pairs anastomosing, prominent on lower surface; *lower surface* of midrib bearing stiff pale hairs to 1 mm long, shorter hairs on veins with a few glands, slender erect hairs and a few glands on surface between veins; *upper surface* covered with slender appressed hairs; *pinnae* broadly ovate, and slightly lobed, to 8 mm long, on stalks more than 1 mm long. *Fertile fronds* somewhat smaller than sterile, with more widely-spaced pinnae; *sori* exindusiate, those on lower veins elongate and coalescing, on distal veins round; sporangia bearing several short setae distally and sometimes a yellow gland on the stalk.

Distr. *Malesia*: Philippines (Luzon, Mindanao).

Note. COPELAND made 2 collections at San Ramon, one earlier than the type (1907). The only other collection is by M. G. PRICE (*n.* 2720B) from Mt Banahaw, Luzon, at 1000 m "on rocky slope 10 m above stream"; it only differs from the type in slightly larger fronds with fertile pinnae to 1.1 × 0.8 cm.

11. Pronephrium micropinnatum HOLTTUM, Blumea 20 (1972) 108. — Type: DARBYSHIRE & HOOGLAND 8014, N.E. New Guinea, Sepik Distr. (CANB; BM, L, LAE). — **Fig. 14g–f.**

Caudex short, suberect. *Stipe* to 6 cm long, minutely hairy on abaxial side, hairs in adaxial groove to 1 mm long. *Fronds* uniform, consisting of terminal lamina and 2–3 pairs of pinnae 1–1.5 cm apart. *Terminal lamina* to 18 × 1.4 cm, narrowed both to apex and base, edges crenate; main veins 4–5 mm apart, each with 4–5 pairs of veins of which 1½ pairs anastomose, 1 pair passing to sides of short sinus-membrane; *lower surface* of midrib covered with pale erect hairs almost 1 mm long, similar hairs sparse on main veins, short erect hairs between veins; *upper surface* glabrous apart from midrib; *sori* all medial, not elongate, exindusiate; sporangia bearing several setae nearly as long as the body; spores with many small wings. *Pinnae* of type *c.* 1 mm long, 2 mm wide; of plants cultivated at Kew to 5 × 3 mm; veins free; sori present on largest pinnae.

Distr. *Malesia*: N.E. New Guinea (Sepik and Madang Districts, 3 collections).

Ecol. On shaded river bank (type) and sandstone walls of river gorge, at 30–200 m.

12. Pronephrium bulusanicum (HOLTTUM) HOLTTUM, *comb. nov.* — *Haplodictyum bulusanicum* HOLTTUM, Kalikasan 2 (1973) 61. — Type: ELMER 16585, Mt Bulusan, Luzon (K; BO, FI, G, L.).

Stipe of sterile frond 5–6 cm, of fertile 9–14 cm long. *Lamina* to 12 cm long, 2.2–3.0 cm wide, short-acuminate, at the middle lobed 2/5 towards midrib, more deeply lobed at the base which is not narrowed, the basal lobes almost or quite free; veins in lobes near apex of frond 7–8 pairs, not forked, 1½–2 pairs anastomosing, next pair to sides of sinus-membrane; veins in lower lobes forked, forming areoles on each side of costule and additional irregular ones on each side of sinus-membrane and below it; veins and costules prominent on both surfaces; on *lower surface* of midrib stiff pale hairs 1 mm long and shorter ones abundant, shorter hairs present on costules and veins, yellow glands and fine erect hairs between veins; *upper surface* covered with short appressed hairs, longer ones also on midrib and costules. *Pinnae* 0.9–1.5 × 0.5–0.8 cm, crenate, narrowed towards base on basiscopic side. *Sori* inframedial; indusia rather large, bearing a variable number of short hairs and a few glands; sporangia glandular; spores with a wing and cross-wings.

Distr. *Malesia*: Philippines (Luzon, Sorsogon Province, 2 collections from type locality, 1 from Mt Pulog).

13. Pronephrium heterophyllum (PRESL) HOLTTUM, *comb. nov.* — *Haplodictyum heterophyllum* PRESL, Epim. Bot. (1851) 51; FÉE, Gen. Fil. (1852) 309, t. 18C, f. 2; COPEL. Fern Fl. Philip. (1960) 378; HOLTTUM, Kalikasan 2 (1973) 62. — *Aspidium heterophyllum* (PRESL) HOOK. Ic. Pl. 10 (1854) t. 920; COPEL. Polypod. Philip. (1905) 39. — *Pleocnemia heterophylla* (PRESL) v.A.v.R. Handb. (1908) 171. — Type: CUMING 322, Samar (PRC; B, E, K, P).

Aspidium blumei KUNZE *ex* METT. Fil. Hort. Lips. (1856) 94, t. 22, f. 5. — *Aspidium blumei var. subpinnata* METT. Farngatt. IV (1858) 98, *excl. syn. Polypodium canescens* BL. *et* CUMING 251. — Type: CUMING 322 (formerly at LZ, now lost).

Aspidium canescens (BL.) CHRIST *var.*; CHRIST, Farnkr. der Erde (1897) 244. — *Dryopteris canescens* (BL.) C. CHR. *var.*; C. CHR. Ind. Fil. (1905) 256. — **Fig. 14c–d.**

Caudex short-creeping; fronds dimorphous. *Sterile fronds. Stipe* 1–3 cm long, with spreading pale hairs 1 mm long; *fronds* consisting of terminal lamina and 1–3 pairs of pinnae. *Terminal lamina* to 17 × 2.8 cm, apex rather abruptly pointed, base somewhat narrowed, middle part lobed not quite half-way to midrib, main veins 5–6 mm apart, veins in lobes 6–7 pairs, forked and anastomosing as in lower part of lamina of *P. bulusanicum*; base of lamina more deeply lobed, with transition to 2–3 pairs of pinnae close below it; hairs and glands as in *P. bulusanicum. Fertile fronds. Stipe* to 7 cm long; *terminal lamina* 13 × 1.6 cm, acuminate, lobed less deeply than sterile, veins closer and fewer than in sterile; *pinnae* 2 pairs, rather irregularly spaced, lowest 3–4 mm long; *sori* in terminal lamina medial or inframedial on the veins, not elongate; indusia with short hairs; sporangia usually with 1 gland; spores with translucent wing and cross-wings.

Distr. *Malesia*: Philippines (Samar, Southern Luzon, Mindanao).

Ecol. On rocks in stream-beds at 200–350 m (M. G. PRICE).

14. Pronephrium bakeri (HARR.) HOLTTUM, *comb. nov.* — *Nephrodium bakeri* HARR. J. Linn. Soc. Bot. 16 (1877) 29; BAK. in Hook. Ic. Pl. 17 (1886) t. 1664. — *Dryopteris bakeri* (HARR.) COPEL. Philip. J. Sci. 2 (1907) Bot. 405; v.A.v.R. Handb. (1908) 208. — *Haplodictyum bakeri* (HARR.) CHING, Sunyatsenia 5 (1940) 251; HOLTTUM, Kalikasan 2 (1973) 63. — *Cyclosorus bakeri* (HARR.) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 358. — *Thelypteris bakeri* (HARR.) REED, Phytologia 17 (1968) 262. — Type: STEERE, Panay (MICH, K).

Aspidium canescens (BL.) CHRIST *var. sensu* CHRIST, Farnkr. der Erde (1897) 244. — *Dryopteris canescens* (BL.) C. CHR. *var. sensu* C. CHR. Ind. Fil. (1905) 256.

Caudex short-creeping. *Stipe* of sterile frond 5 cm, of fertile to 11 cm long; *fronds* consisting of terminal lamina and 1 pair (rarely 2 pairs) of pinnae; *terminal lamina* to 13 × 2.1 cm, apex abruptly short-pointed, middle part lobed 1/3 towards midrib, somewhat narrowed towards base which is sometimes dilated; main veins to 5 mm apart, veins to 7 pairs, not forked except sometimes in basal lobes of largest fronds; *lower surface* with pubescence and glands as in *P. bulusanicum*; *pinnae* opposite or not, to 10 × 7 mm, apex rounded, veins anastomosing. *Sori* medial on veins of terminal lamina, sometimes also on pinnae, not elongate; indusia hairy; sporangia sometimes with a gland; spores with a wing and cross-wings.

Distr. *Malesia*: Philippines (Luzon; Panay; Negros Oriental; Mindanao, *cf.* COPELAND, not seen).

Ecol. In forest at 500–800 m, near river (M. G. PRICE).

Notes. CLEMENS 16530, from Isabella Prov., Luzon, has dimorphic fronds; sterile fronds have an apical lamina to 2.5 cm wide, fertile to 1.4 cm. Some fronds also have a pair of very small pinnae some distance below the normal ones.

2. Section Dimorphopteris

(TAGAWA & K. IWATS.) HOLTTUM, Blumea 19 (1971) 36; Blumea 20 (1972) 113–121. — *Dimorphopteris* TAGAWA & K. IWATS. Acta Phytotax. Geobot. 19 (1961) 8. — *Thelypteris subg. Dimorphopteris* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 35.

Type species: *Pronephrium moniliforme* (TAGAWA & K. IWATS.) HOLTTUM.

Plants of moderate size, always with a relatively short deltoid apical lamina on fronds of adult plants, young plants rarely (as in *P. menisciicarpon*) having simple fronds 10 cm or more long; sterile and fertile fronds often dimorphous, the latter with longer stipes and smaller pinnae than the former; pinnae in most cases distinctly auricled on the acroscopic base.

Distr. 45 species, all Malesian (*P. beccarianum* extending to Fiji) except *P. articulatum* (HOULST. & MOORE) HOLTTUM in Ceylon, India to S. China, and *P. palauense* (HOSOKAWA) HOLTTUM in Palau island.

Notes. I suggest that a probable prototype for this section is shown by the Indian species *P.*

articulatum (see HOLTTUM 1972: 116); the Malesian *P. glandulosum* differs from it in smaller size and greater abundance of glands. The other species are mostly still smaller, with a pronounced tendency to dimorphism, the most extremely dimorphic being the type species *P. moniliforme.*

This section agrees with *Sphaerostephanos* in the presence of spherical yellow glands, on either the lower surface of pinnae or on indusia or sporangia, in a majority of species; it differs from *Sphaerostephanos* in the absence of much-reduced basal pinnae and (in most species) in the pustular nature of the lower surface of dried fronds. But there appears to be an evolutionary trend within *Sphaerostephanos* towards reduction in the number of such small basal pinnae, and there are species in which some fronds may have 1–2 pairs of reduced pinnae and others none, on the same plant. I see no sharp distinction between such species and others which have no reduced basal pinnae. Thus on this character there appears to be no clear separation of this section from *Sphaerostephanos.* The section does however give the impression of being natural if one excludes from it species with deeply lobed non-pustular normal pinnae (*e.g. Nephrodium diversilobum* PRESL); such species are here placed in *Sphaerostephanos* (in some cases they have obvious relatives in that genus). Even when this is done, the present section may still include species of two different ancestral origins: those derived from ancestors with, and without, reduced basal pinnae. The whole problem of recognizing affinities is complex; the present arrangement is one of convenience pending further investigation of an experimental nature.

The present arrangement includes some species placed in *sect. Pronephrium* in 1972; *P. buwaldae* HOLTTUM, included here in 1972, is now transferred to *Christella.*

KEY TO THE SPECIES

1. Sori exindusiate.
 2. Pinnae not more than 3 cm long.
  3. Upper surface short-appressed-hairy; sori elongate . . . . . **15. P. millarae**
  3. Upper surface glabrous; sori not elongate . . . . . **16. P. peramelense**
 2. Pinnae longer on mature plants.
  4. Fertile pinnae 2 mm wide . . . . . **17. P. moniliforme**
  4. Fertile pinnae to at least 1 cm wide.
   5. Surfaces between veins glabrous.
    6. Sporangia setiferous . . . . . **18. P. amboinense**
    6. Sporangia not setiferous.
     7. Pinnae 2–3 cm wide . . . . . **19. P. firmulum**
     7. Pinnae not over 1 cm wide . . . . . **20. P. aquatiloides**
   5. Surfaces both short-hairy between veins.
    8. Pinnae *c.* 15 pairs . . . . . **21. P. simillimum**
    8. Pinnae 2–3 pairs . . . . . **22. P. giluwense**
1. Sori indusiate.
 9. Fronds simple, 10–20 cm long with cordate base . . . . . **37. P. menisciicarpon**
 9. Fronds pinnate or, if simple, smaller and sterile.
  10. Lower surface between and/or on veins bearing sessile spherical glands.
   11. Veins free . . . . . **23. P. kjellbergii**
   11. Veins anastomosing.
    12. Free pinnae not over 7 pairs, not over 2.0 cm wide.
     13. Hairs on lower surface of costules and on upper surface between veins not appressed **24. P. amphitrichum**
     13. Hairs on lower surface of costules and on upper surface appressed.
      14. Indusium bearing glands . . . . . **25. P. clemensiae**
      14. Indusium bearing hairs . . . . . **25b. P. clemensiae *var.* degenerum**
    12. Free pinnae more numerous or wider.
     15. Lower pinnae with stalks 1–2 mm long . . . . . **26. P. glandulosum**
     15. Lower pinnae sessile.
      16. Hairs on lower surface of costae and costules erect . . . . . **27. P. debile**
      16. Hairs on lower surface of costae and costules slender, appressed.
       17. Sterile and fertile pinnae both 8–9 cm long . . . . . **25b. P. clemensiae *var.* degenerum**
       17. Sterile and fertile pinnae dimorphous, smaller.
        18. Sterile pinnae *c.* 4.5 × 1.4 cm; rachis almost glabrous on abaxial surface **28. P. minahassae**
        18. Sterile pinnae *c.* 2.0 × 0.8 cm; rachis bearing copious erect hairs on abaxial surface **29. P. solsonicum**
  10. Lower surface between and on veins lacking sessile spherical glands.
   19. Glands present on sporangia, in some cases setae also.

20. Fertile pinnae 3–4 mm wide; sterile to 10 mm wide . . . . . **30. P. celebicum**
20. Fertile pinnae 10 mm or more wide; little dimorphism.
21. Pinnae 6–10 pairs; sporangia bearing small glands only.
22. Pinnae 2–3 cm wide . . . . . **19. P. firmulum**
22. Pinnae not over 1 cm wide . . . . . **20. P. aquatiloides**
21. Pinnae 3–4 pairs; sporangia often with both glands and setae . . . . **31. P. granulosum**
19. Sporangia lacking glands; setae present in most cases.
23. Fertile pinnae less than 1.5 cm long; sori in 1 row on each side of costa . **32. P. samarense**
23. Fertile pinnae to at least 2 cm long; sori in several rows.
24. Pinnae and/or frond-apex on both young and adult plants ± dilated and irregularly lobed distally . . . . . **33. P. × xiphioides**
24. Pinnae not thus dilated nor irregularly lobed.
25. Basal pinnae narrowly cuneate at base both sides, not auricled; fertile pinnae not or little narrower than sterile. . . . . **18. P. amboinense**
25. Basal pinnae otherwise, usually auricled; fertile pinnae in most cases narrower than sterile.
26. Indusia *not* very small, bearing many short hairs.
27. Upper surface of pinnae bearing short suberect hairs between veins.
28. Pinnae 7 pairs; indusia thin with some superficial hairs . . . . **34. P. trachyphyllum**
28. Pinnae 15 pairs; indusia firm with stiff marginal hairs . . . . . **35. P. thysanoides**
27. Upper surface glabrous between veins.
29. Sporangia setiferous.
30. Sterile pinnae barely 1 cm wide . . . . . **36. P. hosei**
30. Sterile pinnae commonly 2 cm or more wide.
31. Sterile pinnae entire, to 13 × 4 cm . . . . . **37. P. menisciicarpon**
31. Sterile pinnae crenate, to 11 × 2.5 cm . . . . . **31. P. granulosum**
29. Sporangia lacking setae.
32. Indusia firm, almost circular, with hairs in the middle . . . . . **38. P. hewittii**
32. Indusia thin, shrivelled when dry, hairy throughout.
33. Sterile pinnae crenate, at least distally . . . . . **39. P. affine**
33. Sterile pinnae entire . . . . . **37. P. menisciicarpon**
26. Indusia small, with dark red cell-walls; marginal hairs few or none.
34. Fertile pinnae 1.5 cm or more wide . . . . . **40. P. borneense**
34. Fertile pinnae not more than 1 cm wide.
35. Sterile pinnae not or little more than 1 cm wide, fertile 3–6 mm wide.
36. Pinnae thick; lower surface glabrous with thick pale prominent veins **41. P. exsculptum**
36. Pinnae thin; hairs present on lower surface of costae; veins concolorous, not prominent.
37. Pinnae to 15 pairs, sterile ones 4–6 cm long, narrowly acuminate . . **42. P. merrillii**
37. Pinnae not over 10 pairs, sterile ones shorter, abruptly pointed . . **43. P. rhombeum**
35. Sterile pinnae 1.5 cm or more wide, fertile 5–10 mm wide . . . . . **44. P. peltatum**

15. Pronephrium millarae HOLTTUM, Blumea 20 (1972) 115. — Type: WOMERSLEY & MILLAR NGF 8500, N.E. New Guinea, Morobe Distr., Wau-Salamaua Road 1600 m (LAE).

Caudex short-creeping; fronds dimorphous. *Sterile fronds. Stipe* 7–8 cm long, covered densely with hairs 0.1–0.2 mm long. *Lamina* 14 cm long; pinnae 7–8 pairs, all with stalks 1–1.5 mm long; basal pinnae slightly reduced and deflexed, basiscopic base rounded, acroscopic truncate and slightly auricled. *Largest pinnae* 2.5–3.5 × 1 cm; base subtruncate, apex rounded to bluntly pointed, edges slightly crenate near base, more distinctly so distally; costules 2.5–3.5 mm apart, at little more than 45° to costa; veins slender and slightly prominent beneath, 3–4 pairs, 1½ pairs anastomosing, sinus-membrane not distinct; *lower surface* of rachis and costa bearing stiff erect hairs 0.2–0.4 mm long, hairs on costules and veins shorter and somewhat antrorse, on surface between veins many appressed hairs 0.1–0.2 mm long, no glands; *upper surface* throughout bearing stiff suberect hairs 0.2–0.3 mm long. *Fertile fronds. Pinnae* 2.0–2.3 cm long, 0.8 cm wide, lower ones rather widely spaced, shape and pubescence as sterile; *sori* exindusiate, occupying whole of basal veins and sometimes the base of an excurrent vein, on middle part of distal veins; sporangia sometimes with a gland, not setiferous.

Distr. *Malesia*: Eastern New Guinea, Goodenough Island.

Ecol. On Goodenough Island "common in a moist gully" (BRASS 24636).

16. Pronephrium peramelense HOLTTUM, Blumea 20 (1972) 115. — Type: PULLE 415, Western New Guinea, Perameles bivouac, 1000 m (BM; L).

Caudex horizontal, 2–2.5 mm diameter, bearing stipes 5 mm or more apart; fronds not dimorphous. *Stipe* 10–20 cm long, dark, short-hairy;

basal scales 3–4 mm long, narrow, rather firm with few hairs. *Lamina* to 15 cm long; apex broadly triangular, pinnae to 8 pairs, basal ones a little deflexed with somewhat asymmetric and sometimes slightly auricled base. *Middle pinnae* to 3.0 × 1.3 cm; base truncate, apex rather abruptly narrowed to a rounded tip, edges irregularly slightly crenate to subentire; costules to 4 mm apart; veins 2 pairs, 1–1½ pairs anastomosing; sinus-membrane not evident; *lower surface* of rachis covered with dense spreading dark rigid curved hairs 0.3 mm long, rest glabrous; *upper surface* of costa hairy near base only, rest of surface glabrous. *Sori* inframedial, on all veins, not elongate, exindusiate; sporangia without glands or setae.

Distr. *Malesia*: Western New Guinea; only known from the type.

17. Pronephrium moniliforme (TAGAWA & K. IWATS.) HOLTTUM, Blumea 20 (1972) 115. — *Dimorphopteris moniliformis* TAGAWA & K. IWATS. Acta Phytotax. Geobot. 19 (1961) 8, f. 14–16. — *Thelypteris moniliformis* (TAGAWA & K. IWATS.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 36. — Type: HARADA *s.n.* 30 June 1944, Halmahera (KYO).

Caudex short-creeping, 3–3.5 mm diameter; fronds dimorphous. *Sterile fronds. Stipe* 7–10 cm long, pale, minutely hairy; *lamina* 15–20 cm long; pinnae *c.* 15 pairs; basal pinnae deflexed, not reduced; *middle pinnae* 4 × 1 cm, base truncate with acroscopic auricle, apex acute, edges serrulate; costules 2.5 mm apart; veins 4–5 pairs, 2 pairs anastomosing; lower surface minutely hairy. *Fertile frond. Stipe* 20–24 cm long; *lamina* 20–24 cm long; pinnae more than 20 pairs, 4 cm long, 2 mm wide, entirely covered beneath with sporangia (which spread to the surface between veins); veins forming a single row of narrow areoles with a short free vein in each crenature of margin; sporangia bearing glands; spores with longitudinal wing and cross-wings.

Distr. *Malesia*: Moluccas (Halmahera; Batjan ALSTON 16908, BM).

18. Pronephrium amboinense (WILLD.) HOLTTUM, Blumea 20 (1972) 120. — *Aspidium amboinense* WILLD. Sp. Pl. ed. 4, 5 (1810) 228. — *Thelypteris amboinensis* (WILLD.) REED, Phytologia 17 (1968) 259. — Type: VENTENAT, Amboina (B, Herb. Willd. 19751).

Aspidium canescens forma nephrodiiformis CHRIST, Ann. Jard. Bot. Btzg 15 (1898) 131, *quoad* SARASIN 975, Celebes, Palopo (BAS).

Dryopteris subconformis C. CHR. Bot. Jahrb. 66 (1933) 47. — Syntypes: KJELLBERG 1999, Celebes, Lamasie, Palopo (BO); KJELLBERG 1360, S.E. Celebes, Labibia (BO).

Pronephrium palopense HOLTTUM, Blumea 20 (1972) 116. — Type: KJELLBERG 1999, Celebes (BO). — **Fig. 15a.**

Caudex short, suberect; fronds slightly dimorphous. *Stipe* 20–40 cm long (longest on fertile fronds), minutely hairy; *lamina c.* 20 cm long, apex acuminate, deeply lobed with gradual transition to pinnae; free pinnae 10–15 pairs, basal pair not reduced, narrowed to base both sides. *Middle pinnae c.* 5.0 × 1.3 cm (sterile), to 6.0 × 1.1 cm (fertile); base truncate and slightly auricled on acroscopic side, apex short-acuminate (more abruptly pointed on pinnae of smaller fronds), edges crenate to a depth of 1–2 mm; costules to 3 mm apart; veins 4–5 pairs, 1–1½ pairs anastomosing, ½–1 pairs to sides of short sinus-membrane; *lower surface* of rachis, costae and costules bearing rather sparse minute hairs, surface between veins slightly pustular; hairs on *upper surface* of costae less than 0.5 mm, sparse and shorter hairs on costules, a few minute hairs sometimes between veins near margin. *Sori* medial; indusia small, short-hairy (in some cases absent?); sporangia with several setae; spores pale with translucent wing and a few cross-wings.

Distr. *Malesia*: S.E. & Central Celebes, Moluccas (Amboina).

Ecol. At low altitudes, in forest, on streambank (KJELLBERG 1360).

Notes. Four collections known. The type from Amboina is a small frond (pinnae to 3.0 × 0.8 cm) of which the sori are in poor condition; a few sporangia are certainly setiferous but no indusia are present. SARASIN 975 from Palopo agrees closely with the type in shape of frond and pinnae (to 4.5 × 1.2 cm) and certainly has small indusia. One of KJELLBERG's specimens on which CHRISTENSEN based *Dryopteris subconformis* (*n.* 1999), also from Palopo, is somewhat larger than SARASIN's and apparently lacks indusia; KJELLBERG's second specimen (*n.* 1360) from S.E. Celebes has indusia. In 1972 I confusedly cited KJELLBERG 1999 both as type of *D. subconformis* and of *Pronephrium palopensis*; I had intended to cite 1360 as type of the former.

BLUME misinterpreted *Aspidium amboinense* WILLD. and described under that name small specimens of *Christella subpubescens* which had many club-shaped glands on them. This error was copied by later authors and all subsequent citations of WILLDENOW's species are erroneous.

19. Pronephrium firmulum (BAK.) HOLTTUM, Blumea 20 (1972) 116. — *Polypodium firmulum* BAK. Kew Bull. (1893) 211. — *Dryopteris firmula* (BAK.) C. CHR. Ind. Fil. (1905) 266; Gard. Bull. Str. Settl. 7 (1934) 249. — *Phegopteris firmula* (BAK.) v.A.v.R. Handb. (1908) 501. — Type: C. HOSE 295, Sarawak, Mt Dulit (K).

Caudex long-creeping, 3–5 mm diameter, bearing fronds 1–1.5 cm apart; fronds not or little dimorphous. *Stipe* to 45 cm long, glabrous; *lamina* to 35 cm long, apical section subentire with widened base, small on largest fronds, pinnae to

12 pairs, of firm texture; basal pinnae narrowed both sides towards the base, acroscopic base sometimes with a slight auricle. *Middle pinnae* from Mt Dulit to 11 × 2.5 cm, from Mt Kinabalu to 15 × 3.3 cm, base subtruncate and distinctly auricled (more on fertile than sterile pinnae), apex acuminate, edges irregularly slightly sinuous; costules 3.5–4.5 mm apart, at less than 60°; veins 5–7 pairs, prominent on both surfaces, almost all anastomosing with continuous zig-zag excurrent veins; *lower surface* of rachis covered with thick curved hairs barely 0.5 mm long, costae of Dulit specimens bearing sparse short antrorse (not appressed) hairs, many such hairs on Kinabalu specimens, rest glabrous, surface between veins pustular; *upper surface* of rachis as lower, of costae bearing rather sparse hairs less than 0.5 mm long, no others. *Sori* somewhat inframedial; indusia none or very small, glabrous; sporangia many, with rather small red or yellow glands, no setae; spores not seen.

Distr. *Malesia*: Borneo (Sarawak; Sabah).

Ecol. On rocks by streams in forest at 250–1000 m.

Note. Kinabalu specimens have broader and somewhat thinner pinnae than those from Dulit; indusia have only been seen on some sori of the former.

20. Pronephrium aquatiloides (COPEL.) HOLTTUM, Blumea 20 (1972) 108. — *Dryopteris aquatiloides* COPEL. Philip. J. Sci. 7 (1912) Bot. 59; v.A.v.R. Handb. Suppl. (1917) 177. — *Thelypteris aquatiloides* (COPEL.) REED, Phytologia 17 (1968) 260. — Type: BROOKS 9, Sarawak, Bongo Range (MICH; BM, L).

Cyclosorus jacobsii HOLTTUM, Blumea 11 (1962) 530. — *Thelypteris jacobsii* (HOLTTUM) REED, Phytologia 17 (1968) 285. — Type: JACOBS 5086, Sarawak, Mt Penrissen (L; K).

Caudex long-creeping, 2–3 mm diameter; fronds *c.* 5 mm apart. *Stipe* 15–30 cm long, minutely hairy; *lamina* to 27 cm long, apex pinna-like, pinnae 6–8 pairs; basal pinnae narrowed towards base both sides, with stalks to 4 mm long. *Middle pinnae* 9–11 × 1.0 cm; base auricled on acroscopic side; apex acuminate with rounded tip 2 mm wide; edges almost entire; costules 3 mm apart; veins 3–4 pairs, anastomosing to form a zig-zag excurrent vein, slightly prominent; hairs on *lower surface* of rachis thick, brown, curved, 0.5 mm long, on costae same length, slender, antrorsely appressed, no others hairs; surface between veins pustular; *upper surface* of rachis hairy as lower, costal hairs shorter, no others hairs. *Sori* medial, basal ones sometimes coalescent; indusia very small, glabrous or glandular; sporangia bearing red glands; spores not seen.

Distr. *Malesia*: Borneo (W. Sarawak).

Ecol. On rocks by streams in forest at 300–1000 m.

21. Pronephrium simillimum (C. CHR.) HOLTTUM, Blumea 20 (1972) 116. — *Dryopteris simillima* C. CHR. Ind. Fil. (1905) 292, new name for *Nephrodium simulans* BAK. J. Bot. 26 (1888) 325, *non* BAK. 1874; v.A.v.R. Handb. (1908) 223. — *Thelypteris simillima* (C. CHR.) K. IWATS. Acta Phytotax. Geobot. 21 (1965) 169. — Type: G. F. HOSE 231, Sarawak, limestone hills (K).

Caudex short-creeping to suberect; fronds hardly dimorphous. *Stipe* 12–25(–45) cm long, minutely hairy, basal scales dark, narrow, rigid, to 8 mm long with stiff pale hairs 0.2 mm long; *lamina* very firm, 25–40 cm long, apex deltoid and deeply lobed, pinnae 12–16 pairs; basal pinnae slightly reduced, narrowed to base on basiscopic side. *Largest pinnae* of type 4.7 × 1.6 cm (width above base), largest seen 6.0 × 1.7 cm; base truncate and distinctly auricled on acroscopic side; apex abruptly narrowed, rounded or broadly pointed; edges lobed to depth of 1.5–2 mm (on young plants almost entire), lobes oblique, rounded, more or less distinctly dentate at ends of veins; costules to 4 mm apart, at *c.* 50° to costa; veins 5–6 pairs, slightly prominent both sides, 1½–2 pairs anastomosing, 1 pair to sides of sinus-membrane; *lower surface* of rachis covered with stiffly erect pale hairs 0.2–0.4 mm long, similar hairs 0.1–0.2 mm long on costae, costules, veins and on surface between veins; *upper surface* similarly hairy, hairs between veins more dense than on lower surface. *Sori* small, medial, exindusiate; sporangia with 6–8 slender setae; spores with rather broad finely erose translucent wing and cross-wings.

Distr. *Malesia*: Borneo; S.W. Celebes (BROOKS 16853, Maros).

Ecol. On limestone, 0–1700 m.

Notes. One specimen from a shaded place at entrance to a cave has thinner pinnae more deeply lobed than above described, to 2.2 cm wide, costules 5 mm apart, pinna-lobes distinctly dentate at all vein-ends, veins often forked, only 1 pair anastomosing. A specimen from 1700 m on G. Mulu is small, with 5 pairs of free pinnae, largest 3.0 × 1.3 cm, hairs on lower surface of rachis and costae more than 0.5 mm long.

22. Pronephrium giluwense HOLTTUM, *sp. nov.*

Pinnae paucijugatae, inferiores leviter redactae auriculatae stipitataeque, pinnae majores 5 cm longae, 1.5 cm latae, vix dimorphae; pagina inter venas utraque pilis brevibus vestita; sori exindusiati, sporangia setis 3–6 praedita. — Type: WOODHAMS 138, Papua, Mt Giluwe, 2400 m, cult. Hort. Kew. (K).

Caudex short-creeping; *stipe* to 14 cm long, short-hairy; *lamina* thin, to 16 cm long consisting of apical section 7 × 2.4 cm lobed as pinnae and 3 pairs of pinnae; basal pinnae 2.5 × 1.4 cm, rather strongly auricled, with stalks 1.5 mm long. *Largest pinnae* 5.0 × 1.5 cm with stalks 1 mm; base broadly

cuneate and slightly auricled on acroscopic side, apex abruptly short-acuminate; edges lobed 1/3 towards costa; costules 4 mm apart at 45° to costa; veins slender, slightly prominent, 5–6 pairs, 1 pair anastomosing, 1–1½ pairs to sides of sinus-membrane; *lower surface* of rachis and costae bearing spreading hairs of varied length to 0.8 mm, shorter slender hairs on costules, veins and surface between them; *upper surface* covered with suberect hairs 0.2–0.3 mm long, longer hairs present on costae and scattered on costules and veins. *Sori* medial, lowest supramedial, exindusiate; sporangia bearing 3–6 rather long setae; spores with a longitudinal wing and cross-wings.

Distr. *Malesia*: Papua New Guinea. The only other collection is CLEMENS 12110 D, from a branch of the Buso River, Morobe District, at 1500–1800 m (MICH); this is a less mature plant with longer apical lamina than the type; it differs also in having a few glands on the lower surface of pinnae.

Note. The type plant perhaps did not attain its full size before dying. Possibly this species should be transferred to *Sphaerostephanos* but it does not match any known species in that genus.

23. Pronephrium kjellbergii HOLTTUM, Blumea 20 (1972) 117. — KJELLBERG 2638, Central Celebes, Mt Porema 1400 m (BO).

Caudex short-creeping; fronds subdimorphous. *Stipe* of sterile frond 3–4 cm long, of fertile 10 cm, short-hairy, basal scales 4 × 1 mm bearing short hairs; *lamina* 8 cm long, thin; pinnae 7 pairs, lower sterile ones sometimes a little reduced, fertile not; apical lamina deltoid and deeply lobed. *Largest pinnae* 1.5 × 0.6 cm (sterile) 1.0 × 0.6 cm (fertile); base truncate and a little dilated on acroscopic side; apex blunt; edges crenate; costules 2.5 mm apart; veins 2 pairs (sometimes 3 pairs in basal acroscopic lobe), all free; *lower surface* of rachis, costae and costules bearing sparse hairs 0.5 mm long, many glands on and between veins; *upper surface* throughout bearing short antrorse hairs with longer ones scattered on costules and veins. *Sori* near bases of veins; indusia bearing a few hairs and glands; sporangia sometimes with a gland.

Distr. *Malesia*: Central Celebes, 1400 m. Only known from the type.

Note. This specimen was named *Dryopteris urdanetensis* COPEL. by CHRISTENSEN (Bot. Jahrb. 66, 1933, 48) but differs from that species in having a much shorter apical lamina and no much-reduced basal pinnae.

24. Pronephrium amphitrichum HOLTTUM, *sp. nov.*

P. clemensiae (Copel.) Holttum affinis, differt: pinnis multo minoribus; pilis costarum costularumque subtus patentibus, pilis inter venas paginae superioris non appressis; soris venarum inferiorum elongatis. — Type: EDAÑO BS 75790, Luzon, Camarines Sur, Mt Potianay (MICH; NY).

Caudex suberect; fronds subdimorphous. *Stipe* 3 cm long (sterile) 6–7 cm (fertile), short-hairy, basal scales 3 mm long, narrow; *lamina* 5 cm long; pinnae 4–5 pairs; basal pinnae slightly reduced, much narrowed towards base on basiscopic side. *Largest pinnae* to 1.8 × 0.9 cm (sterile) 1.5 × 0.8 cm (fertile); base truncate and slightly auricled on acroscopic side, narrowed and rounded on basiscopic; apex abruptly blunt-pointed; edges crenate to depth of 1 mm; costules to 3 mm apart at little over 45° to costa; veins 3 pairs, 1 pair anastomosing; *lower surface* of rachis bearing thick pale spreading hairs 0.5 mm long, hairs on costae and costules similar but shorter, abundant slender erect hairs and a few glands on surface between veins; hairs on *upper surface* of rachis thick, curved, to 1 mm long, on costae 0.2–0.3 mm, on costules and veins scattered longer hairs, between veins copious suberect hairs 0.2 mm long. *Sori* inframedial to medial, lower ones elongate; indusium small with short stiff hairs; sporangia sometimes with a gland.

Distr. *Malesia*: Philippines (Luzon). Only known from the type.

25. Pronephrium clemensiae (COPEL.) HOLTTUM, Blumea 20 (1972) 118. — *Dryopteris clemensiae* COPEL. Philip. J. Sci. 46 (1931) 213. — *Cyclosorus clemensiae* (COPEL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 243; COPEL. Fern Fl. Philip. (1960) 369. — *Thelypteris clemensiae* (COPEL.) REED, Phytologia 17 (1968) 268. — Type: CLEMENS 16490, Luzon, Isabella Prov., Mt Moises (UC; US).

a. *var.* clemensiae

Caudex short-creeping; fronds subdimorphous. *Stipe* 8–10 cm long (sterile), 16 cm (fertile), hairy as rachis distally, basal scales to 3 × 1 mm, firm; *lamina* 13 cm long, texture firm, apex broadly triangular and deeply lobed, pinnae 5 pairs, basal pinnae not reduced, narrowed towards base of basiscopic side. *Largest pinnae* 4.3 × 1.8 cm (sterile) 3.2 × 1.5 cm (fertile); base subequally broadly cuneate; apex abruptly narrowed to acute tip; edges lobed to depth of 2 mm; costules 3.5–4 mm apart, at 45° to costa; veins 4–5 pairs, prominent both sides, 1–1½ pairs anastomosing; *lower surface* of rachis covered with coarse erect hairs, hairs on costae and costules shorter and antrorsely appressed, glands abundant on lower surface generally; hairs on *upper surface* of costae, costules and veins antrorse as lower surface, between veins rather sparse appressed hairs. *Sori* medial; indusia rigid, dark, with yellow glands and sometimes a few hairs; sporangia often with a yellow gland.

Distr. *Malesia*: Philippines (Luzon); only known from the type.

b. *var.* degenerum (CHRIST) HOLTTUM, *comb. nov.* — *Dryopteris canescens var. degenera* CHRIST, Philip. J. Sci. 2 (1907) Bot. 199. — *Phegopteris canescens var. degenera* (CHRIST) v.A.v.R. Handb. (1908) 507. — *Cyclosorus degener* (CHRIST) COPEL. Fern Fl. Philip. (1960) 356. — *Thelypteris degenera* (CHRIST) REED, Phytologia 17 (1968) 271. — Lectotype (HOLTTUM 1972): LOHER *s.n.* March 1906, Luzon, Montalban (P).

Differs from *var. clemensiae*: indusia densely setose; sporangia bearing glands or setae. Spores have a complete translucent wing.

Distr. *Malesia*: Philippines, Luzon (C. B. ROBINSON BS 9455, Tayabas Prov. Infanta; RAMOS BS 1791, Rizal Prov.; M. G. PRICE 2824, Zambales Prov., Mts above Palauig at 1000 m).

Notes. PRICE's specimen is much larger than the others (pinnae to 8.5 × 2.0 cm) and has rather sparse glands on lower surface but agrees in other respects. I designate the LOHER collection from Montalban as lectotype because I did not find the other syntype, also collected by LOHER, at Paris.

26. Pronephrium glandulosum (BL.) HOLTTUM, Blumea 20 (1972) 118. — *Aspidium glandulosum* BL. En. Pl. Jav. (1828) 144; METT. Farngatt. IV (1858) 111, *quoad descr. tantum.* — *Nephrodium glandulosum* (BL.) J. SM. in Hook. J. Bot. 3 (1841) 411, *nomen tantum*; PRESL, Epim. Bot. (1851) 45, *excl. pl. Zoll.*; HOOK. Spec. Fil. 4 (1862) 76, *excl. syn. omn. praeter Bl.*; RACIB. Fl. Btzg 1 (1898) 185. — *Abacopteris glandulosa* (BL.) FÉE, Gen. Fil. (1852) 310. — *Dryopteris glandulosa* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 215. — *Dryopteris malayensis* C. CHR. Dansk Vid. Selsk. Skr. VII, 10 (1913) 171, *nom. nov. illegit.*; BACKER & POSTH. Varenfl. Java (1939) 59. — *Cyclosorus glandulosus* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 227; HOLTTUM, Rev. Fl. Malaya 2 (1955) 278, f. 160. — *Thelypteris malayensis* (C. CHR.) REED, Phytologia 17 (1968) 291. — Type: BLUME *s.n.*, W. Java (L, *n.* 908, 337–89).

Dryopteris iridescens v.A.v.R. Bull. Jard. Bot. Btzg II, 11 (1913) 11; Handb. Suppl. (1917) 176. — *Thelypteris iridescens* (v.A.v.R.) REED, Phytologia 17 (1968) 285. — Type: MATTHEW 517, Sumatra, Padang Panjang (BO).

Dryopteris excrescens COPEL. Univ. Cal. Publ. Bot. 14 (1929) 374. — Type: RAHMAT SI TOROES 142, Sumatra (UC; L).

Dryopteris bartlettii COPEL. *ibid. l.c.* — *Thelypteris bartlettii* (COPEL.) REED, Phytologia 17 (1968) 263. — Type: BARTLETT 6692, Sumatra, Asahan (UC).

Nephrodium lineatum sensu BEDD. Handb Suppl. (1892) 71, excl. syn. *Aspidium affine* BL.

Caudex short-creeping; fronds dimorphous. *Sterile fronds. Stipe* 20–30 cm long, minutely hairy; *lamina* 30–40 cm long; pinnae 12 pairs; basal pinnae narrowed at base, more on basiscopic than acroscopic side, with stalks 2 mm long. *Largest pinnae* commonly to 12 × 2.5 cm; base truncate, auricled on acroscopic side, apex abruptly short-acuminate; edges obliquely lobed to a depth of 1–2 mm or sometimes more deeply; costules to 5 mm apart; veins to 8 pairs, 2–4 pairs anastomosing (according to depth of lobing), 1½–2 pairs to sides of sinus-membrane; *lower surface* of rachis covered with thick curved hairs more than 0.5 mm long, similar but shorter hairs on costae, very short and sparse on costules and veins, surface between veins pustular, bearing many glands and sometimes very short erect hairs; *upper surface* covered throughout more or less closely with fine appressed hairs 0.2–0.3 mm long. *Fertile fronds.* Stipe to 50 cm long; pinnae more widely spaced than sterile, commonly to 7 × 1.5 cm, edges shallowly crenate; *sori* medial, lower ones at least somewhat elongate along veins; indusia thin bearing many very short hairs; sporangia with glands on body and a hair with glandular tip on stalk; spores with a complete wing and cross-wings.

Distr. *Malesia*: Java, Sumatra, Malaya.

Ecol. Lowland, up to 800 m, in forest near streams.

Notes. The lobing of pinnae is variable. One Java specimen at Kew (coll. LOBB) has both sterile and fertile pinnae almost entire. A specimen collected by KURZ on G. Salak (PR) has fertile pinnae 7 × 1.7 cm, lobed fully half-way to costa.

The name *Aspidium glandulosum* BL. was variously misinterpreted by J. SMITH, KUNZE and HOOKER, who cited specimens of other species; these citations were copied by METTENIUS and PRESL who both gave good descriptions. Apart from the presence of copious glands on lower surface and appressed hairs on the upper, this species is very similar to *A. affine* BL., with which BEDDOME confused it under the name *Nephrodium lineatum.*

27. Pronephrium debile (BAK.) HOLTTUM, Blumea 20 (1972) 118. — *Nephrodium debile* BAK. J. Bot. 18 (1880) 212. — *Dryopteris pseudoreptans* C. CHR. Ind. Fil. (1905) 286, *nom. nov.* (not *D. debilis* (METT.) C. CHR.); v.A.v.R. Handb. (1908) 223. — *Thelypteris pseudoreptans* (C. CHR.) REED, Phytologia 17 (1968) 306. — Type: BECCARI 433, Sumatra, G. Singgalang 1700 m (K).

Nephrodium pilosiusculum RACIB. Fl. Btzg 1 (1898) 189. — *Dryopteris pilosiuscula* (RACIB.) C. CHR. Ind. Fil. (1905) 284; v.A.v.R. Handb. (1908) 215; BACKER & POSTH. Varenfl. Java (1939) 65, excl. syn. *Aspidium pilosiusculum* METT. — *Thelypteris pilosiuscula* (RACIB.) REED, Phytologia 17 (1968) 304. — Type: RACIBORSKI, Java, G. Salak, Tjiapoes (BO; K, L, P).

Caudex short-creeping; fronds slightly dimorphous. *Stipe* 15–20 cm long, glabrous except base which is covered with minute hairs and firm setiferous scales 2 × 1 mm; *lamina* 15–25 cm long,

firm in texture; apical lamina narrowly acuminate; pinnae 10–15 pairs; basal pinnae slightly narrowed at base on basiscopic side, sessile. *Largest pinnae* 4.5 × 1.5 cm (sterile) 3.0 × 1.0 cm (fertile); base truncate and slightly auricled; apex abruptly short-acuminate with rounded tip; edges crenate or in the largest sterile pinnae lobed to a depth of 2–3 mm; costules 3–4 mm apart; veins 3–4 pairs, 1 pair anastomosing, next pair to sides of sinus-membrane; *lower surface* of rachis covered with thick spreading brown hairs 0.7 mm or more long and shorter pale ones, hairs on costae and costules dense, pale, 0.4 mm long, somewhat antrorse, hairs on veins shorter with some yellow glands, surface between veins bearing many short erect hairs and a few glands (especially distal on the lobes); *upper surface* of rachis bearing erect thick brown hairs 1 mm long, pinnae covered closely with appressed hairs 0.5 mm long. *Sori* medial; indusia covered with short hairs, 1–2 glands also sometimes present; sporangia bearing glands.

Distr. *Malesia*: Sumatra, Java, Flores.

Ecol. On wet rocks by streams at 1400–1800 m.

Note. BECCARI's specimen from G. Singgalang has more deeply lobed pinnae than RACIBORSKI's from Tjiapoes but differs little in other respects. RACIBORSKI cited a specimen of ZIPPELIUS (to whom he attributed the name) as well as his own; I have not found the former and take RACIBORSKI's own, which he described, to be the type. Confusion has been caused because METTENIUS independently published the name *Aspidium pilosiusculum* ZIPP. as a new name for *Gymnogramme appendiculata* BL. (here transferred to *Sphaerostephanos*). Both species were collected by RACIBORSKI at Tjiapoes (Mt Salak, W. Java).

28. Pronephrium minahassae HOLTTUM, Blumea 20 (1972) 119. — Type: ALSTON 16410, N. Celebes, G. Tetawiran (BM).

Caudex short, suberect; fronds dimorphous. *Sterile fronds. Stipe* to 15 cm long, minutely hairy, basal scales small. *Lamina* to 25 cm long, texture thin; apical lamina pinna-like, to 10 cm long; pinnae to 10 pairs, basal pair more remote and narrowed to base on basiscopic side, widest in middle. *Largest pinnae* 4.5 cm long, 1.5 cm wide above base; base truncate, slightly auricled especially on lower pinnae; apex abruptly short-pointed, edges lobed to a depth of 1.5–2 mm; costules 3.5–4 mm apart; veins 6–7 pairs, 1½ pairs anastomosing, 1 pair to sides of sinus-membrane; *lower surface* of rachis glabrous or sparsely hairy, of costae, costules and veins covered with slender appressed hairs, glands abundant throughout; *upper surface* covered with slender appressed hairs. *Fertile fronds. Pinnae* 2.8 cm long, 0.7–0.9 cm wide above base, lobed as sterile and similarly hairy and glandular; *sori* at maturity covering whole surface; indusia hairy; sporangia bearing glands; spores with a translucent wing and cross-wings.

Distr. *Malesia*: N. Celebes; only known from the type.

29. Pronephrium solsonicum HOLTTUM, Kalikasan 3 (1974) 197. — Type: M. G. PRICE 2903, Luzon, Ilocos Norte, Solsona, 1100 m, in forest (K; PNH).

Caudex short-creeping; fronds dimorphous. *Sterile fronds. Stipe* 5–6 cm long, short-hairy near base, basal scales thin, 3 mm long. *Lamina* to 15 cm long; apex 8 cm long, deeply lobed; pinnae 9 pairs, basal pair slightly reduced and narrowed to base on basiscopic side. *Largest pinnae* 2.1 × 0.8 cm; base truncate and slightly auricled; apex obtuse; edges lobed to a depth of 1 mm; costules 2.5 mm apart; veins slender, 3 pairs, basal pair anastomosing, next pair to edge; *lower surface* of rachis bearing coarse spreading pale hairs 1 mm long, hairs on costae and costules much shorter, slender, appressed, many glands on surface between veins; *upper surface* of rachis as lower, hairs on costae 0.5 mm long, similar hairs scattered on costules and veins, no others. *Fertile fronds. Stipe* 12–20 cm long; *pinnae* to 1.4 × 0.7 cm, edges subentire or slightly crenate; *sori* near costules, indusia large, glabrous; sporangia bearing glands.

Distr. *Malesia*: Philippines (Luzon); only known from the type.

30. Pronephrium celebicum (BAK.) HOLTTUM, Blumea 20 (1972) 119. — *Acrostichum celebicum* BAK. Kew Bull. (1901) 741. — *Leptochilus celebicus* (BAK.) C. CHR. Ind. Fil. (1905) 384; v.A.v.R. Handb. (1908) 741. — *Dryopteris celebica* (BAK.) COPEL. Philip. J. Sci. 37 (1928) 410. — *Thelypteris celebica* (BAK.) REED, Phytologia 17 (1968) 267. — Lectotype (HOLTTUM 1972): DE LA SAVINIERRE 61, N. Celebes (K; P).

Aspidium canescens forma acrostichoides CHRIST, Ann. Jard. Bot. Btzg 15 (1898) 132. — *Dryopteris acrostichoides* (CHRIST) v.A.v.R. Handb. Suppl. (1917) Corr. 49, *non* O. KTZE 1891 *excl. var. rhombea & var. lanceola.* — Lectotype (HOLTTUM 1972): KOORDERS 17153, N. Celebes (BO; L).

(?) *Meniscium hosei var. sumbensis* v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 21 (1908) 7. — *Phegopteris hosei var. sumbensis* v.A.v.R. Handb. (1908) 510. — Type: TEYSMANN 10693, Sumba (BO?; not seen). — **Fig. 15b–d.**

Caudex short-creeping; fronds dimorphous. *Sterile fronds. Stipe* 6–15 cm long, pale, minutely hairy or glabrescent, basal scales thin, narrow, 3 mm long. *Lamina* thin, 15–18 cm long; apex acuminate and deeply lobed; pinnae 8–10 pairs, basal pinnae narrowed to base on basiscopic side, sessile or with a very short stalk. *Largest pinnae* 4.2 × 1.2 cm (width above base); base truncate, strongly auricled on acroscopic side; apex short-acuminate; edges serrate-crenate to a depth of

1–1.5 mm; costules 2.5 mm apart; veins slender and little prominent, 4–5 pairs, 2 pairs anastomosing, sinus-membrane hardly evident; *lower surface* of rachis bearing hairs 0.3 mm long, pale, sometimes sparse, on costae and costules hairs much shorter and always sparse, surfaces between veins pustular; hairs on *upper surface* of rachis thick, to 0.5 mm long, on costae 0.2 mm, rather sparse, no others. *Fertile fronds. Stipe* 20–30 cm long; lamina to 25 cm; *pinnae* widely spaced, 2.5–4.0 cm long, 2–4 mm wide above auricled base, edges crenate; veins 3 pairs, basal pair only anastomosing; lower surface covered with *sori* (also upper surface near apex?); indusia very small with a few hairs; sporangia of type bearing both glands and short setae, of Curtis specimen (also cited by Baker) glands only; spores light brown, with a translucent wing and cross-wings.

Distr. *Malesia*: Celebes, Moluccas (Ceram, Tenimber Is.), West New Guinea (Vogelkop), and ? Lesser Sunda Is. (Sumba).

Notes. SARASIN 1022, from Central Celebes, cited by CHRIST with those of KOORDERS, has sterile pinnae to 6 × 1.5 cm and sporangia strongly setiferous. v.A.v.R.'s description of *D. acrostichoides* was based on KOORDERS's specimens at Bogor named by CHRIST; these were not cited by CHRIST in 1898; I have selected KOORDERS 17153 as the type of v.A.v.R.'s name.

31. Pronephrium granulosum (PRESL) HOLTTUM, Blumea 20 (1972) 119. — *Polypodium granulosum* PRESL, Rel. Haenk. (1825) 24, pl. 4, f. 2; HOLTTUM, Novit. Bot. Inst. Bot. Univ. Carol. Prag. 1968 (1969) 19. — *Dryopteris granulosa* (PRESL) C. CHR. Ind. Fil. (1905) 269; CHRIST, Philip. J. Sci. 2 (1907) Bot. 217. — *Phegopteris granulosa* (PRESL) v.A.v.R. Handb. (1908) 503, *p.p.* — *Cyclosorus granulosus* (PRESL) COPEL. Fern Fl. Philip. (1960) 373, *p.p.* — *Thelypteris granulosa* (PRESL) REED, Phytologia 17 (1968) 280. — Type: HAENKE, Luzon (PRC; specimen at W is marked HAENKE 98).

Dryopteris chamaeotaria CHRIST, Philip. J. Sci. 2 (1907) Bot. 203. — *Phegopteris chamaeotaria* (CHRIST) v.A.v.R. Handb. (1908) 505. — *Thelypteris chamaeotaria* (CHRIST) REED, Phytologia 17 (1968) 267. — Lectotype (COPELAND 1960): WHITFORD 1369, Luzon, Mt Mariveles (not found at MICH, P, US); Neotype (HOLTTUM 1972): ELMER 6970, same locality (K).

Dryopteris maquilingensis COPEL. Philip. J. Sci. 56 (1935) 103, pl. 8. — Type: COPELAND *s.n.* Nov. 1932, Luzon, Mt Makiling (formerly in PNH); Neotype (HOLTTUM 1972): ELMER 18169, same locality (K; BISH, G, L).

Cyclosorus subdimorphus COPEL. Philip. J. Sci. 81 (1952) 38; Fern Fl. Philip. (1960) 374. — *Thelypteris palawanensis* REED, Phytologia 17 (1968) 300, *nom. nov.* — Type: EDAÑO PNH 13925, Palawan (MICH). — **Fig. 15m–n.**

Caudex short to long-creeping, 3 mm diameter; fronds close or 1–2 cm apart, subdimorphous. *Stipe* 15–20 cm long (sterile) 30–45 cm (fertile); *lamina* of mature plants 15–24 cm long, thin but firm, consisting of apical section 8–15 cm long, 1.5–3.0 cm wide, and 2–4 pairs of pinnae; lowest pinnae stalked 1–2 mm, widest at about the middle, base asymmetric and ± auricled. *Middle pinnae* to 11 × 2.5 cm (sterile; fertile smaller, to 9 × 2.2 cm); base truncate and slightly auricled; apex acuminate (narrowly on longest pinnae); edges crenate to depth of 1 mm (entire on pinnae of young plants); costules to 4 mm part; veins 5–6(–8) pairs, slender and slightly prominent, 2–5 pairs anastomosing (according to width of pinnae); *lower surface* of rachis bearing a variable number of coarse pale hairs to 0.8 mm long; hairs on costae sparse and much shorter, surface between veins pustular and sometimes with very short erect hairs; *upper surface* of rachis covered with thick pale hairs 1 mm long, costal hairs rather sparse, 0.3 mm long, no other hairs. *Sori* inframedial; indusia small, soon caducous, dark red with short hairs on surface and margin; sporangia bearing glands and also short setae; spores with translucent wing and cross-wings.

Distr. *Malesia*: Philippines (Luzon, Palawan, Balabac, Panay, Mindanao).

Ecol. In forest at low altitudes, to 500 m.

Notes. One frond in HAENKE's collection at Prague has two pinnae widened and irregularly deeply lobed distally; PRESL named this *var. lobata*. This feature may indicate hybridity; it needs experimental investigation.

Young plants have much smaller pinnae than above described; the smallest fertile pinna seen measures 4.5 × 1.2 cm. A specimen from Balabac (J. B. STEERE) has no glands on sporangia, and pinnae crenate to a depth of 2 mm; otherwise it is very near the type. A specimen from Mindanao has very narrow pinnae, the largest fertile one 5.0 × 0.8 cm.

32. Pronephrium samarense (COPEL.) HOLTTUM, Blumea 20 (1972) 119. — *Cyclosorus samarensis* COPEL. Philip. J. Sci. 81 (1952) 35. — *Thelypteris samarensis* (COPEL.) REED, Phytologia 17 (1968) 311. — Type: GACHALIAN PNH 15240, Samar (MICH; 15220 at SING).

Caudex short-creeping, 2 mm diameter; fronds dimorphous. *Sterile fronds. Stipe* 3–5 cm long, basal scales to 2 mm long, pale stiff hairs 0.7 mm long in the groove. *Lamina* 5–8 cm long; apex narrowly triangular, 2.5 cm long, lobed at base only; pinnae to 5 pairs, stalked 1 mm, lowest a little reduced and narrowed to base on basiscopic side. *Largest pinnae* 2–3 cm long, 0.8–1.0 cm wide; base subtruncate, slightly auricled on acroscopic side, rounded on basiscopic; apex obtusely pointed to rounded; edges entire; costules 2 mm apart; veins mostly 3 on basiscopic side of costule, 2 on

acroscopic, anastomosing to form one series of areoles with irregular additional ones; hairs on *lower surface* of rachis 0.3 mm long, on costae and costules shorter and sparse, no other hairs, surface between veins pustular; *upper surface* of rachis and costae similarly hairy, a few minute hairs present near margin. *Fertile fronds. Stipe* 8–18 cm long; lower *pinnae* widely spaced, largest pinnae to 1.2 × 0.5 cm, shaped and stalked as sterile; costules simple or forked; where forked the branches anastomosing near margin; *sori* in one row on each side of costa with additional ones present in basal acroscopic lobe; indusia small, dark red, bearing short hairs; sporangia with 1 or 2 short setae.

Distr. *Malesia*: Philippines (Samar, 3 collections).

Ecol. Streambanks at *c.* 100 m.

33. Pronephrium x xiphioides (CHRIST) HOLTTUM, Blumea 20 (1972) 119. — *Dryopteris xiphioides* CHRIST, Philip. J. Sci. 2 (1907) Bot. 201. — *Phegopteris xiphioides* (CHRIST) v.A.v.R. Handb. (1908) 501. — *Cyclosorus xiphioides* (CHRIST) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 349. — *Thelypteris xiphioides* (CHRIST) REED, Phytologia 17 (1968) 324. — Type: COPELAND *s.n.* April 1905, Mindanao, San Ramon (MICH).

Cyclosorus edanyoi COPEL. Philip. J. Sci. 81 (1952) 37; Fern Fl. Philip. (1960) 370. — *Thelypteris edanyoi* (COPEL.) REED, Phytologia 17 (1968) 274. — Type: Edaño BS 46065, Panay (UC).

Dryopteris diversiloba sensu CHRIST, Philip. J Sci. 2 (1907) Bot. 199, *excl. var. acrostichoides.*

Dryopteris rhombea sensu COPEL. Philip. J. Sci. 56 (1935) 102, pl. 6, *p.p.* — *Cyclosorus rhombeus sensu* COPEL. Fern Fl. Philip. (1960) 357, *p.p.*

Plants with a frond-form intermediate between *P. granulosum* and *P. rhombeum*, with pinnae of irregular shape; young plants with lamina 4–5 cm long often with 2–3 pairs of pinnae; adult plants mostly with 4–6 pairs of pinnae (rarely 8 pairs); in almost all cases some or all pinnae, often also the apical lamina of the frond, irregularly dilated and irregularly ± deeply lobed distally (see COPELAND 1935, line drawings on pl. 6); at least the lower pinnae ± stalked as in *P. granulosum*; indusia small with a few short hairs; sporangia always setiferous.

Distr. *Malesia*: Philippines, widely.

Notes. These plants look like a hybrid swarm, which needs experimental cytotaxonomic investigation. The type collection of *P. granulosum* includes a frond with one pinna dilated and deeply lobed at the apex, indicating perhaps a slight degree of hybridity. Both parent species have very similar indusia; the sporangia of *P. granulosum* have glands on sporangia, but the hybrids do not. I have regarded this as an important distinction. The type of *D. xiphioides* is the only specimen seen in which no pinnae are dilated distally.

34. Pronephrium trachyphyllum HOLTTUM, *sp nov.*

Stipes frondis fertilis 23 cm longus; lamina 14 cm longa pinnis 7-jugatis laminaque 5 cm longa constituta; pinnae usque 3.0 × 0.8 cm, crenatae, eglandulosae, supra inter venas pilis minutis suberectis multis vestitae; sori inframediales, non elongati; indusia parva tenuia atrorubra, pilis multis 0.2–0.3 mm longis vestita; sporangia setis pluribus praedita. — Type: A. B. COLINA 772, Mindanao, Surigao (K *ex* CAHP).

Caudex short-creeping, bearing small sterile and much larger fertile fronds. *Sterile fronds. Stipe* 1.5 cm long; *lamina* 4 cm long, apex deltoid and lobed, pinnae 3–4 pairs, to 1.3 × 0.5 cm, subentire. *Fertile fronds. Stipe* 10–23 cm long, minutely hairy; basal scales thin, narrow, to 3 mm long. *Lamina* 8–14 cm long; apex 3–4 cm long, rather deeply lobed throughout with some subapical lobes irregularly elongate; pinnae to 7 pairs; basal pinnae of largest frond not reduced but more widely spaced, not opposite, 3.0 cm long, 0.8 cm wide above base, somewhat dilated distally with a few lobes irregularly slightly elongate. *Suprabasal pinnae* 2.7 cm long, 0.8 cm wide above truncate and auricled base; apex abruptly obtuse; edges lobed to a depth of 1 mm; costules 2.5 mm apart; veins to 4 pairs, 1½ pairs anastomosing; *lower surface* of rachis covered with pale hairs 0.2–0.3 mm long, costae bearing pale spreading hairs of mixed length to 0.6 mm, sparse short hairs on costules and veins and between veins; hairs on *upper surface* of rachis 0.5 mm, on costae 0.2 mm, very short suberect hairs present on surface between veins. *Sori* inframedial, not elongate; indusia small, thin, dark red, with many stiff pale hairs 0.2–0.3 mm; sporangia with several short setae; spores pale with translucent wing and cross-wings.

Distr. *Malesia*: Philippines (Mindanao), only known from type.

Notes. It is possible that larger sterile fronds might be produced on other plants. The fertile fronds differ from those of *P. amphitrichum* (in which the upper surface is hairy in a similar way) in having larger pinnae, sori not elongate and setose sporangia. The smaller fertile fronds of the type have shallowly crenate pinnae, but agree with the largest in having irregular long lobes on the apical lamina. Such irregular lobes are sometimes a sign of hybridity, but there are abundant good spores.

35. Pronephrium thysanoides HOLTTUM, *sp. nov.*

P. simillimo (C. Chr.) Holttum affinis, ab ea differt: frondibus minoribus; pinnis non auriculatis; rachide costisque subtus glabris; soris indusiatis, indusiis parvis, rigidis, setis brevibus

ciliatis. — Type: JERMY 14049, Sarawak, Gunong Mulu, Ulu Sungei Air Jernih, north wall (BM).

Caudex short-creeping; *stipe* 15–20 cm long, glabrous, basal scales narrow, firm, *c.* 3 mm long with few hairs; fronds of type all fertile. *Lamina* to 24 cm long; pinnae 15 pairs, lower ones only subopposite; apical lamina 4 cm long, deeply lobed at base and grading to upper pinnae; basal pinnae slightly narrowed towards their bases, more on basiscopic than on acroscopic side, not auricled. *Largest pinnae* 3.5 × 1.1 cm; base truncate; apex abruptly acute, ± upcurved; edges crenate to a depth of less than 1 mm; costules 3 mm apart, at *c.* 60° to costa; veins 4 pairs, slender, 1 or 1½ pairs anastomosing, next vein passing to the short sinus-membrane; *lower surface* of rachis and costae glabrous, of costules, veins and surface between veins bearing rather sparse very short hairs which may be abraded from old fronds; *upper surface* of rachis and costae bearing rather sparse pale hairs 0.3 mm long, rather sparse very short hairs between veins. *Sori* medial, small; indusia small but firm, with many short stiff marginal hairs; sporangia with several short setae; spores with many small wings.

Distr. *Malesia*: Borneo (Sarawak: Mt Mulu), only known from the type.

Ecol. "In clay in crevice of open rock-face", on limestone at 700 m.

36. Pronephrium hosei (BAK.) HOLTTUM, Blumea 20 (1972) 120. — *Meniscium hosei* BAK. J. Linn. Soc. Bot. 22 (1886) 142. — *Dryopteris hosei* (BAK.) C. CHR. Ind. Fil. (1905) 271; COPEL. Philip. J. Sci. 10 (1915) Bot. 146. — *Phegopteris hosei* (BAK.) v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 21 (1908) 7; Handb. (1908) 510. — *Cyclosorus hosei* (BAK.) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 352. — *Thelypteris hosei* (BAK.) K. IWATS. Acta Phytotax. Geobot. 21 (1965) 170. — Type: G. F. HOSE 160, Sarawak (K).

Meniscium proliferum sensu HOOK. 2 Cent. Ferns (1861) t. 15, *quoad plantam totam et fig.* 2 *tantum*.

Caudex short-creeping; fronds dimorphous. *Sterile fronds. Stipe* 5–15 cm long, minutely hairy at base, scales *c.* 2 × 1 mm, caducous. *Lamina* 12–15 cm long, firm; apex to 7 cm long, narrowly triangular, lobed near base only; pinnae 6–8 pairs; lower pinnae not or little reduced, in most cases narrowed slightly near base on basiscopic side, edges sometimes crenate. *Middle pinnae* to 5 cm long, 0.9 cm wide above base; base truncate, always auricled on acroscopic side, often slightly also on basiscopic; distal half of pinna evenly attenuate to narrow rounded apex; edges entire or ± crenate distally; costules 2 mm apart; veins 4–5 on basiscopic side of costules, 3–4 on acroscopic, to 7 pairs in basal auricle, 2 pairs anastomosing; sinus-membrane not evident; *lower surface* of rachis bearing curved hairs 0.5 mm long, hairs on costae 0.1–0.2 mm, no other hairs except on margin, surface between veins very pustular; hairs of *upper surface* of rachis to 1 mm long, on costae copious, 0.3 mm long, some longer hairs present near edge. *Fertile fronds. Stipe* to 25 cm long; *lamina* 10–12 cm long; apex 2.5 cm long; pinnae to 9 pairs, to 3.0 cm long, 0.4 cm wide above auricled base; pubescence as sterile but hairs on rachis shorter; *sori* near costules, spreading somewhat long veins; indusia persistent, bearing many hairs 0.1 mm long; sporangia with 1–2 short setae; spores pale, with longitudinal wing and cross-wings. *Chromosomes*: n = 36 (T. G. WALKER).

Distr. *Malesia*: Borneo; Philippines (Mindanao: Zamboanga Prov., SANTOS 4114).

Ecol. On rocky stream-banks in forest, at low altitudes.

37. Pronephrium menisciicarpon (BL.) HOLTTUM, Blumea 20 (1972) 111. — *Aspidium menisciicarpon* BL. En. Pl. Jav. (1828) 142. — *Dryopteris menisciicarpa* (BL.) POSTH. Bull. Jard. Bot. Btzg III, 13 (1933) 93; BACKER & POSTH. Varenfl. Java (1939) 61, excl. syn. *Dryopteris verruculosa* v.A.v.R. — *Abacopteris menisciicarpa* (BL.) HOLTTUM, Rev. Fl. Malaya 2 (1955) 290, f. 168. — *Thelypteris menisciicarpa* (BL.) K. IWATS. Acta Phytotax. Geobot. 21 (1965) 171. — Type: BLUME, W. Java (L, *n.* 908, 333–724).

Nephrodium latifolium PRESL, Epim. Bot. (1851) 45, excl. CUMING 16; HOLTTUM, Novit. Bot. Inst. Bot. Univ. Carol. Prag. 1968 (1969) 40. — *Cyclosorus latifolius* (PRESL) COPEL. Fern Fl. Philip. (1960) 370. — *Thelypteris latifolia* (PRESL) REED, Phytologia 17 (1968) 287. — Lectotype (HOLTTUM 1969): CUMING 298, Leyte (PRC).

Abacopteris truncata FÉE, Gen. Fil. (1852) 310. — Type: CUMING 298 (not seen).

Dryopteris holophylla C. CHR. Ind. Fil. (1905) 271, *nom nov.* for *Polypodium holophyllum* BAK. J. Bot. 26 (1888) 325, *non* BAK. 1879. — *Phegopteris holophylla* (C. CHR.) v.A.v.R. Handb. (1908) 500. — Type: C. HOSE 242, Sarawak, Niah (K; E).

Dryopteris cordifolia v.A.v.R. Bull. Jard. Bot. Btzg II, 11 (1913) 19, pl. 5; Handb. Suppl. (1917) 320. — Type: AMDJAH 322 *p.p.* N. Borneo (BO; K, L).

Dryopteris mirabilis COPEL. Philip. J. Sci. 6 (1911) Bot. 137, pl. 19; v.A.v.R. Handb. Suppl. (1917) 174; C. CHR. Gard. Bull. Str. Settl. 4 (1929) 391; 7 (1934) 249. — Type: BROOKS 16a, Sarawak, Bidi (MICH; BM).

Dryopteris korthalsii ROSENST. Meded. Rijksherb. *n.* 31 (1917) 5. — Type: KORTHALS, Sumatra (L; K).

Dryopteris verruculosa var. sumatrana v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 151. — Type: BROOKS 157/S, Sumatra, Lebong Tandai (BO; BM).

Dryopteris urophylla var. peraspera v.A.v.R.

Bull. Jard. Bot. Btzg III, 5 (1922) 303. — Type: LAM 666, W. New Guinea (BO; L).

Nephrodium glandulosum sensu BEDD. Handb. Suppl. (1892) 70, *p.p.*

Caudex short-creeping; fronds tufted, dimorphous. *Sterile fronds. Stipe* to 20 cm long, minutely hairy; basal scales thin, broad, soon shrivelling. *Lamina* 30–40 cm long, consisting of 4–6(–8) pairs of pinnae and an apical lamina which is longest on fronds with few pinnae; young plants in Borneo (*D. holophylla*) have simple fronds to 25 × 8 cm with cordate base. *Pinnae* to 13.5 × 4.5 cm, usually widest at or above the middle; base truncate with a slight acroscopic auricle (especially on lower ones); apex abruptly short-pointed; edges ± crenate distally; costules to 4 mm apart; veins to 10 pairs, anastomosing to form a zig-zag excurrent vein; *both surfaces* of rachis covered with coarse pale hairs, those on costae much shorter, sparse on costules, surface between veins strongly pustular. *Fertile fronds. Stipe* to 45 cm long; *pinnae* more widely spaced than sterile ones, commonly 7 × 1.5 to 10 × 2.5 cm (on some plants much smaller), shape as sterile but edges almost entire; *sori* medial to supramedial, slightly elongate; indusia with many short hairs; sporangia bearing 0–2 setae; spores with longitudinal wing and cross-wings.

Distr. *Malesia*: Sumatra, Malaya, Borneo, W. Java; Philippines (Samar, Leyte); W. New Guinea, Papua, New Britain.

Ecol. In forest near streams at low altitudes.

Notes. In Malaya (Pahang and Perak) plants grow on earthen banks of streams; in such places they are swept away by floods before they have attained their full size, but they commonly produce fertile fronds with pinnae to *c.* 3.0 × 0.6 cm. Young plants with very large simple fronds like the type of *Dryopteris holophylla* have not been found in Malaya, but the largest adult specimens from Malaya are not different from those from Borneo. In the Philippines the largest simple fronds seen are 18 × 6 cm (sterile) and 13 × 4 cm (fertile). The type of *Dryopteris korthalsii* has up to 6 pairs of rather small fertile pinnae (4 × 1.3 cm); there are similar fronds from Borneo with pinnae 10 × 2 cm.

Under the name *Aspidium menisciicarpon* BL. METTENIUS described a specimen of a species of *Tectaria* from the Philippines; his description was copied by HOOKER who transferred the name to *Polypodium*. BEDDOME's description of *Nephrodium glandulosum* (Handb. Suppl. 70) was based mainly on specimens cited which belong to the present species, but in part on the true *Aspidium glandulosum* BL. CHRISTENSEN (Ind. Fil. 1905) confused the present species with *A. lineatum* BL. and *A. affine* BL.

38. Pronephrium hewittii (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris hewittii* COPEL. Philip. J. Sci. 3 (1909) Bot. 344; v.A.v.R. Handb. Suppl. (1917) 189. — *Thelypteris hewittii* (COPEL.) REED, Phytologia 17 (1968) 282. — Type: BROOKS & HEWITT *s.n.* Feb. 1908, Sarawak, Bongo Range (MICH).

Dryopteris compacta COPEL. Philip. J. Sci. 6 (1911) Bot. 137, pl. 18; v.A.v.R. Handb. Suppl. (1917) 176. — *Thelypteris compacta* (COPEL.) REED, Phytologia 17 (1968) 268. — Type: BROOKS 4, Sarawak, Bongo Range (MICH; BM). — **Fig. 15e–i.**

Caudex short-creeping; fronds subdimorphous. *Sterile fronds. Stipe* 10–15 cm long, glabrous; basal scales thin, to 3 × 1 mm. *Lamina* to 25 cm long; apex narrowly acuminate, to 5 × 1 cm, lobed at base; *pinnae* to 20 pairs, close, spreading at right angles to rachis; lower pinnae deflexed, narrowed to base on both sides, with a small acroscopic auricle. *Middle pinnae* 4–6 cm long, 0.9–1.1 cm wide above the truncate and strongly auricled base; apex acuminate; edges crenate throughout, distally to a depth of 1 mm; costules 2.5–3 mm apart, at 45° to costa; veins to 3 pairs, 1½–2 pairs anastomosing, sinus-membrane distinct but very short; *lower surface* of rachis glabrous, of costae bearing scattered hairs 0.5 mm long, a few shorter hairs on costules and veins, surface between veins slightly pustular; *upper surface* of rachis bearing thick pale hairs 1 mm long, costae covered with hairs 0.2–0.3 mm long, a few longer ones near ends of veins. *Fertile frond. Stipe* to 25 cm long; *pinnae* to 4 cm long, 0.5–0.9 mm wide, auricled as sterile but usually less deeply crenate; *sori* near costules; indusia firm, dark, almost circular with hairs in the middle; sporangia not setiferous.

Distr. *Malesia*: Borneo (Western Sarawak, 4 collections).

Ecol. "On small rock well above stream" (MOLESWORTH ALLEN 3048, foot of Gunong Santubong).

Notes. The type of *D. hewittii* is a small plant with dimorphic fronds; that of *D. compacta* much larger with fertile pinnae nearly as wide as sterile; two later collections have narrower fertile pinnae. In 1972 I united this species with *P. merrillii* but the latter is quite distinct in venation and sori.

39. Pronephrium affine (BL.) PRESL, Epim. Bot. (1851) 259; HOLTTUM, Blumea 20 (1972) 121, *excl. syn. praeter* BL. *et Gymnogramme macrotis* KUNZE. — *Aspidium affine* BL. En. Pl. Jav. (1828) 148. — Type: BLUME, W. Java (L, *n.* 908, 333–740).

Gymnogramme macrotis KUNZE, Bot. Zeit. 6 (1848) 114. — *Dryopteris oxyotis* ROSENST. Meded. Rijksherb. *n.* 31 (1917) 5, *nom. nov.* (not *D. macrotis* (HOOK.) O. KTZE). — Type: ZOLLINGER 324z, Java (L).

Aspidium lineatum sensu METT. Farngatt. IV (1858) 110, *quoad syn. A. affine* BL. *et G. macrotis*

KUNZE *tantum.* — *Nephrodium lineatum sensu* HOOK. Spec. Fil. 4 (1862) 75, *p.p.*; RACIB. Fl. Btzg 1 (1898) 186. — *Dryopteris lineata sensu* C. CHR. Ind. Fil. (1905) 63, 275, *p.p.*; *sensu* v.A.v.R. Handb. (1908) 209; *sensu* BACKER & POSTH. Varenfl. Java (1939) 60.

Caudex short-creeping or suberect; fronds dimorphous. *Sterile fronds. Stipe* 15–20 cm long, glabrous except in groove, basal scales very thin, to 4 × 2 mm. *Lamina* to 25 cm long, thin; apex small and deeply lobed; pinnae to 12 pairs; basal pinnae somewhat narrowed towards base both sides with acroscopic auricle. *Middle pinnae* of type 4 × 1.7 cm (width above base), of a Sumatran specimen 7 × 2.0 cm; base truncate with acroscopic auricle 2–4 mm long; apex of type abruptly short-pointed, of Sumatran specimen short-acuminate; edges crenate throughout in smaller plants, distally on larger ones; costules 3–3.5 mm apart, at less than 60°; veins 5–6 pairs, 3–3½ pairs anastomosing, sinus-membrane very short; *lower surface* of rachis bearing coarse hairs to 0.7 mm long, hairs on costae 0.1 mm, sometimes with a few longer ones, similar hairs distally on costules and veins, surface between veins pustular; hairs on *upper surface* of rachis to 0.5 mm long, very short on costae and scattered distally on veins, none between veins. *Fertile fronds. Stipe* to 35 cm long; *pinnae* of type 3.0 × 0.7 cm, of others to 4.0 × 0.9 cm, base strongly auricled (sometimes on both sides), edges almost entire; veins to 4 pairs; *sori* medial, slightly elongate; indusia thin, bearing copious acicular hairs 0.1–0.2 mm or sometimes short capitate hairs; sporangia lacking setae; spores pale with a rather broad continuous wing and cross-wings.

Distr. Peninsular Thailand, in *Malesia*: Central & S. Sumatra, West Java.

Ecol. By streams in forest, low altitudes.

Notes. The description by METTENIUS of *A. lineatum* was evidently based on specimens of several distinct species, doubtfully including the type of *A. affine*; it was copied by HOOKER who varied the list of synonyms, and the status of *A. affine* as a synonym of *A. lineatum* was accepted by CHRISTENSEN, who cannot have read BLUME's descriptions. But the descriptions of RACIBORSKI, VAN ALDERWERELT and BACKER & POSTHUMUS clearly apply to the present species only.

BLUME's type matches specimens from a low altitude in Sumatra which, like BLUME's, were found on limestone rocks by streams. A specimen from Pattani in Thailand is similar.

40. Pronephrium borneense (HOOK.) HOLTTUM, *comb. nov.* — *Polypodium borneense* HOOK. Spec. Fil. 5 (1863) 11. — *Dryopteris labuanensis* C. CHR. Ind. Fil. (1905) 273, *nom. nov.* (not *D. borneensis* (HOOK.) O. KTZE). — *Phegopteris borneensis* (HOOK.) v.A.v.R. Handb. (1908) 500. — *Thelypteris borneensis* (HOOK.) REED, Phytologia 17 (1968) 264. — Type: T. LOBB, Labuan (K).

Caudex short-creeping; fronds not or little dimorphous. *Stipe to* 12 cm long, pale, minutely hairy; basal scales thin, *c.* 2 × 1 mm. *Lamina* thin, to 18 cm long; apex 6–9 cm long, triangular, lobed near base which is 3–4 cm wide; pinnae 4–5 pairs, not opposite; basal pinnae narrowed towards base on basiscopic side, slightly so to auricled acroscopic base. *Middle pinnae* 3.5 × 1.5 to 5.0 × 2.2 cm; base truncate with auricle 2–3 mm long; apex abruptly short-pointed; edges shallowly crenate throughout; costules 2.5–3 mm apart; veins 6 pairs, slender, at a broad angle to costules, almost all anastomosing to form a zig-zag excurrent vein (rarely with gaps in it), sinus-membrane not evident; *lower surface* of rachis and costae sparsely short-hairy, rest glabrous and slightly pustular; *upper surface* of rachis with copious hairs 0.2–0.7 mm long, costal hairs 0.3 mm, a few short hairs also present near margin. *Sori* small, not elongate, mostly medial; indusia very small (sometimes lacking?), red when young, variable in shape, with a few mostly marginal hairs 0.1 mm long; sporangia with 4–5 short setae; spores with a narrow wing and a few cross-wings.

Distr. *Malesia*: Borneo (Sarawak, Sabah).

Ecol. "Hill forest, on clay bank, 420 m" (JERMY 13072, G. Mulu); "on wet rocks, 300 m" (BROOKS 16c, Bongo Range).

Notes. The type is a single fertile frond. Living plants of JERMY 13072, cultivated at Kew, resemble the type closely and have sterile and fertile fronds of similar size; the above description is based on the type and cultivated plants. Dried specimens of JERMY 13078, also from G. Mulu, are larger, with stipes 30 cm long and dimorphous fronds to 30 cm long with 6 pairs of pinnae; sterile pinnae to 8.5 × 2.8 cm (veins 7 pairs), fertile to 4.5 × 1.6 cm.

41. Pronephrium exsculptum (BAK.) HOLTTUM, Blumea 20 (1972) 117. — *Acrostichum exsculptum* BAK. J. Bot. 26 (1888) 326. — *Leptochilus exsculptus* (BAK.) C. CHR. Ind. Fil. (1905) 9, 385; v.A.v.R. Handb. (1908) 740. — *Dryopteris exsculpta* (BAK.) COPEL. Philip. J. Sci. 37 (1928) 410; C. CHR. Gard. Bull. Str. Settl. 7 (1934) 248, *p.p.* — *Thelypteris exsculpta* (BAK.) K. IWATS. Acta Phytotax. Geobot. 21 (1965) 170. — Type: C. HOSE 244, Sarawak, Niah (K).

Meniscium stenophyllum BAK. J. Bot. 29 (1891) 108. — *Phegopteris stenophylla* (BAK.) v.A.v.R. Handb. (1908) 510. — *Thelypteris stenophylla* (BAK.) REED, Phytologia 17 (1968) 315. — Type: G. F. HOSE 20, Sarawak (K).

Caudex short-creeping; fronds dimorphous. *Sterile fronds*: *Stipe* 10–17 cm long, glabrous except distally; basal scales to 5 × 1 mm, dark, firm. *Lamina* 25 cm long, very firm; apex small, triangular, deeply lobed; pinnae 20–25 pairs; basal

pinnae slightly narrowed both sides towards auricled base. *Middle pinnae* 3.5 × 1.0 cm; base truncate, slightly auricled; apex short-acuminate (pinnae of type of *M. stenophyllum* to 2.0 × 0.8 cm, apex shortly obtuse); edges crenate to a depth of 0.5 mm; costules 2–2.5 mm apart; veins 3 pairs, thick, pale and prominent on lower surface, 2 pairs anastomosing, sinus-membrane not evident; *lower surface* of rachis bearing thick curved hairs less than 0.5 mm long, a few minute hairs on costae, rest of surface glabrous, not or hardly pustular; *upper surface* of rachis as lower, sparse short hairs on costa. *Fertile fronds*: *Stipe* 25 cm or more long; *pinnae* to 2.0 cm long (type of *M. stenophyllum* 1.0 cm), 0.3–0.4 cm wide above base which is strongly auricled (sometimes both sides); veins 2 pairs; *sori* near costules, at maturity filling lower surface; indusia small with a few very short marginal hairs; sporangia not setiferous; spores not seen.

Distr. *Malesia*: Borneo (Sarawak).

Ecol. Probably on limestone.

Note. CHRISTENSEN (*l.c.* 1934) referred here specimens with thinner pustular pinnae and setiferous sporangia; these are now placed in *P. rhombeum* and *P. peltatum*.

42. Pronephrium merrillii (CHRIST) HOLTTUM, Blumea 20 (1972) 117. — *Dryopteris merrillii* CHRIST, Philip. J. Sci. 2 (1907) Bot. 201. — *Phegopteris merrillii* (CHRIST) v.A.v.R. Handb. Suppl. (1917) 505. — *Cyclosorus merrillii* (CHRIST) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 352. — *Thelypteris merrillii* (CHRIST) REED, Phytologia 17 (1968) 292. — Type: FOXWORTHY 742, Palawan (P).

Differs from 38. *P. hewittii* as follows: fertile pinnae to 2.7 × 0.4 cm, entire or nearly so; indusia very small, asymmetric, with a few very short marginal hairs.

Distr. *Malesia*: Philippines (Palawan, 2 collections; second is ELMER 13031).

43. Pronephrium rhombeum (CHRIST) HOLTTUM, Blumea 20 (1972) 120. — *Dryopteris diversiloba var. acrostichoides subvar. rhombea* CHRIST, Philip. J. Sci. 2 (1907) Bot. 200. — *Dryopteris acrostichoides var. rhombea* (CHRIST) v.A.v.R. Handb. Suppl. (1917) Corr. 49. — *Dryopteris rhombea* (CHRIST) COPEL. Philip. J. Sci. 56 (1935) 102, pl. 6 *quoad icon. photogr. tantum*. — *Cyclosorus rhombeus* (CHRIST) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 192; COPEL. Fern Fl. Philip. (1960) 357, *p.p.* — *Thelypteris rhombea* (CHRIST) REED, Phytologia 17 (1968) 309. — Lectotype (COPELAND 1935): CUMING 149, Luzon (orig. PNH destroyed; isotype K).

Dryopteris diversiloba var. acrostichoides subvar. lanceola CHRIST, *l.c.* — *Dryopteris acrostichoides var. lanceola* (CHRIST) v.A.v.R., *l.c.* — *Dryopteris lanceola* (CHRIST) COPEL. Philip. J. Sci. 56 (1935) 102, pl. 7. — *Cyclosorus lanceolus* (CHRIST) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 353. — *Thelypteris lanceola* (CHRIST) REED, Phytologia 17 (1968) 286. — Lectotype (COPELAND 1935): COPELAND 250, Luzon, Mt Mariveles (orig. PNH destroyed; isotypes K, MICH, US). — **Fig. 15j–l.**

Caudex short-creeping; fronds dimorphous. *Sterile fronds*. *Stipe* 5–8 cm long with pale hairs 1 mm long throughout. *Lamina* to 15 cm long, thin but firm; apex narrowly triangular, longer than pinnae; pinnae 8(–10) pairs; basal pinnae not or little narrowed towards base. *Middle pinnae* 2.0–3.5 cm long, 0.7–1.0 cm wide above auricled base; apex abruptly acute or obtuse, sometimes a little dilated; edges crenate, more deeply towards apex; costules 2 mm apart, at little more than 45° to costa; veins mostly 3 pairs, concolorous and slightly prominent, 2 pairs anastomosing, sinus-membrane not evident; *lower surface* of rachis bearing pale hairs 0.7 mm long, a few similar hairs with shorter ones present on costae, sparse short hairs on costules and veins, surface between veins pustular; *upper surface* of rachis hairy as lower, hairs on costae 0.2–0.3 mm long, a few short hairs near margin. *Fertile fronds*. *Stipe* to 25 cm long; lamina 10–20 cm long, in the latter case pinnae more widely spaced; *pinnae* 2.0–3.0 cm long, 0.4–0.6 cm wide, base auricled, edges almost entire; *sori* near costules, not elongate; indusia small, red, with marginal hairs 0.2–0.3 mm long; sporangia mostly with 2–3 short setae (in some cases none); spores with translucent wing and cross-wings.

Distr. *Malesia*: Philippines (Luzon to Mindanao), N. Borneo, Celebes.

Notes. The Kew isotypes of the lectotypes cited do not differ in the ways indicated in COPELAND's keys and descriptions of 1960, and among many specimens seen I cannot see two distinct forms. The Kew specimen of COPELAND 250 has pinnae more dilated distally than that of CUMING 149, though COPELAND indicates the contrary. The pinnae with irregular large distal lobes figured (as line drawings) with the photograph of the type of *D. rhombea* by COPELAND (1935) are representative of a group of forms, almost always with 4–5 pairs of pinnae, which appear to be hybrids and are here treated as *P.* × *xiphioides*.

44. Pronephrium peltatum (v.A.v.R.) HOLTTUM, *comb. nov.* — *Dryopteris peltata* v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 12; Handb. Suppl. (1917) 190. — *Thelypteris peltata* (v.A.v.R.) REED, Phytologia 17 (1968) 303. — Type: MATTHEW 632, Sumatra, Gunong Tandikat (BO).

Dryopteris zippelii ROSENST. Meded. Rijksherb. *n.* 31 (1917) 6. — Type: ZIPPEL, Java (L).

Dryopteris lineata var. subacrostichoides

v.A.v.R. Bull. Jard. Bot. Btzg II, 28 (1918) 24. — Type: CRAMER 37, S. Sumatra, Kota Agoeng (BO).

KEY TO THE VARIETIES

1. Indusia glabrous; sporangia not setiferous.
 2. Sterile pinnae thin, margin deeply serrate distally . . . . . **a.** *var.* **peltatum**
 2. Sterile pinnae rigid when dry, entire **b.** *var.* **tenompokense**
1. Indusia with a few short hairs; sporangia setiferous or not.
 3. Sporangia not setiferous **c.** *var.* **peninsulare**
 3. Sporangia setiferous.
  4. Sporangia with several setae; basal pinnae not reduced . . . **d.** *var.* **persetiferum**
  4. Sporangia with 0–2 setae; reduced basal pinnae present on most specimens **e.** *var.* **aberrans**

a. *var.* **peltatum**

Stipe of sterile frond 14 cm long, of fertile 20 cm. *Lamina* to 21 cm long; pinnae *c.* 10 pairs. *Sterile pinnae* to 6 cm long, base rounded on basiscopic side and auricled on acroscopic, 1.5 cm wide above base, apex short-acuminate, edges crenate throughout or in distal part only; costules 2.5 mm apart; veins 3–4 pairs, almost all anastomosing; lower surface glabrous, pustular when dry; upper surface hairy on costae only. *Fertile pinnae* to 4 × 1 cm; sori medial; indusia firm, dark, lacking acicular hairs; sporangia not setiferous.

Distr. *Malesia*: Central & S. Sumatra, W. Java, at 900–1500 m.

Note. Specimens from Tjibodas in W. Java have sterile pinnae to 8 × 1.6 cm. One specimen from Sumatra has lower sterile pinnae auricled on both sides at the base.

b. *var.* **tenompokense** (C. CHR.) HOLTTUM, *stat. nov.* — *Dryopteris tenompokensis* C. CHR. Gard. Bull. Str. Settl. 7 (1934) 248. — Type: HOLTTUM 25388, Sabah, Mt Kinabalu, Tenompok (BM; K, SING).

Differs from *var. peltatum* as follows: texture of lamina firm; edges of pinnae almost entire; lower surface of costae glabrous or sparsely minutely hairy.

Distr. *Malesia*: Sabah (Mt Kinabalu).

Ecol. In forest, on rocks by streams or near streams, at 1500 m.

c. *var.* **peninsulare** HOLTTUM, *var. nov.* — *Abacopteris lineata sensu* HOLTTUM, Rev. Fl. Mal. 2 (1955) 292, excl. syn., f. 169. — Type: A. G. PIGGOTT 1668, Malaya, Negri Sembilan, G. Telapak Burok, 900 m (K).

A var. tenompokense differt indusiis semper breviter pilosis.

Distr. *Malesia*: Malaya, on Main Range and Taiping Hills.

Ecol. In forest, not (or not always) by streams, 900–1500 m.

Note. A plant of this variety from Taiping Hills, cultivated at Kew, was found by MANTON to be tetraploid (HOLTTUM *l.c.* p. 625).

d. *var.* **persetiferum** HOLTTUM, *var. nov.* — *Dryopteris exsculpta sensu* C. CHR. Gard. Bull. Str. Settl. 7 (1934) 248, *p.p.* — Type: HOLTTUM *s.n.* 1931, Mt Kinabalu, crest of Penibukan Ridge, 1200 m (SING; BM).

A var. tenompokense differt pinnis leviter crenatis, sporangiis setis pluribus praeditis.

Distr. *Malesia*: Borneo. Besides type, known from G. Mulu, Sarawak, in stream-bed at 1760 m.

e. *var.* **aberrans** HOLTTUM, *var. nov.*

A var. tenompokense differt: frondibus pinnis inferioribus redactis usque 12*-jugatis, aequaliter bilobatis (lobis usque* 1.2 *cm longis) praeditis; pinnis normalibus sterilibus usque* 12 × 2.5 *cm, distaliter crenatis, fertilibus usque* 7 × 1.7 *cm; sporangiis* 0–2 *setis praeditis.* — Type: CLEMENS "33702 & 32020", Sabah. Mt Kinabalu, Colombon Basin, 1400–1600 m (K; G, MICH).

Distr. *Malesia*: Sabah.

Note. These specimens have the frond-form of *Sphaerostephanos*, but the reduced basal pinnae are not like those of that genus; apart from size, the normal pinnae agree with the present species. Spores of a specimen at MICH are normal.

2. Subgenus **Menisciopsis** HOLTTUM, *subg. nov.*

Pinnae subintegrae, plurivenosae, venis plerisque more generis Meniscii Schreb. anastomosantibus; sori exindusiati, saepe elongati, interdum coalescentes; sporangia vel nudis vel pilis rectis vel hamatis praedita.

Type species: *Pronephrium lakhimpurense* (ROSENST.) HOLTTUM, Blumea 20 (1972) 110.

Taxon. The type species, *P. lakhimpurense*, is distributed from N.E. India to southern China and southwards to northern Thailand and Vietnam. It has large entire pinnae with many pairs of anastomosing veins, the excurrent veinlets all free; the sori of large plants spread all along the veins, the sporangia

lacking setae. In these characters it is very close to the species of *Meniscium* of tropical America, and differs from them most conspicuously in the red colour of dried fronds. Another species of the same distribution in Asia, *P. penangianum* (HOOK.) HOLTTUM, has narrower pinnae which are strongly crenate-serrate and distal excurrent veinlets not free. In Malesia, *P. rubrinerve*, *P. rubidum* and *P. scopulorum* are clearly related to the two species of mainland Asia, but their sori are not more than slightly elongate; only in *P. rubidum* are excurrent veinlets all free.

Agreeing with the species mentioned above in the reddish colour of dried fronds and also in elongate sori are species of another Malesian group which are distinguished by having hooked hairs on frond-axes and usually also on sporangia; formerly these species were all included in *Meniscium*. Several of them have buds at the bases of pinnae. They are here included in section *Grypothrix*.

There remain three species which appear to be somewhat intermediate between the two groups above mentioned. Of these, *P. acanthocarpum* has buds at the bases of its pinnae as in *sect. Grypothrix* but sori not elongate and straight setae on its sporangia. The other two, *P. nitidum* and *P. repandum*, have similar sori and sporangia but no buds on the frond; they are very similar to each other in general aspect but differ in sporangia and spores. They are possibly a connecting link between subgenera *Pronephrium* and *Menisciopsis*. They are here placed in section *Menisciopsis*.

The earlier-described species of this group were much confused by HOOKER, and it was not until the work of CHING in 1938 that their taxonomy and nomenclature were clarified. CHING however did not notice the hooked hairs which are the distinctive feature of *sect. Grypothrix*.

3. Section Menisciopsis

KEY TO THE SPECIES

1. Body of sporangium lacking setae.
   2. Pinnae 4–6 cm wide; edges distinctly serrate throughout . . . . . **45. P. rubrinerve**
   2. Pinnae 2.5–3.5 cm wide; edges entire or nearly so.
      3. Excurrent veinlets mostly free; sori close to costules . . . . . **46. P. rubidum**
      3. Excurrent veinlets mostly not free; sori not close to costules . . . . . **47. P. scopulorum**
1. Body of sporangium bearing setae.
   4. Pinnae one pair, a bud at the base of each . . . . . **48. P. acanthocarpum**
   4. Pinnae several pairs on adult plant; no buds present.
      5. Caudex long-creeping; veins very oblique; several acicular hairs on stalk of sporangium **49. P. nitidum**
      5. Caudex short-creeping; veins at a broad angle to costules; a hair of 2–3 cells, not acicular on stalk of sporangium . . . . . **50. P. repandum**

45. Pronephrium rubrinerve (METT.) HOLTTUM, Blumea 20 (1972) 110; Allertonia 1 (1977) 213; BROWNLIE, Pterid. Fiji (1977) 258. — *Phegopteris rubrinervis* METT. in Kuhn, Linnaea 36 (1869) 116; KUHN, Verh. Zool. Bot. Ges. Wien 19 (1869) 576; v.A.v.R. Handb. Suppl. (1917) 316. — *Goniopteris rubrinervis* (METT.) CARR. in Seem. Fl. Vit. (1873) 366. — *Polypodium rubrinerve* (METT.) BAK. Syn. Fil. ed. 2 (1874) 315. — *Cyclosorus rubrinervis* (METT.) COPEL. Gen. Fil. (1947) 143; J. Arn. Arb. 30 (1949) 438. — *Thelypteris rubrinervis* (METT.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 195. — Lectotype (HOLTTUM 1972): TURNER, New Ireland (B).

Caudex massive, short-creeping to suberect; fronds closely tufted; scales small, thin, broad-ovate, glabrous or nearly so. *Stipe* to 145 cm long, glossy, glabrous apart from a few very short acicular hairs near base (often lost), drying light reddish; *lamina* to 170 cm long, thin but firm, drying brown-olivaceous with red costae and in some cases costules; pinnae to 24 pairs, upper ones on large fronds gradually decrescent; apex pinna-like; basal pinnae distinctly stalked, narrowly cuneate at base, the lamina on basiscopic side ending 1.5–2.0 cm from rachis. *Largest pinnae* to 43 × 6 cm; base broadly cuneate; apical half gradually narrowed to short-acuminate tip; edges crenate to a depth of 1 mm, cartilaginous margin thick, pale to reddish; costules 4–5 mm apart, at 60° to costa, falcate distally; veins 15–20 pairs, at 45° to costules, almost straight, fine and slightly prominent on lower surface, almost all anastomosing, excurrent veinlets, except basal ones, rarely free; *lower surface* of rachis and pinnae quite glabrous (young fronds may have thin reddish scales on rachis and costae), surface between veins slightly pustular; *upper surface* of both rachis and costae glabrous. *Sori* medial or supramedial, basal ones sometimes meeting and slightly elongate; no indusia; sporangia lacking setae, a hyaline hair of 2 cells on the sporangium-stalk; spores red-brown, with a rather broad translucent wing and cross-wings.

Distr. Polynesia (Fiji), Melanesia (New Hebrides) and *Malesia*: New Guinea (New Ireland).

Ecol. On river banks in forest at low altitude (to 900 m in Fiji).

Notes. In 1977 I reported the caudex of this species to attain a height of 30 cm, on the evidence of a herbarium label; but BRAITHWAITE reports it to be prostrate, and this is also true of a plant he sent from the New Hebrides, cultivated at Kew.

46. Pronephrium rubidum (HOOK.) HOLTTUM, Blumea 20 (1972) 111. — *Polypodium rubidum* HOOK. Spec. Fil. 5 (1863) 12, excl. DE VRIESE 41. — *Dryopteris rubida* (HOOK.) C. CHR. Ind. Fil. (1905) 289; CHRIST, Philip. J. Sci. 2 (1907) Bot. 207, excl. WHITFORD 272. — *Phegopteris rubida* (HOOK.) v.A.v.R. Handb. (1908) 502. — *Cyclosorus rubidus* (HOOK.) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 375. — *Thelypteris rubida* (HOOK.) K. IWATS. Mem. Coll. Univ. Kyoto B, 31 (1965) 195. — Type: CUMING 415, Luzon (K; E, FI-W, G, LE, P).

Caudex short, suberect. *Stipe* dark reddish, glabrous except for minute hairs near base, to 100 cm long; basal scales not seen, reported by CHRIST to be 2 cm long. *Lamina* to 120 cm long; apex pinna-like; pinnae to 20 pairs, subopposite, drying dark reddish; basal pair not or little reduced, with stalks 1–2 mm long. *Largest pinnae* of type 21 × 2.7 cm, largest seen 28 × 3.8 cm; base cuneate (angle *c.* 45° each side); apex caudate-acuminate (cauda 2.5–3.0 cm long); edges irregularly slightly sinuous to slightly crenate, cartilaginous margin rather broad and red; costules 3–5 mm apart, at 60°; veins 9–13 pairs, at 45° to costules, slightly curved, dark and not prominent on lower surface, excurrent veinlets all free; *lower surface* of rachis and pinnae quite glabrous; *upper surface* of rachis with a few short hairs in the groove, hairs on costae sparse, slender. *Sori* very close to costules except basal basiscopic ones on large pinnae, sporangia few; no indusia; no setae on body of sporangia; hair on sporangium-stalk 3-celled, distal cell not much enlarged.

Distr. *Malesia*: Philippines (Luzon; Palawan, 4 collections).

Ecol. "Streamside, in open pine forest, 1700 m" (PRICE 2831; no other record).

Notes. The largest specimen is FOXWORTHY 684 from Palawan (MICH). HOOKER described *var. β*, but he cited no specimen and I have not found one so marked. DE VRIESE 41, wrongly cited by HOOKER, is *P. ramosii*, as also WHITFORD 272 wrongly cited by CHRIST.

47. Pronephrium scopulorum HOLTTUM, *sp. nov.*

A P. rubido differt: pinnis omnibus basi anguste inaequaliter cuneatis, pinnis basalibus non stipitatis; venulis excurrentibus plerisque non liberis; soris costulas non contingentibus. — Type: BUWALDA 5168, Aru Is., P. Kabroor, on limestone (K; BO).

Caudex not seen. *Stipe* probably to 50 cm long, dark reddish, glabrous; basal scales not seen. *Lamina c.* 50 cm long; apex pinna-like; pinnae to 8 pairs, firm, drying dull reddish, subopposite; bases of all pinnae narrowly unequally cuneate, lowest pinnae with narrowest base. *Middle pinnae* 18 × 2.8–3.5 cm, widest 1/3 from base; acroscopic base narrowed to attachment to rachis, lamina on basiscopic side ending 3–4 mm from rachis; apex narrowly caudate; edges entire or slightly sinuous distally; costules 3–4 mm apart at 60° to costa; veins to 10 pairs, at *c.* 45° to costules, almost straight, almost all anastomosing to form zig-zag excurrent veins between costules, basal basiscopic vein arising from costa; *both surfaces* quite glabrous (upper surface of rachis and costae probably have some hairs when pinnae are young). *Sori* near costules but not touching them, basal ones sometimes supramedial; no indusia; sporangia lacking setae.

Distr. *Malesia*: S.E. Moluccas (Aru Is.: P. Kabroor) and West New Guinea (Waigeu I.: CHEESMAN 1240–1243, BM).

Ecol. On steep limestone which carries little other vegetation.

48. Pronephrium acanthocarpum (COPEL.) HOLTTUM, Blumea 20 (1972) 107. — *Dryopteris acanthocarpa* COPEL. Philip. J. Sci. 6 (1911) Bot. 136, pl. 17. — *Phegopteris acanthocarpa* (COPEL.) v.A.v.R. Handb. Suppl. (1917) 315. — *Thelypteris acanthocarpa* (COPEL.) REED, Phytologia 17 (1968) 257. — Type: BROOKS 54, Sarawak, Mt Penrissen (MICH; BM).

Caudex short-creeping; bases of stipes less than 1 cm apart. *Stipe* to 50 cm long, dark at base with small dark scales and sparse minute hairs, rest glabrous, dull reddish-brown. *Lamina* consisting of one pair of opposite pinnae with a bud at the base of each and an apical section larger than pinnae, the whole dull reddish when dry. *Apical lamina* to 23 × 10 cm, widest near broadly rounded and symmetric base, apex short-acuminate, edges irregularly slightly sinuous; main veins 6 mm apart, at wide angle to midrib, falcate distally; veins more than 20 pairs, not prominent, at a wide angle to main veins, almost all anastomosing with occasional irregularities, excurrent veinlets free; *lower surface* of midrib copiously minutely hairy (less than 0.1 mm), similar hairs sparse on main veins, surface between veins not pustular; *sori* medial or inframedial, those on basal veins sometimes supramedial, in many cases slightly elongate; sporangia bearing several short straight setae; spores not seen. *Pinnae* to 17 × 7 cm; base broadly cuneate and very asymmetric, the basiscopic side 4.5 cm wide at 1/3 length of pinna, acroscopic side 3 cm; veins to 18 pairs on basiscopic side; pubescence and sori as terminal lamina.

Distr. *Malesia*: Borneo (Western Sarawak, two localities; the second is Mt Merinjak).

Ecol. On rocks near streams at 900 m.

49. Pronephrium nitidum HOLTTUM, Blumea 20 (1972) 109. — *Dryopteris urophylla* (METT.) C. CHR. *var. nitida* HOLTTUM, Gard. Bull. Str. Settl. 7 (1934) 249, 251 (fig.). — *Thelypteris urophylla var. nitida* (HOLTTUM) K. IWATS. Acta Phytotax. Geobot. 22 (1966) 94. — Type: HOLTTUM SFN 25592, Sabah, Mt Kinabalu, Menetendok (SING; BO, K).

Cyclosorus urophyllus sensu COPEL. Fern Fl. Philip. (1960) 373, excl. loc. Malacca. — **Fig. 16g–h.**

Caudex long-creeping, 5–8 mm diameter. *Stipe* commonly 70–100 cm long; base dark with dark rigid scales c. 5 × 1 mm bearing many short stiff hairs, above base brownish to slightly reddish, glabrous. *Lamina* 50 cm long, firm; apex pinna-like, often with almost symmetrical base; pinnae 6–7 pairs, subopposite, lowest pinnae usually with a stalk to 4 mm long, narrowly and asymmetrically cuneate at base, upper pinnae sessile with broader and more symmetric bases (very variable). *Middle pinnae* commonly 20 × 4–5 cm, narrowly elliptic, ± abruptly narrowed to cuneate base and to caudate apex (cauda commonly 2 cm long); edges crenate-serrate with a thick pale cartilaginous margin; costules 3.5–4 mm apart, at a broad angle, falcate distally; veins 18–20 pairs, slender and slightly prominent both sides, very oblique and slightly S-curved, excurrent veinlets almost all free; *lower surface* of rachis and costae covered with pale thin hairs 0.2–0.3 mm long (antrorse but not appressed on costae), similar and sometimes also longer hairs on costules, surface between veins glabrous or with some very short erect hairs, at most slightly pustular; *upper surface* of rachis and costae glabrous or with sparse short hairs, surface between veins smooth and glossy. *Sori* supramedial, those on connivent veins sometimes ± confluent; receptacle bearing many short acicular hairs with the sporangia; sporangia short-stalked with several acicular hairs on stalks, also 8–12 short acicular hairs distally on body; spores closely and minutely papillose.

Distr. *Malesia*: Banka, Borneo, N. & Central Celebes, Philippines (Sulu Archipelago, Mindanao).

Ecol. At 0–1200 m, usually in secondary forest, often on edges of forest or rather open places on stream-banks.

Note. COPELAND (1960) reports from Palawan, but I have seen no specimen thence. Both sporangia and spores are markedly different from those of *P. repandum*.

50. Pronephrium repandum (FÉE) HOLTTUM, Blumea 20 (1972) 109. — *Goniopteris repanda* FÉE, Gen. Fil. (1852) 251. — Type: GAUDICHAUD, Penang (FI-W, isotype).

Polypodium cuspidatum ROXB. Calc. J. Nat. Hist. 4 (1844) 491 (not *Pronephrium cuspidatum* (BL.) HOLTTUM). — Type: WALLICH 299, Penang (BR; K).

Goniopteris dalhousiana FÉE, 8e Mém. (1857) 92. — Type: Lady DALHOUSIE, "Indes Orientales" (Herb. Graham, not seen; probable isotype, from Penang, K).

Phegopteris urophylla METT. Farngatt. IV (1858) 26, *excl. var. aspera* (PRESL). — *Polypodium urophyllum* (METT.) HOOK. Spec. Fil. 5 (1863) 9, *excl. syn. et var.* — *Nephrodium urophyllum* (METT.) KEYSERL. Pol. et Cyath. Herb. Bung. (1873) 49; BEDD. Handb. (1883) 274, *p.p.* — *Dryopteris urophylla* (METT.) C. CHR. Ind. Fil. (1905) 299, *p.p.*; v.A.v.R. Handb. (1908) 216, *p.p.*; BACKER & POSTH. Varenfl. Java (1939) 64, *p.p.* — *Ābacopteris urophylla* (METT.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 251; HOLTTUM, Rev. Fl. Malaya 2 (1955) 296, f. 172. — *Cyclosorus urophyllus* (METT.) TARD. Notul. Syst. 7 (1938) 77; TARD. & C. CHR. Fl. Gén. I.-C. 7, pt. 2 (1941) 391, *p.p.* — *Thelypteris urophylla* (METT.) K. IWATS. S.E. Asian Studies 3 (1965) 81; Acta Phytotax. Geobot. 22 (1966) 94. — Type: WALLICH 299, Penang (B?; isotype K).

Polypodium pinwillii BAK. Ann. Bot. 5 (1891) 460. — *Nephrodium uropyllum var. pinwillii* BEDD. Handb. Suppl. (1892) 72. — Type: PINWILL, Malacca (K). — **Fig. 1n, 16i–j.**

Caudex short-creeping, fronds tufted at its apex. *Stipe* to 80 cm long, slightly flushed with red, densely short-hairy with narrow very hairy scales at base, glabrescent above base. *Lamina* to 60 cm long, firm, drying green but rachis, costae and costules ± flushed with red; apex pinna-like with ± asymmetric cuneate base; pinnae 3–6 pairs; lowest pinnae usually slightly smaller than next, always more narrowed at base than the rest, which are very variable in width in relation to length. *Middle pinnae* commonly c. 22 × 4.0 cm, largest 30 × 7 cm, widest at, or more commonly above, the middle, gradually narrowed to a rather abruptly cuneate base, apex abruptly caudate-acuminate, cauda 3–4 cm long; edges ± deeply crenate-serrate with very narrow pale cartilaginous margin; costules 4–5 mm apart, at 45–60°, slightly curved; veins 15–18 pairs, slender, slightly prominent both sides, slightly curved; at 45° to costule, excurrent veinlets often but not always free (if free, extending almost to the junction of the next pair of connivent veins); *lower surface* of rachis and costae ± densely covered with erect pale hairs 0.2–0.3 mm long, similar hairs more sparse on costules, surface between veins finely pustular, bearing a variable number of short erect hairs some of which may be hooked; *upper surface* of rachis and costae hairy as lower surface, rest glabrous, surface between veins minutely pustular. *Sori* medial or supramedial, not elongate, exindusiate; sporangia bearing 10 or more short setae distally, stalk longer than in *P. nitidum* with a hair of

one cell which is in some cases almost spherical; spores with a continuous wing and cross-wings.

Distr. South Thailand & Vietnam, from Moulmein southwards to *Malesia*: Malaya, Sumatra, Riouw, Lingga & Anambas Is., and West Java.

Ecol. In lowland forest, not in exposed places.

4. Section Grypothrix

HOLTTUM, Blumea 19 (1971) 36.

Type species: *Pronephrium cuspidatum* (BL.) HOLTTUM.

Taxon. See discussion under *subg. Menisciopsis*. The earlier-known species of this section were placed in the genus *Meniscium* SCHREB. by SWARTZ, BLUME, PRESL, HOOKER, BEDDOME and RACIBORSKI, and in *Phegopteris sect. Meniscium* by METTENIUS and VAN ALDERWERELT. CHRISTENSEN (Monogr. Dryopteris 1, 1913, 248) was the first author to regard them as belonging to a group distinct from the type of *Meniscium*. CHING (1938) clarified the taxonomy and nomenclature of the species of Mainland Asia but did not note the hooked hairs by which these species are distinguished from those here placed in *sect. Menisciopsis*.

P. triphyllum is distributed throughout the range of the genus *Pronephrium*; the others are more local in distribution. There are plants which appear to be hybrids of which one parent is *P. triphyllum*. In Malesia *P.* × *parishii* is so designated; there are others, more irregular in frond-form, in Sri Lanka and the Ryukyu Islands. FÉE described a species *Abacopteris elegans* (Gen. Fil. 1852, 310), based on a specimen from Cochinchina which I have not seen; he stated that it had hooked hairs on sporangia, indusiate sori, and excurrent veinlets not free, a combination of characters which I have never seen, and I doubt the accuracy of his observations.

KEY TO THE SPECIES

1. Caudex long-creeping with well-spaced fronds.
 2. Pinnae one pair, opposite, always asymmetric . . . . . **51. P. triphyllum**
 2. Pinnae 2–6 pairs, distal ones small and adnate, rest with variable asymmetry . **52. P. × parishii**
1. Caudex short-creeping, fronds close together.
 3. Pinnae all narrowly cuneate at base, fertile ones commonly 1 cm wide; hooked hairs lacking on lamina and sporangia . . . . . **53. P. salicifolium**
 3. Pinnae not all narrowly cuneate at base, fertile ones always much more than 1 cm wide; hooked hairs present on some parts of lamina and usually on sporangia.
  4. Pinnae 1–3 pairs; no buds at their bases.
   5. Pinnae always opposite; fertile pinnae with undulate margins; hooked hairs present on basal scales and on sporangia . . . . . **54. P. rubicundum**
   5. Pinnae not always opposite; fertile pinnae sharply serrate-crenate distally; no hooked hairs on scales nor on sporangia . . . . . **55. P. sulawesiense**
  4. Pinnae of well-grown plants more than 3 pairs; a bud always present at base of uppermost pinna.
   6. Bud confined to base of uppermost pinna; pinnae widest in basal half; hydathodes on upper surface conspicuous . . . . . **56. P. cuspidatum**
   6. Buds present at bases of several pinnae; pinnae usually widest above middle; hydathodes not conspicuous . . . . . **57. P. ramosii**
    7. Hooked hairs present on sporangia . . . . . **57a. P. ramosii *var.* ramosii**
    7. Hooked hairs lacking on sporangia . . . . . **57b. P. ramosii *var.* minahassae**

51. Pronephrium triphyllum (SW.) HOLTTUM, Blumea 20 (1972) 122; Allertonia 1 (1977) 214; BROWNLIE, Pterid. Fiji (1977) 257. — *Meniscium triphyllum* SW. in Schrad. J. Bot. 1800, 2 (1801) 16; HOOK. & GREV. Ic. Fil. (1820) t. 120; BEDD. Ferns S. India (1863) t. 56; Handb. (1883) 397; RACIB. Fl. Btzg 1 (1898) 66. — *Phegopteris triphylla* (SW.) METT. Fil. Lechl. (1859) 21; v.A.v.R. Handb. (1908) 509. — *Dryopteris triphylla* (SW.) C. CHR. Ind. Fil. (1905) 298; BACKER & POSTH. Varenfl. Java (1939) 59. — *Abacopteris triphylla* (SW.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 241; HOLTTUM, Rev. Fl. Malaya 2 (1955) 287, f. 166. — *Cyclosorus triphyllus* (SW.) TARD. Notul. Syst. 7 (1938) 78; TARD. & C. CHR. Fl. Gén. I.-C. 7, pt. 2 (1941) 386; COPEL. Fern Fl. Philip. (1960) 371. — *Thelypteris triphylla* (SW.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 190. — Type: China (S-PA).

Meniscium cumingii FÉE, Gen. Fil. (1852) 222. — Type: CUMING *s.n.*, Philippines (not seen). — **Fig. 16k–l.**

Caudex long-creeping, 2–3 mm diameter, covered with short pale hooked hairs; scales *c.* 3 mm long, narrow, bearing many short straight hairs. *Stipe* of sterile fronds 7–20 cm long, of fertile 20–50 cm, ± tinged with dull red, rather sparsely hairy, hairs as caudex. *Lamina* consisting of an apical section and one pair of opposite pinnae attached 0.5–2.0 cm below it. *Sterile apical lamina* 10–18 cm long, 2.5–4.0 cm wide; base almost symmetrical, broadly cuneate to rounded, rarely somewhat cordate; apex short-acuminate; edges entire or slightly sinuous; main veins 4–4.5 mm apart along midrib; veins 10–12 pairs, pale, slender, slightly prominent on lower surface, at a broad angle to main veins, excurrent veinlets free or meeting the junction of the next pair of connivent veins; *lower surface* of midrib and main veins bearing pale hooked hairs 0.3–0.4 mm long, rest of surface glabrous, or with a few short erect hooked hairs, slightly pustular between veins; *upper surface* of midrib bearing copious short hooked hairs, hairs on main veins sparse. *Fertile apical lamina* 1.0–2.5 cm wide; veins to 7 pairs, almost at right angles to main veins; excurrent veinlets almost always short and free; *sori* extending all along each vein so that sporangia are distributed in a crescent-shaped row along each pair of connivent veins; sporangia bearing hooked hairs distally and sometimes a hair of 2 cells on the stalk; spores bearing many separate but not crowded small wings. *Sterile pinnae* 5–10 cm long, 1.5–3.0 cm wide, with stalks 1–3 mm long, shaped as apical lamina but asymmetric, the lamina wider on basiscopic side of costa than on acroscopic; veins to *c.* 8 pairs on basiscopic side. *Fertile pinnae* 1.0–2.5 cm wide, sori as apical lamina.

Distr. Tropical and subtropical mainland S.E. Asia, Taiwan, Ryukyu Islands; throughout *Malesia*; N. Queensland, Fiji (only 1 record from Fiji).

Ecol. Low altitudes in light shade, sometimes abundant under fruit trees or palms in villages; few collections from Philippines and New Guinea.

52. Pronephrium × parishii (BEDD.) HOLTTUM, Blumea 20 (1972) 123. — *Meniscium parishii* BEDD. Ferns Brit. India (1866) t. 184. — *Meniscium triphyllum var. parishii* BEDD. Handb. (1883) 399. — *Abacopteris triphylla var. parishii* (BEDD.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 241; HOLTTUM, Rev. Fl. Malaya 2 (1955) 287. — *Thelypteris triphylla var. parishii* (BEDD.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 191. — *Thelypteris parishii* (BEDD.) PANIGRAHI, Phytologia 31 (1975) 372. — Type: PARISH 135, Burma, Moulmein (K).

Caudex long-creeping, to 4 mm diameter, as *P. triphyllum* in hairs and scales (hairs on scales of some Indian specimens not hooked). *Lamina* variable; *apical section* about as in *P. triphyllum* but often with 1 or 2 narrow lobes at the base, or 1–2 small narrow adnate free pinnae just below it, no buds at the bases of upper pinnae; *pinnae* to 6 pairs, usually opposite but sometimes not, usually increasing in size from apex to base of frond, upper ones always ± adnate to rachis at basiscopic base; largest 15 × 2–3 cm, sometimes with lamina symmetrically divided by the costa, sometimes the two halves unequal in width as in *P. triphyllum*; pubescence as in *P. triphyllum* but more numerous erect hooked hairs often present on lower surface between veins. *Sori* as in *P. triphyllum*; sporangia sometimes with longer hooked hairs; spores not seen.

Distr. Assam, Burma, Thailand, Vietnam; in *Malesia*: Malaya (Perak and Pahang).

Ecol. In Malaya along stream banks in rather open forest, at low altitudes.

Notes. The specimens referred here are variable, and in their small adnate upper pinnae agree with *Meniscium thwaitesii* HOOK. of Ceylon, but the pinnae of the latter are more irregular and some of its hairs are not hooked. Variability among the present specimens suggests hybridity, one parent certainly being *P. triphyllum*; it is possible that plants in different areas have different genetic origins.

53. Pronephrium salicifolium (WALL. *ex* HOOK.) HOLTTUM, Blumea 20 (1972) 123. — *Meniscium salicifolium* WALL. *ex* HOOK. Ic. Pl. 10 (1854) t. 990; BEDD. Ferns Brit. India (1866) t. 207; Handb. (1883) 399. — *Phegopteris salicifolia* (WALL. *ex* HOOK.) METT. Fil. Lechl. 2 (1859) 22; v.A.v.R. Handb. (1908) 511. — *Abacopteris salicifolia* (WALL. *ex* HOOK.) HOLTTUM, Rev. Fl. Malaya 2 (1955) 288, f. 167. — *Thelypteris salicifolia* (WALL. *ex* HOOK.) REED, Phytologia 17 (1968) 311. — Type: WALLICH 63, Penang (K).

Caudex short-creeping, 7–8 mm diameter, bearing sparse hooked hairs. *Stipe* 20–60 cm long; near base a few hooked hairs and rigid dark scales to 10 × 1 mm bearing pale hooked hairs, rest of stipe glabrous, glossy, ± castaneous. *Lamina* 30–80 cm long, very firm, somewhat dimorphous, slightly flushed with red when dry; apex pinna-like, not or little larger than distal pinnae; *pinnae* to 18 pairs, a bud sometimes present at base of uppermost pinna; basal pinnae asymmetric at base, the blade decurrent to the attachment to rachis on acroscopic side, ending 5 mm or more from rachis on basiscopic side. *Middle pinnae* commonly 10–15 cm long, fertile ones 0.6–1.2 cm wide, sterile sometimes wider, largest sterile pinnae 20 × 2.5 cm, fertile rarely to 2 cm wide; base always very narrowly cuneate; apex narrowly acuminate but not caudate; edges quite entire; costules 3–4 mm apart, at 45° to costa; veins 3–10 pairs (according to width of pinna), almost all anastomosing, not prominent on either side, excurrent veins all free except distal ones; *both surfaces* quite glabrous. *Sori* supramedial, elongate along

veins, those on connivent veins usually meeting; no hairs on body of sporangia and none seen on stalk; spores with a ± continuous wing and cross-wings.

Distr. *Malesia*: Malaya, Sumatra, Borneo.

Ecol. On rocks in and beside streams, in forest, in flood zone, at 0–500 m; plants in the more exposed places on rocks in a stream-bed have smallish fronds with narrow pinnae. The very firm narrow pinnae are probably an adaptation to dry conditions when the stream is low and also to survival in the periodic rush of floodwater; in form they closely resemble the pinnae of *Dipteris lobbiana* (HOOK.) MOORE, which grows in similar habitats.

54. Pronephrium rubicundum (v.A.v.R.) HOLTTUM, Blumea 20 (1972) 123. — *Phegopteris rubicunda* v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 162. — *Abacopteris rubicunda* (v.A.v.R.) HOLTTUM, Rev. Fl. Malaya 2 (1955) 292, f. 170. — *Thelypteris rubicunda* (v.A.v.R.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 195. — Type: BROOKS 232/S, Sumatra, Lebong Tandai (BO; BM). — **Fig. 1o, 16a–d.**

Caudex short-creeping, to 8 mm diameter, bearing hooked hairs. *Young plants* bearing simple fronds up to 30 × 12 cm, sometimes with fertile ones 20 × 5 cm; later fronds on these plants having lateral pinnae, the apical lamina progressively smaller. *Stipe* 20–30 cm long on sterile fronds, to 70 cm on largest fertile ones, base bearing thin narrow scales to *c.* 8 × 1 mm with a variable number of hooked hairs on them, above base ± flushed with dull red and bearing sparse pale short hooked hairs. *Lamina* 20–35 cm long, firm, drying dull reddish, consisting of an apical segment and 1–3 pairs of opposite pinnae; no buds at bases of pinnae; all pinnae asymmetric, broader on basiscopic side of costa than on acroscopic; basal pinnae short-stalked. *Apical lamina* of fronds with 3 pairs of pinnae 15–20 × 5–8 cm (proportion of length to width very variable), base broadly rounded to broadly cuneate, apex short-acuminate, edges entire to rather strongly undulate. *Largest pinnae* usually at a wide angle to rachis, 10–24 × 3–7 cm, widest about the middle or sometimes above the middle, base cuneate to rounded, apex abruptly caudate (cauda commonly to 2 cm long), edges entire (sterile) or undulate (most fertile ones); costules 3.5 mm apart (fertile) or 4.5 mm (sterile); veins 12–15 pairs, slightly prominent on lower surface, where sterile at 45° to costules, where fertile closer and almost at right angles to costules, excurrent veinlets all free; *lower surface* of rachis and costae sparsely to rather copiously hairy, most abundantly on young plants, hairs all hooked, similar hairs sometimes present on surface between veins; *upper surface* of rachis and costae bearing ± abundant pale hooked hairs less than 0.5 mm long. *Sori* medial, ± elongate, those on connivent veins often uniting; sporangia usually with 2 hooked hairs distally, hairs on stalk not seen; spores with rather narrow wing and a few cross-wings.

Distr. Peninsular Thailand, in *Malesia*: Sumatra, Malaya.

Ecol. In primary forest at 0–800 m, not on stream-banks.

55. Pronephrium sulawesiense (K. IWATS.) HOLTTUM, *sp. nov.* — *P. rubicundum ssp. sulawesiense* K. IWATS. Acta Phytotax. Geobot. 28 (1977) 162, f. 2. — Type: K. SOMA *et al.* 218, 249, Central Celebes, inland from Polo, Kelawi Distr. 1000–1700 m (TUS, not seen).

Differs from *P. rubicundum* as follows: *scales* on rhizome 4 × 2.5 mm, on stipe 5 × 1.8 mm, lacking hooked hairs; *pinnae* not always opposite, to 24 × 4.5 cm including apical cauda 4 cm long, more oblique to rachis, distal ones longest, apparently almost symmetric in shape, widest 1/3 from apex, edges of fertile pinnae strongly crenate-serrate distally, of sterile ones less strongly; *sori* medial, those on connivent veins not meeting; sporangia lacking hooked hairs.

Distr. *Malesia*: Central Celebes, only known from the type.

Notes. This is geographically remote from *P. rubicundum* and differs in scales, proportionately narrower more oblique more symmetrical pinnae with different edges. The figure shows a fertile frond with distinctly alternate pinnae. In frond-form this is nearer to *P. ramosii* of the Philippines but differs in other characters.

56. Pronephrium cuspidatum (BL.) HOLTTUM, Blumea 20 (1972) 123, *excl. syn. praeter Bl.* — *Meniscium cuspidatum* BL. En. Pl. Jav. (1828) 114; Fl. Jav. Fil. (1828) 102, t. 45; RACIB. Fl. Btzg 1 (1898) 65. — *Phegopteris cuspidata* (BL.) METT. Farngatt. IV (1858) 25; v.A.v.R. Handb. (1908) 511. — *Dryopteris cuspidata* (BL.) CHRIST, Philip. J. Sci. 2 (1907) Bot. 205, *p.p.*; BACKER & POSTH. Varenfl. Java (1939) 63, f. 10. — *Abacopteris cuspidata* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 245. — *Cyclosorus cuspidatus* (BL.) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 375, *nomen tantum.* — *Thelypteris cuspidata* (BL.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 192. — Type: BLUME, Java (L).

Dryopteris amaiensis ROSENST. Meded. Rijksherb. *n.* 31 (1917) 6. — Type: HALLIER 3157, Java (L).

Caudex short-creeping, 7–10 mm diameter, bearing hooked hairs. *Stipe* to 50 cm or more long, dark at base with sparse hooked hairs and firm dark brown scales *c.* 10 × 1 mm bearing a few hooked hairs, above base light-castaneous, glabrous. *Lamina* commonly 30–50 cm long (to

120 cm, *fide* BACKER & POSTHUMUS), firm, drying dull reddish; apical segment of similar size to upper pinnae, base cuneate and slightly asymmetric; pinnae commonly to 6 pairs (10 pairs on type), lowest usually opposite, the rest often not so, a bud always at base of highest pinna only of old fronds; basal pinnae with stalks to 5 mm long, slightly asymmetric on either side of costa, otherwise like the rest. *Pinnae* commonly to 16 × 3.5 cm, sometimes dimorphous, smallest fertile ones 9 × 2 cm, largest sterile 20 × 6 cm, symmetric on either side of costa, usually widest 1/4–1/3 from base, base narrowly to broadly cuneate, slightly asymmetric with the acroscopic edge decurrent to junction with rachis, the basiscopic edge less decurrent; apex caudate-acuminate to abruptly cuspidate (narrow tip 1.5–2.5 cm long); edges entire or nearly so; costules 3.5–4 mm apart, at 45° to costa, grooved above when dry and slightly prominent beneath; veins 10–12 pairs, not prominent either side, dark on lower surface, at a narrower angle to costules in sterile than in fertile fronds, excurrent veinlets mostly free and ending in a conspicuous hydathode on upper surface (with white incrustation on old fronds); *lower surface* glabrous throughout or (especially in Sumatra) with a few hooked hairs on costae and costules; *upper surface* quite glabrous, even in groove of rachis. *Sori* near costules, somewhat elongate, those on connivent veins near costa uniting, distal ones sometimes not; sporangia lacking hooked hairs on Java specimens, such hairs present on specimens from Sumatra.

Distr. *Malesia*: Sumatra, Borneo, Java and Lesser Sunda Is. (Flores).

Ecol. On rocks or steep valley-sides in forest at altitudes to 1200 m.

Note. There may be some introgressive hybridization between this species and *P. rubicundum* in Sumatra.

57. Pronephrium ramosii (CHRIST) HOLTTUM, *comb. nov.* — *Dryopteris ramosii* CHRIST, Philip. J. Sci. 2 (1907) Bot. 203. — Lectotype (selected here): RAMOS BS 1792, Luzon, Rizal Prov. (P; FI, K).

Cyclosorus cuspidatus sensu COPEL. Fern Fl. Philip. (1960) 375, *excl. syn. Meniscium cuspidatum* BL. — **Fig. 16e–f.**

a. *var.* ramosii.

Differs from *P. cuspidatum* as follows: *scales* at base of stipe to 4 × 1 mm, lacking hooked hairs; *pinnae* always alternate, including basal ones, in almost all cases widest above the middle and narrowly cuneate at base (exceptions are specimens from Mindoro and Sibuyan), commonly *c.* 11 × 2.5 cm, *buds* present at the bases of several pinnae (to 4 on each side of rachis); *veins* 6–8 pairs, no conspicuous hydathodes present at apices of excurrent veinlets; *hooked hairs* usually more abundant on lower surface of costae and costules, often present between veins on lower surface, present also in groove of upper surface of costae and in groove of rachis at base of a costa; *sori* medial; sporangia always bearing hooked hairs.

Distr. *Malesia*: Philippines (Luzon to Mindanao), Moluccas (Halmahera), N.E. New Guinea.

Ecol. "Common at 600–800 m along streams in damp gulches" (COPELAND).

b. *var.* minahassae HOLTTUM, *var. nov.*

A var. ramosii differt: pinnis usque 23 × 4 cm (steriles), 18 × 3.5 cm (fertiles); pilis hamatis subtus inter venas carentibus; sporangiis pilis hamatis non praeditis. — Type: ALSTON 16551, N. Celebes, G. Manembo-nembo (BM).

Distr. *Malesia*: N. Celebes.

Note. *Meniscium liukiuense* CHRIST, which I listed in the synonymy of *P. cuspidatum* in 1972, should also be included in *P. ramosii*, perhaps as a distinct variety; its excurrent veins are mostly not free. In the Solomon Islands is another possibly distinct variety which has no hooked hairs on sporangia and lower surface; they occur only at the base of costae on the upper surface.

19. NANNOTHELYPTERIS

HOLTTUM, Blumea 19 (1971) 38; Kalikasan 2 (1973) 64. — **Fig. 17.**

Caudex short-creeping; fronds somewhat dimorphous, sterile ones with shorter stipes and larger pinnae than fertile; pinnae 16–35 pairs, not more than 2.5 cm long, close together except in some fertile fronds, lower pinnae more widely spaced but hardly reduced; veins free or the basal ones anastomosing; lower surface of pinnae between veins ± pustular when dry, not glandular, in some cases with minute acicular hairs; upper surface between veins glabrous or with minute erect acicular hairs; sori indusiate or exindusiate; indusia bearing hairs or glands; sporangia bearing spherical

yellow glands, as in *Sphaerostephanos*; spores with a ± complete wing and some cross-wings.

Type species: *Nannothelypteris aoristisora* (HARR.) HOLTTUM.

Distr. *Malesia*: Philippines (Luzon, Panay, Samar, Mindanao).

Ecol. In forest, in some cases on rocks.

Cytol. n = 36 (M. G. PRICE, *N. camarinensis*).

Taxon. A natural group of species closely related to *Pronephrium sect. Dimorphopteris*, with which it might be united. No transference is here made to *Pronephrium* because of the uncertain status of the latter.

COPELAND's treatment of these species in his Fern Flora of the Philippines is confused because he did not examine details. Some earlier confusion was caused by the inclusion by CUMING of some specimens of *Sphaerostephanos lastreoides* in his *n.* 251, together with the type collection of *Nannothelypteris philippina.*

KEY TO THE SPECIES

1. One pair of veins regularly anastomosing, at least near bases of larger pinnae; short hairs present between veins on upper surface.
2. Sori exindusiate; pinnae less than 2 cm long . . . . . **1. N. aoristisora**
2. Sori indusiate; pinnae to 3 cm long . . . . . **2. N. camarinensis**
1. Veins all free, or with casual slight anastomosis; upper surface between veins glabrous, or nearly so.
3. Pinnae to 1.3 cm long, almost entire; costules mostly forked, the branches of adjacent ones sometimes anastomosing . . . . . **3. N. nervosa**
3. Pinnae (at least sterile ones) to 2 cm or more long, distinctly lobed at least on acroscopic side; veins all free.
4. Sterile pinnae to 2.5 × 1.0 cm, lobed equally both sides half-way to costa or more deeply, not conspicuously auricled; indusia setose . . . . . **4. N. philippina**
4. Sterile pinnae usually not over 2 cm long, 5–6 mm wide above the auricled base, lobed more deeply on acroscopic than on basiscopic side; indusia glandular . . . . . **5. N. inaequilobata**

1. Nannothelypteris aoristisora (HARR.) HOLTTUM, Blumea 19 (1971) 38; Kalikasan 2 (1973) 65. — *Polypodium aoristisorum* HARR. J. Linn. Soc. Bot. 16 (1897) 30. — *Phegopteris aoristisora* (HARR.) v.A.v.R. Handb. (1908) 501. — *Cyclosorus aoristisorus* (HARR.) COPEL. Gen. Fil. (1947) 142; Fern Fl. Philip. (1960) 355, *p.p.* — *Thelypteris aoristisora* (HARR.) REED, Phytologia 17 (1968) 260. — Type: STEERE, Panay (MICH; K).

Stipe 3–12 cm long (longest in fertile fronds), short-hairy; *lamina* to 20 cm long; pinnae to 25 pairs. *Sterile pinnae* to 1.7 × 0.6 cm; base slightly to distinctly auricled on acroscopic side, rounded on basiscopic; apex obtusely pointed to rounded; edges crenate to lobed, more deeply on acroscopic than on basiscopic side; costules 2.5 mm apart; veins 2–3 pairs, basal pair anastomosing except near apex of pinna; *lower surface* of rachis densely short-hairy, hairs more sparse on costules and veins; *upper surface* of rachis with thicker and more sparse hairs, surface of pinnae between veins bearing scattered very short erect hairs. *Fertile pinnae* 1.1 × 0.35 cm; sori at maturity filling lower surface, exindusiate.

Distr. *Malesia*: Philippines (Panay; Luzon: Mt Makiling).

2. Nannothelypteris camarinensis HOLTTUM, Kalikasan 5 (1976) 119. — Type: M. G. PRICE 3101, Luzon, Camarines Norte, Basud, Cone Mt (PNH; K). — **Fig. 17e–f.**

Sterile fronds of young plants: stipe 3–6 cm long; lamina 15 cm long with 10–16 pairs of pinnae; pinnae to 2.0 cm long, 0.4 cm wide above a rounded basiscopic auricle, edges subentire, apex rounded. *Larger fronds, partially fertile*: stipe 5–10 cm long; pinnae to 2.5 × 0.7 cm, basal auricles smaller; apex more narrowly obtuse; edges strongly crenate; costules 3 mm apart at 45° to costa; veins to 4 pairs, basal pair anastomosing; lower surface of rachis bearing copious pale hairs 0.3 mm long, shorter hairs on costae with scattered thick ones 0.5 mm long, minute hairs on surface between veins; upper surface of rachis with more sparse and thicker hairs, whole surface of pinna bearing abundant short erect hairs. *Fully fertile fronds*: stipe slender, to 22 cm long; pinnae to 1.5 × 0.5 cm; sori medial, slightly elongate on the veins, with short-hairy indusia and glandular sporangia.

Distr. *Malesia*: Philippines (Luzon), only known from the type.

Ecol. On forested rocky slope at 250–350 m.

3. Nannothelypteris nervosa (FÉE) HOLTTUM, Kalikasan 2 (1973) 66. — *Phegopteris nervosa* FÉE, Gen. Fil. (1852) 244; 6e Mém. (1853) 13, t. 2,

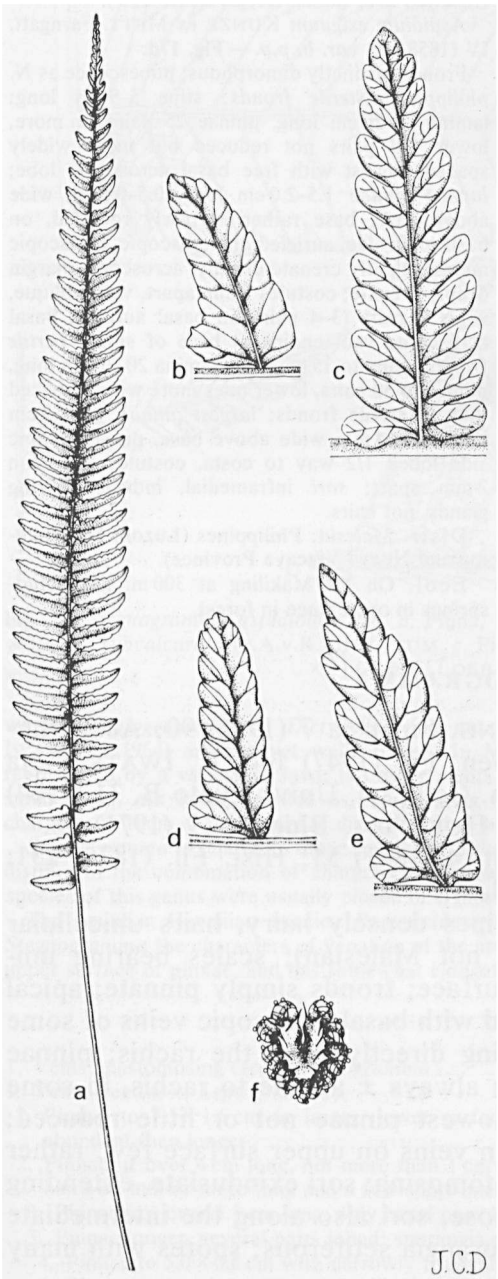

Fig. 17. *Nannothelypteris nervosa* (FÉE) HOLTTUM. *a.* Frond, ×⅔; *b.* pinna, ×3. — *N. philippina* (PR.) HOLTTUM. *c.* Pinna, ×2. — *N. inaequilobata* HOLTTUM. *d.* Sterile pinna, ×2. — *N. camarinensis* HOLTTUM. *e.* Pinna, ×2; *f.* sorus, ×24 (*a–b* PRICE & HERNAEZ 71, *c* isotype K, *d* holotype, *e–f* holotype).

f. 4. — *Aspidium exiguum* KUNZE *ex* METT. Farngatt. IV (1858) 76, *var. a.* — *Lastrea nervosa* (FÉE) COPEL. Philip. J. Sci. 81 (1952) 32; Fern Fl. Philip. (1960) 323, *nomen tantum.* — Type: CUMING *s.n.*, Philippines (FÉE's specimen not seen; specimens at B, BM, G, K agree with FÉE's figure and are perhaps isotypes).

Polystichum auriculatum var. nervosum CHRIST, Bull. Herb. Boiss. 6 (1898) 192; v.A.v.R. Handb. (1908) 165.

Cyclosorus aoristisorus sensu COPEL. Fern. Fl. Philip. (1960) 355, *p.p.* — **Fig. 17a–b.**

Fronds almost uniform, but *stipe* of sterile ones 7–10 cm long, fertile 15 cm. *Lamina* to 24 cm long; pinnae 30–40 pairs. *Largest pinnae* 1.3 cm long, 3–3.5 mm wide above the dilated base which is 4–4.5 mm wide (base more auricled on acroscopic side in fertile than in sterile pinnae); apex obtuse; edges entire or slightly crenate distally; costules 1.5 mm apart, simply forked or with one branch forked again, in basal acroscopic lobe pinnate with 2–3 pairs of veins; veins free or with casual anastomosis; *lower surface* of rachis densely short-hairy, hairs sparse on costae and costules; *upper surface* of rachis with more sparse and shorter hairs than lower, sparse minute hairs on costae. *Sori* near margins of pinnae, on acroscopic branch of each costule; indusia small, hairy.

Distr. *Malesia*: Philippines (Mindanao, Samar), at low altitudes.

Notes. The name *Lastrea exigua* J. SM., on which *Aspidium exiguum* KUNZE *ex* METT. was based, was published (without description) with citation of CUMING 251 and 272, types of *N. philippina* and *N. inaequilobata*; Mettenius cited *P. nervosa* FÉE under his *var. a.* If transferred to *Thelypteris*, *N. nervosa* will need another specific epithet, as *T. nervosa* (KLOTZSCH) TRYON represents another species.

4. Nannothelypteris philippina (PRESL) HOLTTUM, Kalikasan 2 (1973) 66. — *Physematium philippinum* PRESL, Epim. Bot. (1851) 192; HOLTTUM, Novit. Bot. Univ. Carol. Prag. 1968 (1969) 44, *excl. syn. Phegopteris nervosa* FÉE. — *Thelypteris philippina* (PRESL) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 283. — Type: CUMING 251, Luzon, S. Ilocos (PRC; G, K, P, US).

Dryopteris confusa COPEL. Philip. J. Sci. 8 (1911) Bot. 146. — *Lastrea confusa* COPEL. Fern Fl. Philip. (1960) 324. — *Thelypteris confusa* (COPEL.) REED, Phytologia 17 (1968) 268. — Type: CUMING 251 partim (M, destroyed); neotype (HOLTTUM 1973): RAMOS BS 8271 (MICH; US).

Aspidium exiguum KUNZE *ex* METT. Farngatt. IV (1858) 76, *var. b, p.p.* — *Dryopteris exigua sensu* v.A.v.R. Handb. (1908) 190. — **Fig. 17c.**

Fertile and sterile fronds almost alike. *Stipe c.* 20 cm long, pale, copiously short-hairy. *Lamina* to

30 cm long; pinnae to 20 pairs, lower ones more widely spaced and slightly reduced. *Largest pinnae* 2.5 × 1.0 cm, gradually narrowed from truncate base to abruptly obtuse or rounded apex, lobed equally on both sides 1/3–1/2 towards costa; lobes oblique, basal acroscopic one often slightly enlarged; costules 2.5–3 mm apart; veins 3–4 pairs, basal acroscopic one ending at base of sinus, basiscopic one passing to margin above base of sinus; *lower surface* of rachis bearing coarse pale hairs 0.3–0.5 mm long, hairs on costae very short with a few longer ones, sparse on costules; *upper surface* of rachis as lower, hairs on costae minute. *Sori* inframedial; indusia small, setiferous; sporangia bearing glands.

Distr. *Malesia*: Philippines (Luzon).

Note. In some herbaria specimens of CUMING 251 and 272 are mounted without distinction on the same sheet. The number 251 here refers to the specimens at Prague and elsewhere as indicated, but at BM the specimen of the present species bears the number 272.

5. Nannothelypteris inaequilobata HOLTTUM, Kalikasan 2 (1973) 67. — *N. nervosa sensu* HOLTTUM, Blumea 19 (1971) 38, *p.p.* — Type: CUMING 272, Luzon (K; B, E, G, L, P).

Aspidium exiguum KUNZE *ex* METT. Farngatt IV (1858) 76, *var. b, p.p.* — **Fig. 17d.**

Fronds distinctly dimorphous; pubescence as *N. philippina*. *Sterile fronds*: stipe 5–9 cm long; lamina to 20 cm long, pinnae 25 pairs or more, lower 3–4 pairs not reduced but more widely spaced, lowest with free basal acroscopic lobe; *largest pinnae* 1.5–2.0 cm long, 0.5–0.6 cm wide above base, base rather narrowly rounded, on basiscopic side, auricled on acroscopic, basiscopic margin slightly crenate distally, acroscopic margin deeply crenate; costules 2 mm apart, very oblique, veins 2 pairs (3–4 pairs on basal auricle), basal acroscopic vein ending at base of sinus. *Fertile fronds*: stipe to 15 cm long; lamina 20–30 cm long, pinnae to 30 pairs, lower ones more widely spaced than in sterile fronds; *largest pinnae* 1.0–1.3 cm long, to 0.4 mm wide above base, on acroscopic side lobed 1/2 way to costa, costules less than 2 mm apart; *sori* inframedial, indusia bearing glands, not hairs.

Distr. *Malesia*: Philippines (Luzon: Mt Makiling and Nueva Vizcaya Province).

Ecol. On Mt Makiling at 300 m, near mud-springs in open place in forest.

20. STEGNOGRAMMA

BLUME, En. Pl. Jav. (1828) 172; CHING, Sinensia 7 (1936) 90; Acta Phytotax. Sinica 8 (1963) 329; COPEL. Gen. Fil. (1947) 144; K. IWATS. Acta Phytotax. Geobot. 19 (1963) 112; Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 18–21; Amer. Fern J. 54 (1964) 141; HOLTTUM, Blumea 19 (1971) 38. — *Leptogramma* J. SM. in Hook. J. Bot. 4 (1841) 51; Hist. Fil. (1875) 231; CHING, Sinensia 7 (1936) 96. — **Fig. 18.**

Caudex short-creeping or erect; stipes densely hairy, hairs unicellular (pluricellular in *sect. Haplogramma*, not Malesian); scales bearing unicellular acicular hairs on edges and surface; fronds simply pinnate; apical lamina always deltoid and deeply lobed with basal basiscopic veins of some of the middle or lower lobes springing directly from the rachis; pinnae subentire to deeply lobed, upper ones always ± adnate to rachis, in some species only the lowest fully free; lowest pinnae not or little reduced; spherical glands lacking; hairs between veins on upper surface few, rather long, not appressed; veins free or anastomosing; sori exindusiate, extending along the veins (where veins anastomose, sori also along the intermediate excurrent veins between costules); sporangia setiferous; spores with many small wings.

Type species: *Stegnogramma aspidioides* BL.

Distr. Pantropic (excluding New Guinea and the Pacific) and subtropic, *c.* 18 *spp.*; in *Malesia* on mountains in Sumatra, Java, Borneo, Celebes, Luzon, Mindanao.

Cytol. Chromosome number 36 in *sect. Leptogramma* (diploid in Mexico, Ceylon and Japan; tetraploid in Madeira); in other sections unknown.

Taxon. IWATSUKI's arrangement of 1963 is here adopted. In it he recognized four sections, two of

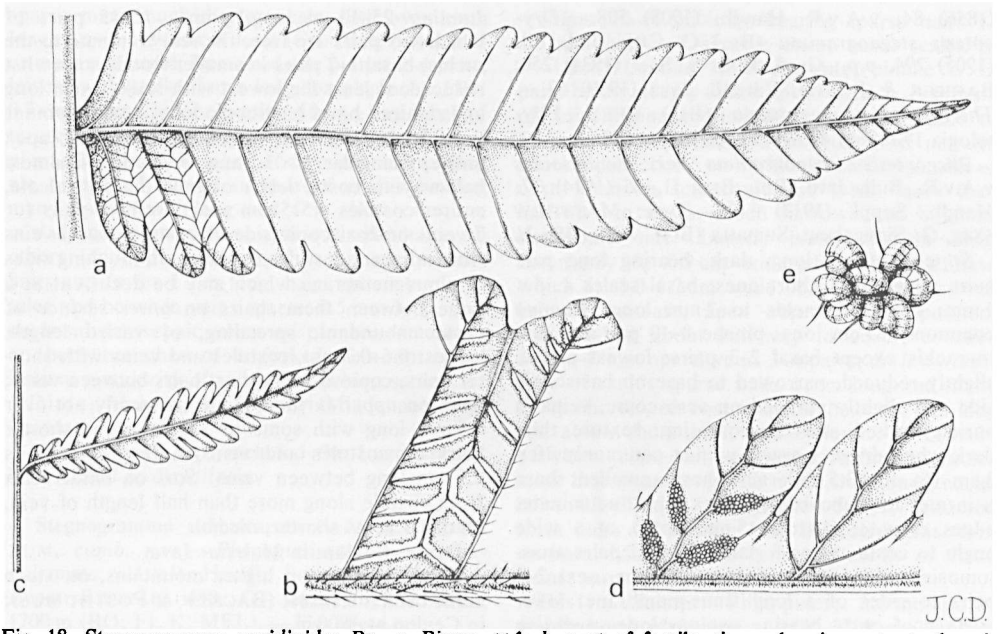

Fig. 18. *Stegnogramma aspidioides* BL. *a.* Pinna, ×1; *b.* part of fertile pinna showing extent of sori, ×3. — *S. subcalcarata* (v.A.v.R.) HOLTTUM. *c.* Pinna, ×1; *d.* venation and sori, ×6; *e.* part of sorus, ×24 (*a–b* T. LOBB *s.n.*, *c–e* isotype K).

which (*Haplogramma* and *Dictyocline*) do not occur in Malesia. The New World species (see IWATSUKI 1964) are not yet well studied. In Malesia, the widely-distributed species *S. pozoi* is represented by a variety in Java; the other plants of *sect. Leptogramma*, from four widely-separated small areas, are here regarded as representing separate species, but more material is needed to characterize them clearly; only *S. dissitifolia* has been well collected.

Stegnogramma is related to those species of *Sphaerostephanos* which have no spherical glands, but is distinct in the combination of characters mentioned in the generic description. In the 19th century, species of this genus were usually placed in *Gymnogramme*.

The peculiar Hawaiian species *Pneumatopteris sandwicensis* (BRACK.) HOLTTUM shares with *Stegnogramma* the characters of venation of the apical lamina and few thick hairs between veins on the upper surface of pinnae, and has somewhat elongate sori, but differs in sporangia and spores.

KEY TO THE SPECIES

1. Veins anastomosing (*sect. Stegnogramma*) . . . . . **1. S. aspidioides**
1. Veins free (*sect. Leptogramma*).
2. Pinnae to 7.5 × 1.6 cm or larger; lower surface of costae bearing many hairs, short ones more abundant than longer . . . . . **2. S. pozoi *var.* petiolata**
2. Pinnae, if over 4 cm long, not more than 1 cm wide; lower surface of costae bearing rather sparse hairs 0.5 mm or more long and a few short ones.
3. Pinnae not over 1.5 cm long, only basal ones lobed; sporangia sparsely setose **3. S. gymnocarpa**
3. Pinnae longer, several pairs lobed; sporangia all freely setose.
4. Pinnae to 5.0 × 0.8 cm with narrowly triangular apex 10 mm long . . . . . **4. S. subcalcarata**
4. Pinnae proportionately wider with short entire apex.
5. Fronds to 30 cm long; basal pinnae lobed more than half-way towards costa **.5. S. dissitifolia**
5. Fronds *c.* 16 cm long; basal pinnae less deeply lobed . . . . . **6. S. celebica**

1. Stegnogramma aspidioides BL. En. Pl. Jav. (1828) 173. — *Gymnogramme stegnogramma* BL. Fl. Jav. Fil. (1829) 98, t. 44. — *Gymnogramme aspidioides* HOOK. Gen. Fil. (1841) t. 120B *non* KAULF. 1824 *nec* DESV. 1827 *nec* BL. 1828; Ic. Pl. 10 (1854) t. 950; Spec. Fil. 5 (1864) 150, *excl. pl. Khasya & Ceylon*; RACIB. Fl. Btzg 1 (1898) 70. — *Phegopteris stegnogramma* METT. Fil. Hort. Lips.

(1856) 84; v.A.v.R. Handb. (1908) 508. — *Dryopteris stegnogramma* (BL.) C. CHR. Ind. Fil. (1905) 294, *p.p.*; Gard. Bull. S. S. 7 (1934) 250; BACKER & POSTH. Varenfl. Java (1939) 63. — *Thelypteris stegnogramma* (BL.) REED, Phytologia 17 (1968) 466. — Type: BLUME, Java.

Phegopteris stegnogramma var. meniscioides v.A.v.R. Bull. Jard. Bot. Btzg II, 16 (1914) 27; Handb. Suppl. (1917) 319. — Type: MATTHEW 584a, G. Singgalang, Sumatra (BO). — **Fig. 18a–b.**

Stipe to 40 cm long, dark, bearing long pale hairs mixed with short ones; basal scales *c.* 6 × 1 mm; hairs on rachis to 2 mm long. *Lamina* commonly 55 cm long; pinnae 8–10 pairs, adnate to rachis except basal 2–3 pairs; lowest pinnae slightly reduced, narrowed to base on basiscopic side and slightly auricled on acroscopic, veins in auricle forked and anastomosing; texture thin, dark when dried. *Largest pinnae* commonly 10 × 3 cm (to 13 × 3.5 cm); aerophores swollen; base truncate to subcordate; apex short-acuminate; edges crenate; costules 5 mm apart, at a wide angle to costa; veins 8 pairs, 3 basal pairs anastomosing with zig-zag excurrent veins, next 2–3 pairs to sides of a long sinus-membrane; *lower surface* of costa bearing copious long spreading hairs mixed with shorter ones, costules and veins with shorter spreading hairs; rather sparse short erect hairs on surface between veins; copious antrorse hairs on *upper surface* of costae, shorter spreading hairs on costules and veins, sparse erect hairs between veins. *Sori* spread all along lower veins and also on the excurrent intermediate veins arising from them, usually on basal part only of distal veins.

Distr. *Malesia*: West and Central Java; Sumatra (G. Kemiri, G. Singgalang, G. Kerinci); Sabah (Mt Kinabalu). Wrongly recorded from Khasya and Ceylon by HOOKER and BEDDOME.

2. Stegnogramma pozoi (LAGASCA) K. IWATS. Acta Phytotax. Geobot. 19 (1963) 124, *var.* **petiolata** (CHING) HOLTTUM, *comb. nov.* — *Leptogramma petiolata* CHING, Acta Phytotax. Sinica 8 (1963) 319. — Type: G. WALL ("WALLICH"), Ceylon (PE).

Gymnogramme aspidioides BL. En. Pl. Jav. (1828) 112, *non* KAULF. 1824 *nec* DESV. 1827. — *Gymnogramme totta sensu* BL. Fl. Jav. Fil. (1829) 90, t. 38. — *Grammitis blumeana* PRESL, Tent. Pterid. (1836) 209, *nom. nov.* — *Phegopteris totta sensu* METT. Farngatt. IV (1858) 18, *quoad pl. javan. tantum*; v.A.v.R. Handb. (1908) 497, *p.p.*; Handb. Suppl. (1917) 515, *excl. var. subcalcarata.* — *Leptogramma totta sensu* BEDD. Handb. (1883) 377, *quoad pl. zeyl. tantum.* — *Dryopteris africana* (DESV.) C. CHR. Ind. Fil. (1905) 251, *p.p.*; BACKER & POSTH. Varenfl. Java (1939) 36. — Type: BLUME, Waterfall Tjikundal, G. Gedeh, Java (L).

Stipe 15–30 cm long; basal scales *c.* 5 × 1 mm. *Lamina* 25–40 cm long; pinnae 12–15 pairs of which 4–5 pairs are free, the rest ± adnate to the rachis; basal 1–2 pairs in smaller fronds somewhat reduced, at least the lowest with stalks 1 mm long and reduced basal basiscopic lobe. *Largest pinnae* seen 7 × 1.6 cm; base subequally truncate; apex entire, triangular, 8 × 3.5 mm; edges lobed almost half-way to costa, lobes oblique, hardly falcate, entire; costules 4.5–5 mm apart; veins 6 pairs (or 7 veins on basiscopic side of costule), basal veins from adjacent costules usually both touching sides of sinus-membrane which may be decurrent as a ridge between them; hairs on *lower surface* of costae abundant, spreading, of varied length, longest 0.6–0.7 mm, costules and veins with shorter hairs, copious erect short hairs between veins; hairs on *upper surface* of costae mostly not over 0.5 mm long with some to 1 mm, sparse shorter hairs on costules and veins, a few thick hairs 0.5 mm long between veins. *Sori* on basal veins from costule along more than half length of vein, on distal veins shorter, medial.

Distr. Ceylon; in *Malesia*: Java.

Ecol. In Java on higher mountains, on steep earth banks in forest (BACKER & POSTHUMUS); in Ceylon at 1800 m.

Notes. The plants of Java and Ceylon here included are closely related to *S. pozoi*, the type of which was collected in northern Spain. Similar plants found in Madeira are tetraploid (MANTON). The latter differ from *var. petiolata* (diploid) in having all pinnae except the lowest adnate to the rachis, hairs on lower surfaces, confined to costae and costules, uniformly 1 mm long, and basal sori not extending to the bases of veins. Plants named *S. pozoi* occur throughout Africa; they are variable and no chromosome counts have been made. BLUME's type has pinnae to 4.0 × 1.3 cm, and all pinnae above the basal ones are adnate; BACKER & POSTHUMUS report plants with fronds to 50 × 25 cm but I have not seen any so large.

Prof. CHING (in lit.) informs me that the type of *Leptogramma petiolata* bears the collector's name WALL, which he interpreted as WALLICH, but it was surely G. WALL, who collected ferns in Ceylon, not WALLICH.

3. Stegnogramma gymnocarpa (COPEL.) K. IWATS. Acta Phytotax. Geobot. 19 (1963) 122. — *Dryopteris gymnocarpa* COPEL. in Elmer, Leafl. Philip. Bot. 3 (1910) 807. — *Phegopteris gymnocarpa* (COPEL.) v.A.v.R. Handb. Suppl. (1917) 313. — *Lastrea gymnocarpa* COPEL. Gen. Fil. (1947) 139; Fern Fl. Philip. (1960) 325, *quoad typ. tantum.* — *Leptogramma gymnocarpa* (COPEL.) CHING, Acta Phytotax. Sinica 8 (1963) 318. — *Thelypteris gymnocarpa* (COPEL.) MORTON, Amer. Fern J. 56 (1966) 179. — Type: ELMER 11508, Mt Apo, Falls of Cati Creek, 1750 m, Mindanao (MICH; BO, K, L *etc.*).

Stipe 2–3 cm long; hairs 1 mm long rather

sparse, many much shorter; scales little over 1 mm long. *Lamina* 9–15 cm long (COPEL.), distal half or more pinnatifid, free or adnate pinnae 3–4 pairs, lowest with stalks 1 mm long; basal pinnae 1.0 × 0.7 cm, distinctly lobed; other pinnae, and lobes of terminal lamina, entire. *Veins* in lobes of basal pinnae 2–3 pairs, in lobes of terminal lamina simple or forked; *lower surface* of rachis bearing many hairs 1 mm long and few short ones, on costae and costules more sparse similar hairs, no others; on *upper surface* of rachis many short hairs and fewer 1 mm long, hairs on costae, costules and between veins sparse, 0.5 mm long. *Sori* on basal acroscopic veins on pinnae, sometimes on both branches of a forked vein on apical lamina; a majority of sporangia lacking setae.

Distr. *Malesia*: Philippines (Mindanao), only known from type.

Note. COPELAND included the Luzon plants here named *S. dissitifolia*.

4. Stegnogramma subcalcarata (v.A.v.R.) HOLTTUM, *comb. nov.* — *Phegopteris totta var. subcalcarata* v.A.v.R. Handb. Suppl. (1917) 515. — Type: BECCARI 430, G. Singgalang, Sumatra, 1700 m (BO; FI, K, MEL). — **Fig. 18c–e.**

Stipe 10–12 cm long; hairs 1 mm long sparse, with shorter ones; scales small, narrow. *Lamina* to 18 cm long; free pinnae 4–5 pairs, above these 4–5 pairs gradually more broadly adnate to rachis; basal pinnae on some fronds reduced, in all cases narrowed towards base on both sides (more so on basiscopic), basal acroscopic lobe 2–3.5 mm long, almost free, stalks 1.5–2 mm long. *Largest pinnae* 3.5–5 cm long, 6.5–8 mm wide; base broadly cuneate; apex entire, triangular, 7–12 mm long, 2.5 mm wide at base; edges lobed half-way to costa, lobes subtriangular; costules 3 mm apart, at less than 60° to costa; veins 4–5 pairs, acroscopic basal vein passing to side of short sinus-membrane, basal basiscopic vein to edge above base of sinus; hairs on *lower surface* of costa sparse, 0.7 mm long with a few shorter ones, very few on costules and veins, none between veins; on *upper surface* hairs few apart from costa. *Sori* on basal acroscopic vein almost from its base, medial on other veins.

Distr. *Malesia*: Sumatra. Apart from type, known from one poor specimen from 2000 m on G. Kerinci (BÜNNEMEIJER 10480).

5. Stegnogramma dissitifolia HOLTTUM, *sp. nov.* — *Lastrea gymnocarpa sensu* COPEL. Fern Fl. Philip. (1960) 325, *p.p.*

Stipes usque 18 cm longus; lamina usque 30 cm longa; pinnae liberae usque 12-jugatae, inferiores 6-jugatae stipitatae, maximae 3.5 cm longae, basi dilatata usque 1.2 cm lata, supra basin 0.9 cm latae, dimidio costam lobatae; pinnae infimae valde dissitae. — Type: M. G. PRICE 1668, Baguio City, Luzon (K).

Stipes 10–18 cm long, bearing sparse hairs 1–1.5 mm long and shorter ones; basal scales to 5 × 1 mm. *Lamina* to 30 cm long; pinnae *c.* 12 pairs below deeply lobed apical lamina, *c.* 6 pairs of lower pinnae distinctly stalked, stalks to 1.5 mm; basal pinnae 2–3 cm from next pair (in another collection 5 cm), wider on basiscopic side of costa than on acroscopic and lobed more than half-way to costa, much narrowed to base on basiscopic side. *Largest pinnae* 3.5 cm long, commonly to 0.9 cm wide above dilated base which is 1.0–1.2 cm wide; base subtruncate to broadly cuneate; apex abruptly short-pointed; edges lobed about half-way to costa; costules 3–3.5(–4) mm apart; veins 3–4 pairs; on *lower surface* of rachis sparse hairs 1 mm long and many much shorter, on costae sparse hairs 0.5 mm long and a few short ones, sparse slender erect hairs between veins; hairs on *upper surface* of rachis more than 1 mm long with many short ones, costal hairs 0.3–0.5 mm, on costules fewer, scattered thick hairs 0.3–0.5 mm long between veins. *Sori* on basal half of basal veins, in middle of distal veins; sporangia all with several setae.

Distr. *Malesia*: Philippines; mountains of middle-north of Luzon at 1400–2700 m (7 collections).

Notes. Young plants of these Luzon collections differ from the small plants of comparable size from Mindanao which constitute the type of *S. gymnocarpa*; the former have more pairs of free pinnae, which are all lobed, and sporangia all have more than one seta.

Leptogramma amabilis TAGAWA, based on small plants from Okinawa (Ryukyu Is.) cannot be effectively compared until better known. Plants described as *S. pozoi* on Orchid Island (near the south of Taiwan) have pinnae 5 cm long.

6. Stegnogramma celebica (CHING) HOLTTUM, *comb. nov.* — *Leptogramma celebica* CHING, Sinensia 7 (1936) 99, t. 5. — *S. gymnocarpa* (COPEL.) K. IWATS. *ssp. celebica* K. IWATS. Acta Phytotax. Geobot. 19 (1963) 123. — *Thelypteris bunnemeijeri* REED, Phytologia 17 (1968) 265. — Type: BÜNNEMEIJER 12073, G. Bonthain, Celebes (NY; BO, L).

Stipe to 7 cm long; hairs hardly 0.5 mm long. *Lamina* to 16 cm long; free pinnae 5 pairs, 5 pairs adnate to rachis; lowest pinnae slightly reduced, smallest seen 1.3 cm long, with stalks 1 mm long, narrowed to base on basiscopic side. *Largest pinnae* 3 cm long, 7–8 mm wide; base broadly and rather unequally cuneate; edges lobed, almost to apex, less than half-way to costa, lobes small, subtriangular; costules 2.5 mm apart, at little more than 45°; veins 3 pairs, basal acroscopic veins passing to side of sinus-membrane, basiscopic vein to edge above base of sinus (in sterile fronds, veins sometimes uniting just below sinus); hairs on *lower surface* of costae rather sparse, on fertile

pinnae hardly 0.5 mm long, on sterile pinnae longer, few hairs on costules, none between veins on fertile pinnae (a few on sterile ones); a few hairs at least 0.5 mm long between veins on *upper surface*. *Sori* along basal half of basal veins, sometimes also on second veins.

Distr. *Malesia*: S.W. Celebes. Known from two collections from about 2000 m on G. Bonthain; the second is EVERETT *s.n.* Oct. 1895 (K, SING).

21. AMPHINEURON

HOLTTUM, Blumea 19 (1971) 45; Blumea 23 (1977) 205. — **Fig. 19.**

Caudex erect, or short- or long-creeping; scales narrow, setiferous; stipe minutely hairy, scaly at the base only except in *A. distinctum*; lamina often very large, pinnate, pinnae in most species deeply lobed; basal pinnae much narrowed at their bases; in a few species 1–2 (rarely 3) pairs of irregularly-placed and -shaped small pinnae sometimes present below the normal ones; aerophores at the bases of pinnae usually narrowly elliptic and (when dry) discoloured, not swollen; veins pinnate in the pinna-lobes, simple, basal veins either free and passing to the margin separately, or connivent at the sinus-membrane, or anastomosing to form an excurrent vein, these conditions sometimes not constant in a single frond; sinus-membrane usually ending in a prominent tooth; short acicular hairs always present on some part of the lower surface, also glandular hairs of varying size and shape, spherical to pyriform or club-shaped, the larger ones sometimes collapsing in drying to form resinous spots which may be faint and hardly detectable; sori in most species medial or supramedial; indusia usually present, bearing glands and/or hairs, apparently lacking in *A. distinctum*; glandular cells often present on the stalks of sporangia, directly attached to the stalk or at the end of a short hair, capitate hairs seen on the body of sporangia only in *A. subattenuatum*; spores usually dark, irregularly rugose or with irregular thick ± branched ridges.

Type species: *Amphineuron opulentum* (KAULF.) HOLTTUM.

Distr. S.E. Asia; *Malesia*; Queensland; in the Pacific to Tahiti; East Africa; in all *c.* 12 species.

Cytol. Base chromosome number 36; *A. opulentum* (Singapore) and *A. terminans* (Ceylon) both tetraploid; no experimental work reported.

Taxon. This genus resembles *Christella* in its spores and in its mainly elongate glandular hairs; the latter are more varied than in *Christella*. The name *Amphineuron* is intended to indicate the fact that in several species the anastomosis of veins is inconstant.

The two most widely-distributed species, *A. opulentum* and *A. terminans*, are both variable, and both have a complex taxonomic and nomenclatural history. Hybrids between them probably exist, at least in Thailand. As indicated in the key, the species may be divided into two groups. Rather large glands, of varied form, occur on most species of the second group and are undoubtedly distinctive, but they are often not well preserved on herbarium specimens and are sometimes not detectable, so that such specimens are difficult to name with certainty, and I have found it impossible to be sure how many species can be recognized. The present arrangement is tentative. Specimens dried without heat retain their glands perfectly, as I have discovered when dealing with plants in cultivation at Kew. It may be that alcohol, sometimes used to preserve specimens temporarily, also has an effect on glands in this genus.

KEY TO THE SPECIES

1. Indusia rather large, persistent; lamina thin, veins slender, slightly prominent on both sides.
2. Caudex long-creeping; pinnae lobed half-way to costa or less deeply; apex of frond ± pinna-like **1. A. terminans**

2. Caudex short-creeping or erect; pinnae lobed more than half-way to costa; apex of frond not pinna-like.
3. Pinnae lobed to 1 mm from costa or more deeply; basal veins free or uniting to form very short excurrent veins.
4. Basal veins not meeting; sori in slight depressions . . . . . **2. A. immersum**
4. Basal veins meeting just below the sinus, sometimes forming a short excurrent vein; sori not immersed . . . . . **3. A. subattenuatum**
3. Pinnae lobed less deeply; basal veins anastomosing to form an excurrent vein on most parts of a frond . . . . . **4. A. opulentum**
1. Indusia small, almost hidden by sporangia at maturity of sorus, or apparently lacking; lamina firm, veins not prominent on either surface.
5. Hairs more than 0.5 mm long present on both sides of costa; stipe and abaxial surface of rachis bearing scales throughout . . . . . **5. A. distinctum**
5. All hairs on costa very short; scales confined to base of stipe.
6. Lower surface between veins (sometimes in part) bearing very short erect acicular hairs; short capitate hairs also in this position on the upper surface . . . . . **6. A. attenuatum**
6. Both surfaces lacking hairs between veins.
7. Pinnae lobed to *c.* 2 mm from costa, basal veins often anastomosing.
8. Many glandular hairs on lower surface between veins, some spherical, some ± elongate; similar hairs also on indusia . . . . . **7. A. ceramicum**
8. Glandular hairs less abundant, always spherical, tending to collapse and form resinous patches or to disappear on drying . . . . . **8. A. pseudostenobasis**
7. Pinnae lobed more deeply; basal veins not anastomosing.
9. Pinnae thin, to 3 cm wide; glands on lower surface of pinnae and on indusia elongate **9. A. paraphysophorum**
9. Pinnae firm, to 1.5 cm wide; glands on lower surface glabular to pyriform, on indusia spherical, resinous . . . . . **10. A. kiauense**

1. Amphineuron terminans (HOOK.) HOLTTUM, Amer. Fern J. 63 (1973) 82; Blumea 23 (1977) 207. — *Nephrodium terminans* HOOK. Spec. Fil. 4 (1862) 73, *excl. syn. N. conioneuron* FÉE & *Lastrea malaccensis* PRESL. — *Thelypteris terminans* (HOOK.) TAGAWA & K. IWATS. Acta Phytotax. Geobot. 26 (1975) 169. — Type: WALLICH 386, Burma, Kamoun (= Kumon) (K).

Nephrodium oreopteris FÉE, Gen. Fil. (1852) 306, *non* (EHRH.) DESV. 1827. — Type: CUMING 48, Luzon (holo?; isotypes G, K, LE, W).

Thelypteris wagneri FOSB. & SACHET, Smiths. Contr. Bot. 8 (1972) 6, *excl. syn. Polypodium pteroides* RETZ. — Type: RACIBORSKI, Java (US).

Nephrodium pteroides sensu BEDD. Handb. (1883) 269; RACIB. Fl. Btzg 1 (1898) 183. — *Dryopteris pteroides sensu* v.A.v.R. Handb. (1908) 209.

Dryopteris interrupta sensu BACKER & POSTH. Varenfl. Java (1939) 56. — *Cyclosorus interruptus sensu* HOLTTUM, Rev. Fl. Malaya 2 (1955) 262, f. 149; COPEL. Fern Fl. Philip. (1960) 361. — **Fig. 19a.**

Caudex long-creeping, *c.* 5 mm diameter (dry); *stipe* commonly to 50 cm long, ± flushed dull reddish, glabrescent abaxially, basal scales *c.* 8 mm long. *Lamina* to 50 cm long; pinnae to 25 pairs, basal pair somewhat reduced, rarely very small, always distinctly narrowed at their bases; apex of frond usually pinna-like but variable. *Largest pinnae* commonly 17–20 × 1.7–2.0 cm, if longer not more than 2 cm wide; base of middle pinnae broadly cuneate to truncate; apex acuminate; edges lobed 1/3 towards costa or less deeply, lobes as wide as long (or wider) with broad asymmetric apex and forward-pointing tip; costules 4–5 mm apart, usually at less than 60° to costa; veins 6–9 pairs, basal pairs spreading at a broad angle to their costules and uniting to form a rather long excurrent vein to the sinus, next veins very oblique, 1 or 2 ending beside the sinus-membrane; *lower surface* of rachis, costae, costules and veins bearing short acicular hairs, longer hairs usually lacking, subsessile almost spherical rather pale glandular hairs abundant on distal veins, usually few and smaller on lower veins, very short acicular hairs often present between veins; *upper surface* of costae bearing antrorse pale acicular hairs, similar hairs scattered on costules and veins. *Sori* close to margins of lobes, not on lower veins; indusia large, thin, often with some short acicular hairs and a few small glandular hairs which are not marginal.

Distr. Ceylon & S. India; Burma to Hainan and Macao; throughout *Malesia*; Queensland (to 18° S); one specimen from Central Africa and one from Fernando Poo.

Ecol. In Malesia only abundant in areas with a distinct dry season, in rather open but not too dry places, spreading by long rhizomes.

Notes. The complex nomenclatural and taxonomic history of this species is set forth and discussed in HOLTTUM 1977. It is probable that in Thailand this species has become hybridized with *A. opulentum* but I have not seen intermediates

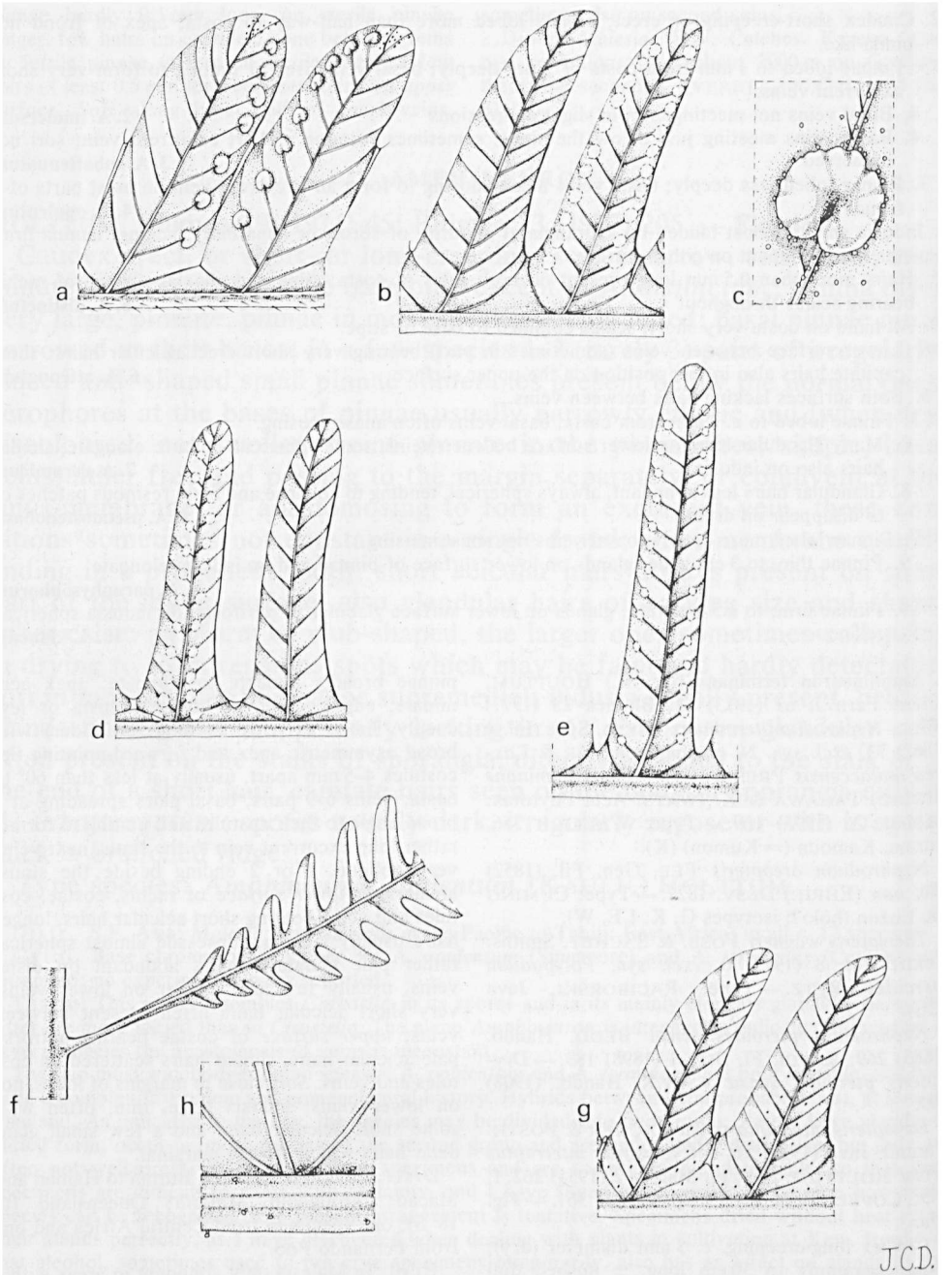

Fig. 19. *Amphineuron terminans* (HOOK.) HOLTTUM. *a.* Venation and sori, ×4. — *A. opulentum* (KAULF.) HOLTTUM. *b.* Two pinna-lobes, showing differences in course of basal veins, ×3; *c.* sorus, ×18. — *A. subattenuatum* (ROSENST.) HOLTTUM. *d.* Venation and sori, ×3. — *A. immersum* (BL.) HOLTTUM. *e.* Venation and sori, ×3. — *A. pseudostenobasis* (COPEL.) HOLTTUM. *f.* Base of basal pinna, ×1; *g.* two pinna-lobes, ×4; *h.* upper surface of costa with capitate hairs, ×16 (*a* FORMAN 145, *b–c* SEEMANN *s.n.*, *d* WOMERSLEY & HOLTTUM 17692, *e* MOUSSET 39, *f–h* HOOGLAND & CRAVEN 10122).

from Malesia. FOSBERG and SACHET used the pinna-like apex of fronds as the main distinguishing character, ignoring the evidence of venation, hairs and glands which appear to me more significant. This is the only species of *Amphineuron* in which anastomosis of veins is invariable.

2. Amphineuron immersum (BL.) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 203; Blumea 23 (1977) 211. — *Aspidium immersum* BL. En. Pl. Jav. (1828) 156; RACIB. Fl. Btzg 1 (1898) 169. — *Lastrea immersa* (BL.) MOORE, Ind. Fil. (1857) lxxxix; BEDD. Ferns Br. India (1867) t. 252; Handb. (1883) 234; COPEL. Fern Fl. Philip. (1960) 327. — *Dryopteris immersa* (BL.) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 188; BACKER & POSTH. Varenfl. Java (1939) 39. — *Thelypteris immersa* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 306; HOLTTUM, Rev. Fl. Malaya 2 (1955) 243. — *Parathelypteris immersa* (BL.) CHING, Acta Phytotax. Sinica 9 (1963) 303. — Type: BLUME, Java (L, *n.* 908, 335–404).

Lastrea caudiculata PRESL, Epim. Bot. (1851) 36; HOLTTUM, Novit. Bot. Univ. Carol. Prag. 1968 (1969) 35. — Type: CUMING *s.n.* Philippines (PRC).

Lastrea verrucosa PRESL, Epim. Bot. (1851) 36; COPEL. Fern Fl. Philip. (1960) 327. — *Thelypteris verrucosa* (PRESL) CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 308. — Type: CUMING 72, Luzon (PRC).

?*Dryopteris diversifolia* v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 18 (1908) 7; Handb. (1908) 189. — Type: RAAP 27, Sumatra, Batu Isl. (BO).

Dryopteris besukiensis v.A.v.R. Bull. Jard. Bot. Btzg II, 1 (1911) 7; Handb. Suppl. (1917) 156. — Lectotype (HOLTTUM 1977): KOORDERS 15436, Java, Besoeki (BO; L).

Thelypteris subimmersa CHING, Bull. Fan Mem. Inst. Biol. Bot. 6 (1936) 306. — *Parathelypteris subimmersa* CHING, Acta Phytotax. Sinica 8 (1963) 303. — Type: S. K. LAU 1395, Hainan (PE, not seen). — **Fig. 19e.**

Caudex short, erect; *stipe* to 70 cm or more long, green when living; basal scales thin, to 15 mm long. *Lamina* to at least 120 cm long (often fertile at a much smaller size); pinnae close, texture thin, drying pale-olivaceous; 1–2 pairs of irregularly spaced small pinnae sometimes present at base of frond. *Largest pinnae* of type 25 × 3 cm, largest seen 45 × 5 cm, lobed to 1 mm from costa or more deeply; lobes, except distally, almost at right angles to costa, separated by wide sinuses; costules 3.5–6 mm apart; veins 14–20 pairs, basal acroscopic vein ending beside the short sinus-membrane, basiscopic one passing to margin above base of sinus; *lower surface* of costae and costules of type lacking acicular hairs except near apex of pinna, of other specimens bearing a variable number of hairs up to 1 mm long, costules and veins usually bearing small pale yellow glands (abundant on the type), between veins sometimes short erect acicular and capitate hairs; *upper surface* with antrorse hairs on costae and scattered hairs on costules and veins. *Sori* supramedial, in depressions in the lamina (forming convexities on the upper surface); indusia thin with a variable fringe of short yellow capitate hairs.

Distr. Assam; Hainan; southern Thailand; throughout *Malesia*; Queensland (to 16° S); New Hebrides, New Caledonia.

Ecol. At low altitudes, in sheltered places but not in deep shade, common on limestone in Malaya, found also on stream banks.

Notes. All the living plants observed by me have an erect caudex, but BACKER & POSTHUMUS state "wortelstok kruipend". ERYL SMITH 2432, from Timor, is a small plant with definitely creeping caudex; it might be a hybrid with *A. opulentum*. The types of *Dryopteris diversifolia* v.A.v.R. and *D. besukiensis* v.A.v.R. are small plants, perhaps stunted owing to exposure. There is much variation in the development of acicular hairs and of small yellowish glandular hairs on the lower surface of pinnae. The types of both *Lastrea caudiculata* PRESL and *L. verrucosa* PRESL have acicular hairs, that of *Thelypteris subimmersa* CHING has none, but the published description gives no other character which would distinguish it from the type of *Aspidium immersum* BL. I know of no other record of this species in China.

3. Amphineuron subattenuatum (ROSENST.) HOLTTUM, Blumea 23 (1977) 412. — *Dryopteris subattenuata* ROSENST. in Fedde, Rep. 10 (1912) 332. — *Thelypteris subattenuata* (ROSENST.) REED, Phytologia 17 (1968) 317. — Type: BAMLER 37, N.E. New Guinea, Logaueng, 300 m (S-PA?; BM). — **Fig. 19d.**

Caudex short, erect; *stipe* to at least 50 cm long, pale, basal scales *c.* 10 × 1.5 mm. *Lamina* 150 cm or more long; pinnae well-spaced, the lowest with very narrow bases bearing auricles 5 mm long on both sides; 1–3 pairs of much-reduced pinnae, similar auricled, present below normal ones. *Largest pinnae* 35 cm long, 2.5–3.5 cm wide, lobed to 1–1.5 mm from costa, lobes separated by wide sinuses and almost at right angles to the costa, not falcate, tips broadly rounded; costules to 6 mm apart; veins to 20 pairs, basal veins spreading at a wide angle, their tips usually touching the sides of a short sinus-membrane or sometimes uniting to form a very short excurrent vein; *lower surface* bearing a variable number of very small colourless spherical glands, sometimes also very short acicular hairs; *upper surface* of costae bearing pale acicular hairs 0.6 mm long, few hairs on costules, between veins a variable number of short acicular and capitate hairs. *Sori* a little supramedial, not impressed; indusia bearing very small glandular

hairs; sporangia sometimes with a small capitate hair; spores pale, with highly prominent thick ridges.

Distr. *Malesia*: Eastern New Guinea (6 collections).

Ecol. In somewhat exposed places near streams in forest.

4. Amphineuron opulentum (KAULF.) HOLTTUM, Blumea 19 (1971) 45; Blumea 23 (1977) 212. — *Aspidium opulentum* KAULF. Enum. Fil. Chamisso (1824) 238. — *Thelypteris opulenta* (KAULF.) FOSBERG, Smiths. Contr. Bot. 8 (1972) 3, *excl. syn. Aspidium terminans* WALL. — Type: CHAMISSO, Guam (LE).

Nephrodium impressum DESV. Mém. Soc. Linn. Paris 6 (1827) 259. — *Dryopteris impressa* (DESV.) POSTH. Verh. K. Akad. Wet. Amst. 36, 5 (1937) 14; BACKER & POSTH. Varenfl. Java (1939) 57. — *Thelypteris impressa* (DESV.) REED, Phytologia 17 (1968) 284. — Type: collector not cited, Timor (P).

Aspidium extensum BL. En. Pl. Jav. (1828) 156. — *Nephrodium extensum* (BL.) MOORE, Ind. Fil. (1858) 91; BEDD. Handb. (1883) 269. — *Dryopteris extensa* (BL.) O. KTZE. Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 210. — *Cyclosorus extensus* (BL.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 182; HOLTTUM, Rev. Fl. Malaya 2 (1955) 264, f. 150; COPEL. Fern Fl. Philip. (1960) 368. — *Thelypteris extensa* (BL.) MORTON, Amer. Fern J. 49 (1959) 113. — Type: no collector cited, Pulu Pinang (L).

Lastrea malaccensis PRESL, Epim. Bot. (1851) 35. — Type: CUMING 391, Malacca (PRC; K).

Nephrodium conioneuron FÉE, Gen. Fil. (1852) 308. — *Aspidium conioneuron* (FÉE) METT. Farngatt. IV (1858) 102. — Type: GARDNER, Ceylon (Isotype W).

Aspidium nephrodioides HOOK. Spec. Fil. 4 (1862) 162, t. 235, *non* KLOTZSCH 1847. — *Aspidium hookeri* BAK. Syn. Fil. (1867) 257, *nom. nov. non* KLOTZSCH 1847 — *Dryopteris orbicularis* C. CHR. Ind. Fil. (1905) 281, *nom. nov.* — *Thelypteris orbicularis* (C. CHR.) REED, Phytologia 17 (1968) 299. — Type: SEEMANN, Indian Archipelago (K). — **Fig. 19b–c.**

Caudex short-creeping; *stipe* to 70 cm long, rufescent, basal scales 10 mm long, hardly 1 mm wide. *Lamina* to 80 cm long; pinnae to 25 pairs or more; a pair of much-reduced basal pinnae sometimes present; apex of frond narrowly acuminate, deeply lobed in its basal part and grading into the upper pinnae. *Largest pinnae* commonly to 25 × 2.5 cm, largest seen 40 × 3.5 cm, lobed 3/5–3/4 towards costa; lobes slightly oblique, slightly falcate; costules commonly 4 mm apart, on large sterile fronds to 6 mm; veins 8–10(–15) pairs, basal pair both touching sinus-membrane or meeting below it at a varying angle to produce an excurrent vein; *lower surface* of rachis, costae and costules bearing very short acicular hairs with scattered longer ones (to 0.5 mm) on costules, veins, sinus-membranes and margin, small pale yellowish glands variously distributed along costules and veins, surface between veins usually bearing some short erect acicular hairs and small colourless to yellowish capitate hairs; *upper surface* of costae covered with pale acicular hairs, similar hairs scattered on costules and veins. *Sori* confined to lobes of pinnae, supramedial, in slight depressions; indusia thin, shrivelled when old, bearing marginal yellow glandular hairs and sometimes a few acicular hairs which are not marginal; an elongate gland sometimes present on stalks of sporangia.

Distr. East Africa; Seychelles; S. India and Ceylon; Burma, Thailand; *Malesia*; N. Queensland; islands of the Pacific to Tahiti; naturalized at various places in tropical America.

Ecol. Few records; apparently adapted to semi-exposed situations among rocks, especially in areas with a dry season; in S.E. New Guinea (dry season area) found in secondary swamp-forest.

Notes. A fuller synonymy, and commentary on it, is given in HOLTTUM 1977. METTENIUS published the first good description (as *Aspidium conioneuron*) with a note on the diversity of venation. The species seems not to be common in most parts of Malesia (doubtfully native in Java, few specimens from Borneo and the Philippines). Plants have long been cultivated in Singapore (origin unrecorded) and occur spontaneously on the edges of drains and elsewhere near the Botanic Garden; these plants are tetraploid. The center of distribution of the species is uncertain; possibly southern India.

5. Amphineuron distinctum (COPEL.) HOLTTUM, Blumea 23 (1977) 215. — *Dryopteris distincta* COPEL. Univ. Cal. Publ. Bot. 18 (1942) 220. — *Cyclosorus distinctus* (COPEL.) COPEL. Gen. Fil. (1947) 142; Philip. J. Sci. 78 (1951) 444, pl. 26. — *Thelypteris distincta* (COPEL.) REED, Phytologia 17 (1968) 273. — Type: BAMLER W.11, N.E. New Guinea, Wareo, 150 m (UC).

Dryopteris longissima var. novoguineensis ROSENST. Hedwigia 56 (1915) 351. — Type: BAMLER 132, same locality (B).

Caudex unknown; *stipe* incomplete, dark at base, distally reddish, minutely hairy, bearing thin narrow scales throughout, basal ones 12 mm long; abaxial surface of rachis also bearing similar scales or their small wart-like bases. Size of *lamina* not known; basal pinnae narrowed in their basal 4 cm, base 4 mm wide. *Largest pinnae* 25 × 3 cm, rather short-acuminate, lobed to 1.5–2 mm from costa, lobes slightly oblique and slightly falcate; costules 4–4.5 mm apart; veins to 18 pairs, basal pair anastomosing to produce an excurrent vein to the sinus or passing to sides of sinus-

membrane; *lower surface* of rachis sparsely short-hairy, of costae bearing copious erect hairs more than 0.5 mm long, fewer such hairs on costules and veins, between veins copious slender erect acicular hairs and small ± yellowish capitate hairs; *upper surface* of costae bearing thick acicular hairs and small capitate ones, shorter hairs of both kinds present between veins. *Sori* inframedial, exindusiate; hairs on stalks of sporangia consisting of 3 cells, distal ones club-shaped, orange; spores dark with irregular thick ridges.

Distr. *Malesia*: Papua New Guinea; only known from the type.

6. Amphineuron attenuatum (O. KTZE) HOLTTUM, Blumea 23 (1977) 215. — *Aspidium attenuatum* KUNZE *ex* METT. Farngatt. IV (1858) 96, *non* SW. 1801. — *Nephrodium attenuatum* BAK. Syn. Fil. (1867) 263, *non* T. MOORE 1858. — *Dryopteris attenuata* O. KTZE, Rev. Gen. Pl. 2 (1891) 812, *nom. nov.*; v.A.v.R. Handb. (1908) 184. — *Dryopteris stenobasis* C. CHR. Ind. Fil. (1905) 294, *nom. nov. superfl.* — *Thelypteris stenobasis* (C. CHR.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 254. — *Mesoneuron attenuatum* (O. KTZE) CHING, Acta Phytotax. Sinica 8 (1963) 326. — *Thelypteris attenuata* (O. KTZE) MORTON, Contr. U.S. Nat. Herb. 38 (1967) 35. — Type: CUMING 327, Samar (B; BRI, E, G, K, L, LE, SING, US).

Dryopteris superficialis v.A.v.R. Bull. Jard. Bot. Btzg II, 20 (1915) 12; Handb. Suppl. (1917) 155. — Type: SA-ANAM 125, Obi I. (BO; L).

Dryopteris erubescens sensu CHRIST, Philip. J. Sci. 2 (1907) Bot. 210. — *Lastrea erubescens sensu* COPEL. Fern Fl. Philip. (1960) 329.

Cyclosorus alatellus sensu COPEL. Fern Fl Philip. (1960) 341, *excl. syn.*

Caudex short, erect or suberect; *stipe* to at least 60 cm long, glabrous, rufescent, basal scales thin, to c. 10 × 1 mm. *Lamina* to 80 cm or more long; lower pinnae much narrowed towards their bases, the narrowed part several cm long, distinctly lobed throughout; no reduced pinnae seen. *Largest pinnae* 30 × 2 cm, lobed to 1.5 mm from costa; apex gradually attenuate to a cauda 3–5 cm long; lobes slightly oblique and slightly falcate; costules 4–4.5 mm apart; veins to 18 pairs, basal pair with upcurved tips passing to sides of sinus-membrane or rarely joining just below the membrane; *lower surface* of costae and costules bearing scattered minute capitate hairs, between veins slender short acicular hairs variably present on different parts of the same frond, also short capitate hairs and almost spherical red resinous glands; *upper surface* of costa bearing very short capitate hairs, also acicular hairs distally, some capitate hairs present between veins. *Sori* somewhat inframedial, lower ones divergent; indusia small with copious marginal spherical red resinous glands; spores dark, rugose.

Distr. *Malesia*: Philippines (Luzon, Samar, Mindanao), Moluccas (Obi Island), N. Celebes?

Ecol. "Edge of forest, petrophytic and terrestrial" on limestone and limestone-derived soils (M. G. PRICE, on Samar), but probably not confined to limestone.

Note. The hairs on the lower surface of pinnae are inconstant. I am not sure of a clear distinction between this species and *A. ceramicum*. A specimen collected by H. H. BARTLETT (*n.* 7693) from Asahan, Sumatra has hairs on the lower surface as in the type of *A. attenuatum*, but glands are not well preserved. ENDERT 4165 from E. Kalimantan is similar.

7. Amphineuron ceramicum (v.A.v.R.) HOLTTUM, Blumea 23 (1977) 217. — *Phegopteris ceramica* v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 18 (1908) 15; Handb. (1908) 506. — Type: TREUB *s.n.* Ceram (BO).

Polypodium erubescens sensu HOOK. Spec. Fil. 4 (1862) 236, *quoad pl. Molucc. tantum.* — *Polypodium erubescens var. amboinense* BAK. Syn. Fil. (1867) 306. — Type: collector not cited, Amboina, *ex* Herb. Webb (K; FI, P).

Dryopteris logavensis ROSENST. in Fedde Rep. 10 (1912) 232. — Lectotype (HOLTTUM 1977): BAMLER L34 (S-PA; BM).

Phegopteris mamberamensis v.A.v.R. Bull. Jard. Bot. Btzg II, 24 (1917) 3; Handb. Suppl. (1917) 516. — Type: THOMSON 645, W. New Guinea, Mamberamo River (BO; L).

Dryopteris moluccana C. CHR. Dansk Bot. Ark. 9 (1937) 64. — Type: FORBES 3273, Amboina (BM; B).

Differing uncertainly from *A. attenuatum* as follows: basal pinnae gradually contracted at their bases to a narrow wing along the costa; no short acicular hairs on lower surface of pinnae between veins, no capitate hairs in that position on the upper surface; glands between veins on the lower surface varying from spherical to pyriform; glands on indusia spherical, resinous.

Distr. *Malesia*: Moluccas (Amboina, Halmahera, Ceram), New Guinea.

Note. The type of *Phegopteris ceramica* v.A.v.R. does not show glands on the lower surface; it has pinnae to 22 × 1.6 cm. HOOKER's Amboina specimen which he wrongly included in *Polypodium erubescens* is larger, with pinnae to 30 × 3 cm, the glands on the lower surface well preserved, those near sinuses distinctly elongate. A specimen of DE VRIESE from Ceram at Kew is similar but sterile.

8. Amphineuron pseudostenobasis (COPEL.) HOLTTUM, *comb. nov.* — *Dryopteris pseudostenobasis* COPEL. J. Arn. Arb. 10 (1929) 176. — *Thelypteris pseudostenobasis* (COPEL.) REED, Phytologia 17 (1968) 306. — Type: BRASS 1000, S.E. New Guinea, Vailala River (A; BRI, UC).

Cyclosorus alatellus sensu COPEL. Philip. J Sci. 78 (1951) 445, *p.p.* — **Fig. 19f–h.**

Differing from *A. attenuatum* as follows: no acicular hairs on lower surface between veins, no capitate hairs in this position on upper surface; glands between veins on lower surface fewer, apparently spherical, tending to collapse and form irregular thin patches of resinous substance or to disappear on drying of specimens; indusia very small, none seen bearing glands (which are possibly present on living fronds).

Distr. Solomon Islands and *Malesia*: S.E. New Guinea.

Ecol. In riverine forest "in large masses" (BRASS).

Notes. The type has pinnae to 26 × 1.8 cm, veins 11 pairs; pinnae on BRAITHWAITE's specimens from the Solomon Islands are up to 40 × 4 cm (*n.* 4505) with veins to 25 pairs. Two of BRAITHWAITE's specimens (4505 from Kolombangara and 4014 from Guadalcanal) certainly have a creeping caudex; his *n.* 4188 from San Cristobal has the note "rhizome short, erect", but otherwise is little different from the others. Spreading resinous glands are only observable on *n.* 4505.

9. Amphineuron paraphysophorum (v.A.v.R.) HOLTTUM, Blumea 23 (1977) 217, *excl. syn. Dryopteris kiauensis* C. CHR. — *Dryopteris paraphysophora* v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 143. — Type: C. J. BROOKS 250S, Sumatra, Lebong Tandai (BO; BM).

Caudex short, erect or suberect; *stipe* to 80 cm long, basal part (up to 20 cm in large fronds) copiously scaly, scales thin, narrow, 7–8 mm long. *Lamina* to 100 cm long (but plants of smaller size may be fertile), texture rather thin; pinnae to 28 pairs; lower pinnae not reduced but 8–10 pairs gradually narrowed towards their bases, lobes on basal 2 cm of lowest pinnae 1–2 mm long, then gradually increasing to a maximum at 7 cm from base. *Largest pinnae* 25–35 cm long, 2.0–3.5 cm wide (widest on sterile fronds), apex acuminate but not long-caudate; edges lobed to 1 mm from costa or more deeply; costules 3–4 mm apart; lobes hardly falcate, at more than 60° to costa; veins to 20 pairs, basal acroscopic vein spreading at a wide angle and abruptly upcurved near its tip which touches the sinus-membrane or ends just above it, basal basiscopic vein more often ending above base of sinus; *lower surface* of rachis and costae bearing very short capitate hairs only, on costules, veins and between veins many pyriform to almost cylindrical yellow glands; *upper surface* of rachis bearing capitate hairs only, basal parts of costae the same, acicular hairs up to 0.3 mm long present on distal parts, very short ones also on costules. *Sori* medial, lower ones divergent; indusia small, lacerate, with elongate yellow glands on the margin; sporangia sometimes with similar glands on their stalks; spores with few large thick protuberances of varied shape.

Distr. *Malesia*: S. Sumatra and Borneo (Sarawak).

Ecol. In Sarawak, in open places in forest at 90 m alt.

Notes. Part of the above description is based on a plant from Gunong Mulu in Sarawak cultivated at Kew. This shows the abundance of glands of a distinctive shape on the lower surface of pinnae and on indusia. The glands on a dried specimen from the same locality are so shrivelled as to be hardly distinguishable.

10. Amphineuron kiauense (C. CHR.) HOLTTUM, *comb. nov.* — *Dryopteris kiauensis* C. CHR. Dansk Bot. Ark. 9, 3 (1937) 64. — Type: ENDERT 4632 (wrongly cited as 4433), E. Kalimantan, Kutai, Kiau, 700 m (BO; L, SING).

Description of type: stipe to 100 cm long; lamina to 100 cm long, texture firm; pinnae (fertile) to 18 × 1.5 cm, lobed to 1–1.5 mm from costa; basal 2 cm of basal pinnae consisting of a narrow wing above which is a gradual transition to full width of the pinna; veins 8–10 pairs, basal pair touching sides of sinus-membrane without anastomosis; short capitate hairs present on lower surface of costae, no glands detectable between veins; sori inframedial; indusia small, lacerate.

Specimens from Sabah (KAKAWA & HOTTA 1291, distributed as *Thelypteris erubescens*) are very similar but have many spherical to pyriform glands on the lower surface, especially near the sinuses, and spherical resinous reddish glands on indusia. It seems probable that these represent the same species as the type of *A. kiauense*; there is a similar specimen (CLEMENS 29765) from Mt Kinabalu, 1200 m.

Distr. *Malesia*: Borneo.

22. CHRISTELLA

LÉVEILLÉ, Fl. de Kouy-tchéou (1915) 472, *emend.* HOLTTUM, Taxon 20 (1971) 533, Blumea 19 (1971) 43, Kew Bull. 31 (1976) 293. — *Nephrodium* SCHOTT, Gen. Fil. (1834) t. 10 *et sp. N. molle tantum, non* RICHARD 1801. — *Thelypteris subg. Cyclosoriopsis* K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1964) 28, *p.p.* — *Cyclosorus sensu auctt. plur. p.p.* — **Fig. 1i, p, 20.**

Caudex erect, suberect or creeping, in some species slender and wide-creeping; scales almost always narrow with many superficial hairs. Lamina in almost all species with 1–5 (rarely to 10) pairs of lower pinnae gradually decrescent, the lowest usually not less than 2 cm long and in almost all cases auricled on the acroscopic base, aerophores at the bases of pinnae not swollen; largest pinnae shallowly to deeply lobed, bearing erect acicular hairs (in some species minute) on all parts of the lower surface, also in almost all species between veins on the upper surface (these hairs never appressed), small capitate hairs sometimes also present; thick orange-red glandular hairs (not erect) present in some species on costules and veins on lower surface, sessile spherical glands lacking; veins free in a few species, in most species at least the basal veins from adjacent costules anastomosing, in some cases several pairs; sori indusiate (except in *C. nana* and *C. buwaldae*); sporangia lacking hairs or glands distally (except in some specimens of *C. subpubescens*) but bearing unicellular elongate glandular hairs on their stalks (except in *spp.* 1–4); spores dark, variously tuberculate or ridged, lacking thin wings.

Type species: *Christella parasitica* (L.) LÉV.

Distr. About 50 *spp.*; throughout the warmer parts of the Old World; one species (*C. hispidula*) also in the neotropics; in addition *c.* 15–20 *spp.* in Africa and the neotropics the status of which still needs to be established.

Ecol. In Malesia, almost all are ferns of open places; species confined to forest occur in the region from N.E. India and Burma to S. China.

Cytol. Base chromosome number 36. *C. dentata*, *C. parasitica* and *C. subpubescens* are tetraploid, *C. hispidula* diploid. Experimental hybridization of these species was undertaken at Leeds (see HOLTTUM 1976, p. 295); *C. dentata* and *C. parasitica* were shown to be allotetraploids with *C. hispidula* as one parent of each. *C. arida* has been shown to be diploid in northern India but has not been experimentally hybridized with tetraploids. It is evident that natural hybrids between some of the commoner species have also developed, but it is difficult to assign a parentage to them.

Taxon. LÉVEILLÉ characterized his genus as follows: pinnae lobed, with simple veins pinnately arranged in the lobes, sori with reniform indusia, seated on the veins in a row on each side of the costules. No type species was indicated. The characters apply to most species of *Thelypteridaceae*, and LÉVEILLÉ's list included representatives of four genera as arranged in the present treatment, also two which do not belong to the family. Three of his species were transferred to other genera by CHING; several others do not strictly conform to LÉVEILLÉ's own generic definition. Three of his species are closely allied and belong to a group recognized by me in my preliminary studies of the family, for which I was seeking an appropriate generic name; I therefore chose a species from this group as type. In 1964 IWATSUKI had cited an allied species, *C. dentata*, as type of *Thelypteris subg. Cyclosoriopsis*, but his definition of the subgenus would include many species which seem to me not nearly allied.

In the earlier literature the species of this genus were not clearly distinguished, so that there is much confusion in the use of names. I have not attempted to assign meanings to all names cited; *e.g. Aspidium patens*, *A. nymphale* and *A. parasiticum* in BLUME's 'Enumeratio' of 1828 are not clearly distinguished and I have not found the particular specimens to which he gave those names, which were copied from earlier works by others, who had described them very briefly.

The single most distinctive character is the presence of an elongate unicellular gland on the stalks of sporangia (shown in SCHOTT's figure of 1834 but mentioned by no-one else); similar glands are also present on the lower surface of pinnae in some species. This character is associated with others less precisely definable, among them the rather thick protuberances or ridges of the perispore, a character shared by *Amphineuron*. But the elongate gland on the sporangium-stalk is lacking in a group of four species in New Guinea, for which I propose a new section as follows:

Leptochristella HOLTTUM, *sect. nov.* — *Plantae parvae, calcicolae; pinnae 2–4.5 cm longae, tenues, subtus omnino piliferae; venae liberae vel inferiores anastomosantes; sori indusiati vel exindusiati; pedicelli sporangiorum glandulis destituti, interdum pilis acicularibus praediti.*

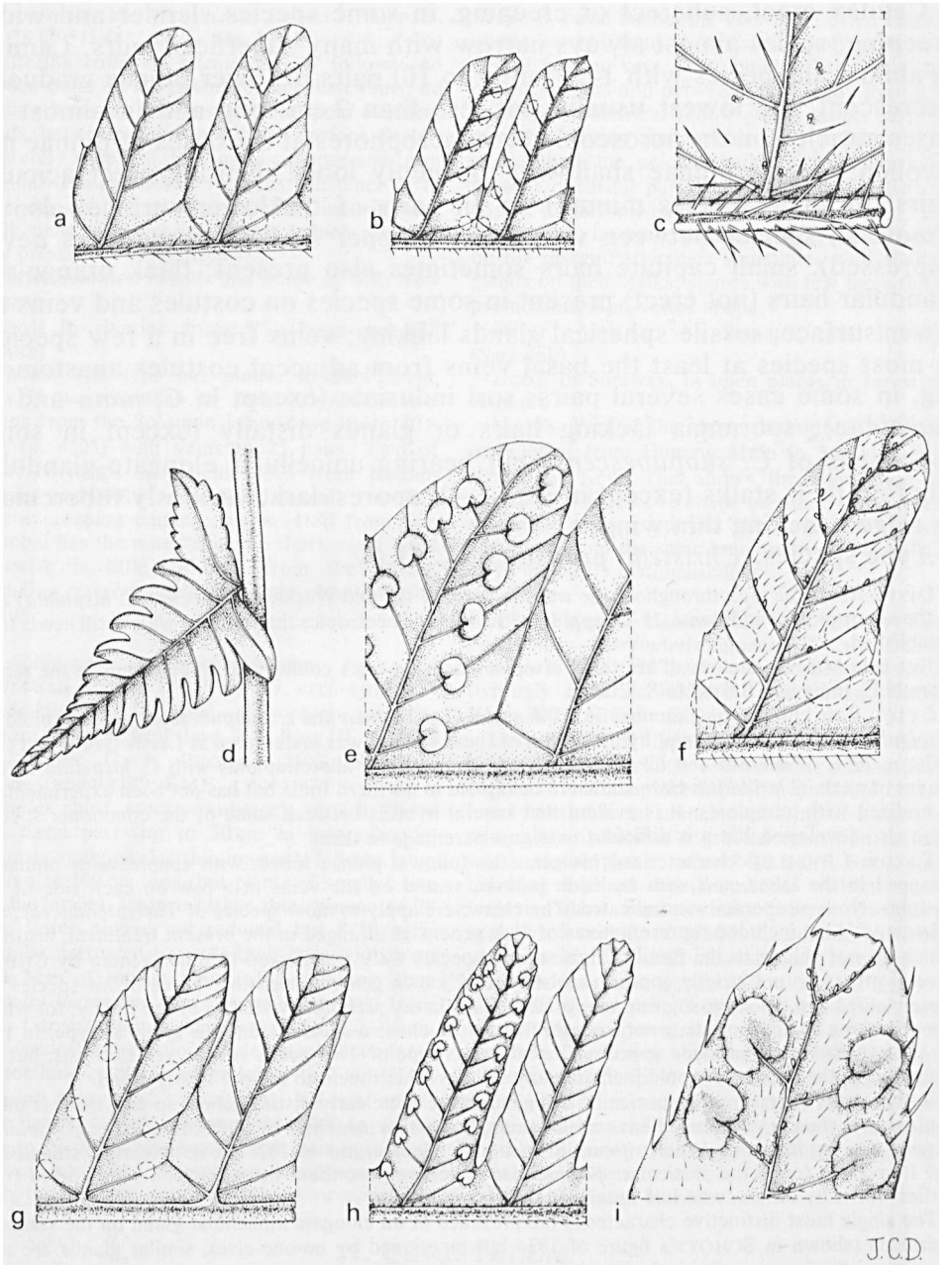

Fig. 20. *Christella dentata* (FORSSK.) BROWNSEY & JERMY. *a.* Two pinna-lobes, ×4. — *C. hispidula* (DECNE) HOLTTUM. *b.* Two pinna-lobes, ×4; *c.* upper surface of costa and base of costule, showing acicular and capitate hairs, ×18. — *C. papilio* (HOPE) HOLTTUM. *d.* A reduced basal pinna, ×1; *e.* venation and sori, showing minute hairs on costa, ×6. — *C. parasitica* (L.) LÉV. *f.* Pinna-lobe, showing hairs and glands, ×6. — *C. subpubescens* (BL.) HOLTTUM. *g.* Venation and sori, ×4. — *C. harveyi* (METT.) HOLTTUM. *h.* Two pinna-lobes, ×4; *i.* tip of a pinna-lobe showing sori, glands and hairs, ×16 (*a* PIGGOTT 1479, *b–c* YAPP 201, *d–e* MOLESWORTH ALLEN 4949, *f* HOLTTUM *s.n.*, *g* WALLICH 354, *h–i* BRYCE 5).

Type species: *Christella perpubescens* (ALSTON) HOLTTUM.

The plants of this group of species, small in stature and consequently simplified in structure, are difficult to characterize and need more study. They have the frond-form of *Christella* with lower pinnae gradually and slightly reduced (shown most notably by *C. perpubescens*), abundant slender acicular hairs (fewest in *C. nana*) and spores of the *Christella* type. I see no other genus to which they could be considered allied.

In Africa also are species with free veins and lacking (so far as I have observed) glandular hairs on the stalks of sporangia. For them I proposed the sectional name *Pelazoneuron* (J. S. Afr. Bot. 40, 1974, 144) but they appear to be related to a group of tropical American species in which glandular hairs of the *Christella* type do occur on the stalks of sporangia of at least two species (A. R. Smith, Univ. Cal. Publ. Bot. 29: 15, 66, 79) and apart from their free veins I see no clear distinction between these American species and *C. hispidula*. A few species in the Western Pacific (including *C. harveyi* in the present work) also have free veins; I suggest that they are derived from Malesian species with anastomosing veins.

KEY TO THE SPECIES

1. Limestone plants; pinnae not over 4.5 cm long; no elongate glands on stalks of sporangia (*sect. Leptochristella*).
 2. Indusia distinctly present.
  3. Pinnae to 27 pairs, 5–7 lower ones gradually reduced . . . . . **1. C. perpubescens**
  3. Pinnae *c.* 6 pairs, lowest only slightly reduced . . . . . **2. C. minima**
 2. Indusia lacking or not clearly distinguishable.
  4. Pinnae lobed almost to costae; veins all free . . . . . **3. C. nana**
  4. Pinnae lobed less deeply; veins near bases of pinnae anastomosing . . . . . **4. C. buwaldae**
1. Plants not confined to limestone; pinnae commonly 10 cm or more long; elongate glands present on stalks of sporangia (*sect. Christella*).
 5. Veins all free.
  6. Red ellipsoid glands present on lower surface of pinnae . . . . . **5. C. harveyi**
  6. Such glands lacking . . . . . **6. C. peekelii**
 5. At least the basal veins anastomosing.
  7. At least 3 pairs of lower pinnae gradually reduced.
   8. Sinus-membrane prominent on lower surface, 3 pairs of veins ending beside it; reduced pinnae hardly auricled . . . . . **7. C. arida**
   8. Sinus-membrane not prominent, at most 1½ pairs of veins ending beside it; reduced pinnae clearly auricled.
    9. Caudex strictly erect.
     10. Reduced pinnae *c.* 8 pairs; hairs on lower surface of costae *c.* 0.1 mm long . **8. C. papilio**
     10. Reduced pinnae 3–4 pairs; some hairs on lower surface of costae 0.3 mm or more long.
      11. Pinnae lobed less than half-way to costa; hairs on lower surface of costae all less than 0.5 mm long . . . . . **9. C. adenopelta**
      11. Pinnae lobed more than half-way to costa; hairs on lower surface of costae mostly more than 0.5 mm long . . . . . **10. C. hispidula**
    9. Caudex short-creeping, or at most suberect distally.
     12. Pinnae lobed at least half-way to costa; only 1 pair of veins truly anastomosing; some hairs 0.3 mm long present on lower surface of costae . . . . . **11. C. dentata**
     12. Pinnae lobed 1/4–1/3 towards costa; at least 1½ pairs of veins truly anastomosing; all hairs on lower surface of costae *c.* 0.1 mm long . . . . . **12. C. subpubescens**
  7. At most 3 pairs of lower pinnae gradually reduced.
   13. Hairs on lower surface of costae all very short.
    14. Pinnae lobed *c.* 1/4; minute capitate hairs present in addition to acicular hairs on lower surface of pinnae . . . . . **12. C. subpubescens**
    14. Pinnae lobed *c.* 2/5; no capitate hairs on lower surface . . . . . **13. C. subdentata**
   13. Hairs on lower surface of costae always conspicuous, to 1 mm long.
    15. Caudex long-creeping.
     16. Pinnae lobed more than 1/2; apices of pinna-lobes not apiculate.
      17. Basal 1–1½ pairs of veins anastomosing, 1 pair passing to sinus-membrane **14. C. timorensis**
      17. Basal 1 pair of veins anastomosing, at most the next acroscopic vein meeting the sinus-membrane . . . . . **15. C. parasitica**
     16. Pinnae lobed less than 1/2; apices of pinna-lobes apiculate . . . . . **16. C. acuminata**
    15. Caudex short-creeping or erect.

18. Pinnae lobed much more than 1/3; some hairs more than 0.5 mm long present on lower surface.
19. Caudex erect; 2 or more pairs of lower pinnae reduced . . . . . **10. C. hispidula**
19. Caudex not erect; basal pinnae not reduced . . . . . **15. C. parasitica**
18. Pinnae lobed little more than 1/2; hairs on lower surface all less than 0.5 mm long **11. C. dentata**

1. Christella perpubescens (ALSTON) HOLTTUM, Kew Bull. 31 (1976) 304. — *Dryopteris perpubescens* ALSTON, J. Bot. 78 (1940) 227; Nova Guinea n.s. 4 (1940) 111, pl. 8, f. 9, 10. — *Thelypteris perpubescens* (ALSTON) REED, Phytologia 17 (1968) 303. — Type: CLEMENS 7902C, N.E. New Guinea, Morobe Distr., Kalasa (B; BM).

Caudex short-creeping; *stipe* 3–5 cm long, densely short-hairy throughout, basal scales 5 mm long, narrow, soft, covered with minute hairs. *Lamina* 22 cm long; texture thin; pinnae to 27 pairs, *c.* 7 pairs of lower ones gradually decrescent, basal pinnae 3–5 mm long; apex of frond also gradually attenuate. *Largest pinnae* of type 2.8 × 0.9 cm (sterile), 2.2 × 0.8 cm (fertile), sessile, short-acuminate, lobed to 0.5 mm from costa, basal pair of lobes sometimes separately adnate to the costa, the acroscopic lobe not elongate but sometimes with a sinuous margin; costules 2.5–3 mm apart; veins to 4 pairs, free, basal acroscopic one sometimes touching side of sinus-membrane, basiscopic one to margin above base of sinus; *lower surface* of rachis and costae densely covered with short hairs, scattered hairs more than 0.5 mm long also present, costules, veins and surface between veins bearing many short erect acicular hairs, also pale capitate hairs; *upper surface* throughout bearing slender erect acicular hairs, also some capitate hairs. *Sori* medial or a little supramedial; indusia firm, hairy; no hairs seen on sporangium-stalks; spores dark, closely and irregularly tuberculate.

Distr. Solomon Islands; *Malesia*: New Guinea.

Ecol. On limestone cliffs near sea-level (Waigeo Island and Solomons); in eastern New Guinea reported to occur in rock crevices (type and BRASS 23774) at 240–500 m.

Note. BRASS 23774, from Milne Bay District, lacks capitate hairs, and also BRAITHWAITE 4841 from the Solomon Islands; the latter also differs in longer stipes and less reduced basal pinnae. L. E. CHEESMAN 1227 from Waigeo Island has pinnae to 4.5 cm long, and a few capitate hairs.

2. Christella minima HOLTTUM, Kew Bull. 31 (1976) 304. — Type: JERMY 7875, New Ireland, on limestone (BM).

Caudex short, apparently erect; *stipe* to 4.5 cm long, slender, short-hairy, basal scales *c.* 3 mm long. *Lamina* to 9 cm long, texture very thin; pinnae 6 pairs; basal pinnae a little reduced, with enlarged basal acroscopic lobes; apex of frond gradually attenuate. *Largest pinnae* 1.8 × 0.9 cm, lobed a little more than halfway to costa; apex obtuse, lobes rounded, entire; costules 3 mm apart; veins free, to 4 pairs in the largest lobes, basal acroscopic vein ending at base of sinus, basiscopic one above base of sinus; *lower surface* covered throughout with slender short hairs, some longer ones present on rachis and costae; *upper surface* covered with short slender hairs, some longer ones also present on costules and veins. *Sori* supramedial, on basal acroscopic veins, a few on the second vein; indusia bearing many slender hairs; spores very dark with irregular blister-like protuberances.

Distr. *Malesia*: New Guinea (New Ireland), only known from the type.

Note. This may be an immature state of *C. perpubescens*.

3. Christella nana HOLTTUM, Kew Bull. 31 (1976) 304. — Type: MCKEE 1938, W. New Guinea, Biak Island (L).

Caudex short-creeping; *stipe* 4–5 cm long, glabrous, basal scales 1.5 mm long, narrow. *Lamina* dimorphous, *c.* 7 cm long, thin; pinnae 6 pairs, wider on basiscopic than on acroscopic side of costa, basal pair a little reduced. *Sterile pinnae* to 3.0 × 1.0 cm, with stalks 1 mm long, lobed almost to the costa near base; lobes oblique, entire, with rounded tips, basal acroscopic lobe a little enlarged; apex of pinnae obtuse; costules to 3 mm apart; veins to 4 pairs, free, both basal ones passing to margin above base of sinus; *lower surface* of rachis covered with stiff erect hairs of varying length, costae and costules bearing very short somewhat antrorse hairs, rest of surface glabrous; *upper surface* glabrous apart from the costae. *Fertile pinnae to* 2.0 × 0.6 cm; sinuses between lobes wider than in sterile pinnae; veins in largest lobes 3 pairs, costules in upper pinnae once forked; *sori* confined to the pinna-lobes, on upper pinnae 1 or 2 in each lobe; no indusia; spores as in *S. minima*.

Distr. *Malesia*: New Guinea (Biak I.), only known from type.

Ecol. Beneath overhanging coral rock just above beach.

4. Christella buwaldae (HOLTTUM) HOLTTUM, *comb. nov.* — *Pronephrium buwaldae* HOLTTUM, Blumea 20 (1972) 115. — Type: BUWALDA 4979, Aru Islands, P. Kobroör (L; K).

Caudex short-creeping; *stipe* to 8 cm long, slender, covered with short pale erect hairs, basal scales to 5 mm long, narrow, with superficial short hairs. *Lamina* of type 16 cm long consisting of an apical section 13 cm long, widening downwards and deeply lobed, the lobes veined as pinnae, with

2–3 pairs of free pinnae; texture very thin, translucent; basal pinnae somewhat reduced. *Largest pinnae* 2.8 × 1.0 cm, sessile or with very short stalks; base symmetrically broadly cuneate; apex abruptly obtuse; edges lobed 1/3 towards costa, lobes subtriangular; costules 3 mm apart; veins 3–4 pairs, basal pair anastomosing except near apex of pinna; *lower surface* of rachis, costae and costules covered with erect hairs of varying length, longest almost 1 mm long, surface between veins bearing very slender erect hairs; *upper surface* similarly hairy. *Sori* small, on pinnae inframedial, on lobes of apical lamina supramedial; no indusia but acicular hairs present on the receptacle (or a very small hairy indusium?); sporangia lacking glands or setae; spores light brown.

Distr. *Malesia*: Moluccas (Buru & Aru Is.).

Ecol. On P. Kobroör "in forest" (the island is mainly limestone); on Buru "limestone, 1200 m" (TOXOPEUS *s.n.* 4 Sept. 1921, BO).

Note. The Buru specimen is larger than the type, with an apical lamina 8 cm long and *c.* 6 pairs of free pinnae, largest pinnae 3.2 × 1.3 cm, lobed more deeply than those of the type; in other respects it agrees. An acicular hair was observed on the stalk of a sporangium of the Buru specimen, and the pubescence of the frond is very like that of *C. perpubescens*, not like that of any species of *Pronephrium*, from which genus the species is here transferred. But the spores of the type need a careful re-examination; sporangia of the Kew isotype are immature.

5. Christella harveyi (METT.) HOLTTUM, Kew Bull. 31 (1976) 306; Allertonia 1 (1977) 219, f. 8 A-D. — *Aspidium harveyi* METT. in Kuhn, Linnaea 36 (1869) 115. — *Dryopteris harveyi* (METT.) O. KTZE, Rev. Gen. Pl. 2 (1891) 812; C. CHR. Bishop Mus. Bull. 177 (1943) 83. — *Thelypteris harveyi* (METT.) PROCTOR *ex* K. IWATS. Amer. Fern J. 53 (1963) 133. — Type: HARVEY, Fiji (B; K).

Dryopteris euaensis COPEL. Univ. Cal. Publ. Bot. 12 (1931) 391. — Type: PARKS, Tonga (UC; BM, K).

Thelypteris novae-hiberniae HOLTTUM, Dansk Bot. Ark. 25, 2 (1967) 50. — Type: KÖIE 1848, New Ireland (C).

Nephrodium patens sensu HOOK. Spec. Fil. 4 (1862) 95, *p.p.* — *Dryopteris patens sensu* v.A.v.R. Handb. (1908) 189, *p.p.* — **Fig. 20h–i.**

Caudex long-creeping, 5–7 mm diameter when dry; *stipe* 20-30 cm long, hairy in groove, basal scales to 8 × 1.5 mm. *Lamina* 50–70 cm long, texture thin; pinnae 20–25 pairs; lower pinnae variously reduced, lowest sometimes only 3 cm long; reduced pinnae more widely spaced, sometimes with basal acroscopic lobe enlarged and lobulate. *Largest pinnae* commonly 15–20 × 1.5–2.2 cm, rarely to 3 cm wide; base not auricled; apex caudate-acuminate; edges lobed to 1–1.5 mm from costa; lobes oblique, slightly falcate, entire, with rounded apices; costules 4–4.5 mm apart; veins 10–12 pairs, basal acroscopic one passing to side of the short sinus-membrane, basiscopic one to margin above base of sinus; *lower surface* of rachis, costae and costules bearing copious short hairs and a variable number of longer ones, some thick orange glandular hairs present on costules and veins, between veins a variable number of slender short erect acicular hairs and glandular hairs; *upper surface* of costae densely hairy, scattered long hairs present on costules and veins, between veins a variable number of short suberect hairs and sometimes glandular hairs. *Sori* near margin; indusia firm, glabrous or with a few hairs; an orange glandular hair on the stalks of some sporangia.

Distr. Solomon Islands, New Hebrides, Fiji, Samoa, Wallis Island, Tonga, in *Malesia*: New Guinea (Admiralty Islands, Bismarck Archipelago).

Ecol. In open places in forest at 0–1000 m.

6. Christella peekelii (v.A.v.R.) HOLTTUM, Kew Bull. 31 (1976) 306. — *Dryopteris peekelii* v.A.v.R. Bull. Dép. Agr. Ind. Néerl. 18 (1908) 7; Handb. (1908) 188. — Type: PEEKEL 44, "New Guinea" (BO).

Caudex probably long-creeping; *stipe* probably to 20 cm long, copiously short-hairy, basal scales not seen. *Lamine* 30–40 cm long; pinnae 18–22 pairs; basal pinnae slightly reduced, their basal pair of lobes almost free, the acroscopic one enlarged and deeply dentate. *Largest pinnae* 10 × 1.6 cm (sterile), 9 × 1.3 cm (fertile), acuminate, lobed to less than 1 mm from costa, lobes entire and slightly falcate; costules of sterile pinnae 4 mm apart, of fertile pinnae 3 mm; veins 8–10 pairs, arranged as in *C. harveyi*; *lower surface* bearing very short hairs throughout, no glandular hairs present; *upper surface* bearing scattered long hairs on costules and veins and short suberect hairs between veins. *Sori* near margins of lobes; indusia short-hairy; orange glands present on stalks of sporangia.

Distr. *Malesia*: Papua New Guinea (New Britain).

Note. PEEKEL collected in the Bismarck Archipelago; the type was probably found in New Ireland. It is closely related to *C. prolixa* (WILLD.) HOLTTUM (*Aspidium obliquatum* METT.) of New Caledonia, which also lacks glandular hairs on the lower surface of pinnae.

7. Christella arida (D. DON) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 206; Kew Bull. 31 (1976) 320; Allertonia 1 (1977) 172, 225, f. 9A. — *Aspidium aridum* D. DON, Prodr. Fl. Nepal (1825) 4. — *Nephrodium aridum* (D. DON) J. SM. in Hook. J. Bot. 4 (1841) 188; BEDD. Handb. (1883) 272. — *Dryopteris arida* (D. DON) O.

KTZE, Rev. Gen. Pl. 2 (1891) 812; v.A.v.R. Handb. (1908) 212; BACKER & POSTH. Varenfl. Java (1939) 50. — *Cyclosorus aridus* (D. DON) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 194; HOLTTUM, Rev. Fl. Malaya 2 (1955) 259, f. 146; COPEL. Fern Fl. Philip. (1960) 362. — *Thelypteris arida* (D. DON) MORTON, Amer. Fern J. 49 (1959) 113. — Type: WALLICH, Nepal (not found at BM; possibly at BR, see MORTON 1974, *infra*).

Aspidium obscurum BL. En. Pl. Jav. (1828) 150. — *Nephrodium obscurum* (BL.) T. MOORE, Ind, Fil. (1858) 98; RACIB. Fl. Btzg 1 (1898) 125. — Type: BLUME, Java (L).

Polypodium acuminatum ROXB. Calc. J. Nat. Hist. 4 (1844) 490, *non* HOUTT. 1786; MORTON, Contr. U.S. Nat. Herb. 38 (1974) 335. — Type: ROXBURGH, "Ind. Or." (BR; G).

Dryopteris arida var. ebeneorachis COPEL. in Elmer, Leafl. Philip. Bot. 2 (1908) 390. — Type: ELMER 1044, Negros (MICH; BO, G). — **Fig. 1i.**

Caudex long-creeping, 4–5 mm diameter; *stipe* 15–30 cm long, glabrous except in groove, basal scales 5 mm long, narrow. *Lamina* to 150 cm long; pinnae to 30 pairs or more; lower 3–5 pairs gradually or subabruptly decrescent and more widely spaced, not or little auricled, lowest commonly 5–10 mm long; apex of frond almost pinna-like; texture very firm. *Largest pinnae* to 16 × 1.8 cm (width above the somewhat dilated base), acuminate, lobed *c.* 1/4 towards costa, lobes with a short stiff point; costules 3–4 mm apart; veins to 10 pairs, prominent beneath, 1½ pairs, at a broad angle to costule, anastomosing, next 3 pairs very oblique and passing to the sinus-membrane which is prominent on the lower surface; *lower surface* of costae bearing rather sparse stiff erect hairs 0.2 mm long and a few very narrow scales, costules and veins with scattered short acicular hairs and thick yellow glandular hairs, short erect hairs sometimes present between veins; *upper surface* of costae covered with short antrorse hairs, costules, veins and surface between veins almost or quite glabrous. *Sori* medial, lower ones divergent; indusia glabrous or with some glandular and short acicular hairs.

Distr. N.W. India to southern China, Thailand and Vietnam; throughout *Malesia*: N. Queensland, New Hebrides, New Caledonia, Fiji, Samoa.

Ecol. In open places in low country, often among tall grasses, less commonly at higher altitudes (once in Malaya at 1800 m). Plants growing in tall grass have a greater number of reduced basal pinnae than those in more exposed places.

Note. Reports on the distribution of this species are often erroneous because it has been confused with *Sphaerostephanos invisus* and *S. unitus* which have a similar habit (see Holttum in Allertonia, 1977). LOYAL found a plant in North India to be diploid; some specimens are possibly hybrids with *C. subpubescens*.

8. Christella papilio (HOPE) HOLTTUM in Nayar & Kaur, Comp. to Bedd. (1974) 208; Kew Bull. 31 (1976) 321. — *Nephrodium papilio* HOPE, J. Bombay Nat. Hist. Soc. 12 (1899) 625, t. 12. — *Cyclosorus papilio* (HOPE) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 214; MOLESWORTH ALLEN, Gard. Bull. Sing. 22 (1967) 180, 185. — *Thelypteris papilio* (HOPE) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 175. — Lectotype (HOLTTUM 1976): LEVIGNE *s.n.* 1880, N.E. India, below Darjeeling 1200 m (K).

Nephrodium molle var. major BEDD. Handb. Suppl. (1892) 76, *p.p.* — **Fig. 20d–e.**

Caudex massive, erect; *stipe* 10–30 cm long, minutely hairy, basal scales thin, *c.* 7 × 1 mm. *Lamina* to 150 cm or more long; *c.* 10 pairs of lower pinnae gradually decrescent, broadly triangular, strongly auricled on acroscopic base, broadly truncate on basiscopic, margins above base shallowly lobed, apex acuminate; lowest pinnae 1–3 cm long. *Largest pinnae* to 17 × 2 cm; base subtruncate; apex acuminate with short cauda; edges lobed 1/4–1/3 towards costa (most deeply in fertile pinnae), lobes slightly falcate and rounded at their tips; costules 4–4.5 mm apart; veins 7–9 pairs, 1½ pairs anastomosing, 1–2 pairs ending beside the sinus-membrane; *lower surface* of all parts bearing very short erect hairs (less than 0.1 mm long on rachis and bases of costae, a little longer on distal parts of pinnae), some thick orange glandular hairs sometimes present on veins in pinna-lobes; *upper surface* of costae covered with hairs 0.3–0.5 mm long, scattered shorter hairs on costules, minute erect hairs on surface between veins. *Sori* medial; indusia rather large, thin, with short hairs as lamina.

Distr. Southern India & Ceylon; N.E. India, Thailand; *Malesia*: to northern Malaya.

Ecol. In Malaya, in forest on sloping ground at 600–900 m.

Notes. The Indian specimens lack orange glandular hairs on the lower surface, but such glands are present on all specimens from Thailand and Malaya. MANTON found a Ceylon plant to be tetraploid, LOYAL found plants in N. India to be diploid.

9. Christella adenopelta HOLTTUM, Kew Bull. 31 (1976) 322. — Type: W. A. SLEDGE 1698, Samoa (K).

Near *C. papilio*, with the same erect caudex and similar pubescence, but only 3–4 pairs of lower pinnae gradually decrescent, the lowest 3.5 cm long; largest pinna 12 × 1.8 cm; hairs between veins on the lower surface a little longer than in *C. papilio* and many short capitate hairs also present with them, some scattered hairs up to 0.5 mm long present distally on costae and costules; indusia large, bearing glandular hairs like those on the lower surface of veins in addition to many very short acicular hairs.

Distr. Samoa and *Malesia*: S.E. New Guinea (Brown River, near Port Moresby).

Ecol. In secondary swamp forest, low altitude.

10. Christella hispidula (DECNE) HOLTTUM, Kew Bull. 31 (1976) 312. — *Aspidium hispidulum* DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 346. — *Dryopteris hispidula* (DECNE) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; C. CHR. Ind. Fil. (1905) 271, *excl. syn. Nephrodium angustifolium* PRESL & *N. smithianum* PRESL. — *Thelypteris hispidula* (DECNE) REED, Phytologia 17 (1968) 283. — Type: GUICHENOT, Timor (P).

Dryopteris contigua ROSENST. Meded. Rijksherb. *n.* 31 (1917) 8; C. CHR. Gard. Bull. Str. Settl. 7 (1934) 244. — *Cyclosorus contiguus* (ROSENST.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 243; HOLTTUM, Rev. Fl. Mal. 2 (1955) 282, f. 163. — *Thelypteris contigua* (ROSENST.) REED, Phytologia 17 (1968) 269. — Type: TEUSCHER, Borneo (L).

Dryopteris hirtopilosa ROSENST. Meded. Rijksherb. *n.* 31 (1917) 7; M. G. PRICE, Kalikasan 2 (1973) 112. — *Thelypteris hirtopilosa* (ROSENST.) REED, Phytologia 17 (1968) 283. — Type: MERRILL 7671, Luzon (L; K).

Dryopteris repandula v.A.v.R. Nova Guinea 14 (1924) 20. — *Cyclosorus repandulus* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 248; PANIGRAHI & MANTON, J. Linn. Soc. Bot. 55 (1958) 729–743. — *Thelypteris repandula* (v.A.v.R.) REED, Phytologia 17 (1968) 308. — Type: H. J. LAM 1058, W. New Guinea, Mamberamo River (BO; L).

Dryopteris parasitica var. falcatula CHRIST, Philip. J. Sci. 2 (1907) Bot. 197. — *Cyclosorus falcatulus* (CHRIST) COPEL. Fern Fl. Philip. (1960) 339. — *Thelypteris falcatula* (CHRIST) REED, Phytologia 17 (1968) 276. — Type: COPELAND 1677, Mindanao (MICH). — **Fig. 20b–c.**

Caudex erect; *stipe* 15–25 cm long bearing slender pale hairs, basal scales 7–10 mm long. *Lamina* 30–50 cm long, texture thin; pinnae 20–30 pairs, 2–4(–6) lower pairs gradually decrescent with dentate acroscopic auricles, lowest commonly 3 cm long. *Largest pinnae* 8–12 (–15) × 1.2–1.5(–2.0) cm; base truncate with basal acroscopic lobe a little elongate; apex short-acuminate; edges lobed 3/4 towards costa, lobes slightly oblique; costules 3–4 mm apart; veins 7–9 pairs, lowest pair, at a wide angle to the costules, uniting to form a short excurrent vein to the sinus, next pair to margin; *lower surface* of rachis bearing rather sparse slender pale hairs 1–1.5 mm long, shorter hairs on costae, costules and veins, short slender hairs on surface between veins, some short capitate hairs usually present on costules and veins, no thick glandular hairs; *upper surface* of rachis and costae hairy as lower surface, scattered long hairs present on costules and veins, short capitate hairs sometimes present between veins. *Sori* medial or a little supramedial; indusia thin, rather small, bearing hairs of varying length.

Distr. Tropical America and wetter parts of tropical Africa; Ceylon & S. India; Khasya Hills southwards to Malaya; throughout *Malesia*: Caroline Islands.

Ecol. Less common than *C. parasitica* and in more sheltered places, low altitudes to 1500 m.

Notes. Plants from Florida, Ascension Island, Ghana, Nigeria, Ceylon and Sarawak have proved to be diploid. For cytotaxonomic studies involving this species, see PANIGRAHI & MANTON 1955 (under *Cyclosorus repandulus*).

Only synonyms based on Malesian specimens are cited above; see HOLTTUM 1976 for a fuller synonymy. The latest information on plants in tropical America is by A. R. SMITH, Univ. Cal. Publ. Bot. 59 (1971) 64, under the name *Thelypteris quadrangularis* (FÉE) SCHELPE. *Christella siamensis* (TAGAWA & K. IWATS.) HOLTTUM, in Thailand and further north, differs only in less deeply lobed pinnae, and a distinction from *T. hispidula* seems doubtful; study of plants in cultivation is desirable.

11. Christella dentata (FORSSK.) BROWNSEY & JERMY, Brit. Fern Gaz. 10 (1973) 338; HOLTTUM, Kew Bull. 31 (1976) 314. — *Polypodium dentatum* FORSSK. Fl. Aegypt. Arab. (1773) 185. — *Dryopteris dentata* (FORSSK.) C. CHR. Vid. Selsk. Skr. VIII, 6 (1920) 24; BACKER & POSTH. Varenfl. Java (1939) 58, *excl. syn. Aspidium parasiticum* & *A. patens*. — *Thelypteris dentata* (FORSSK.) E. ST. JOHN, Amer. Fern J. 26 (1936) 44. — *Cyclosorus dentatus* (FORSSK.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 8 (1938) 206; COPEL. Fern Fl. Philip. (1960) 337, *p.p.* — Type: FORSSKÅL, Arabia (C).

Polypodium nymphale G. FORST. Fl. Ins. Austr. Prodr. (1786) 81. — *Aspidium nymphale* (G. FORST.) SCHKUHR, Kr. Gew. 1 (1806) 36, t. 34; BLUME, En. Pl. Jav. (1828) 157. — *Thelypteris nymphalis* (G. FORST.) REED, Phytologia 17 (1968) 297. — *C. nymphalis* (G. FORST.) PICHI SERMOLLI, Webbia 31 (1977) 252. — Type: G. FORSTER, New Zealand (BM).

Polypodium molle JACQ. Collect. Bot. 3 (1789) 188, *non* SCHREB. 1771. — *Aspidium molle* SW. in Schrad. J. Bot. 1800, 2 (1801) 34, *nom. nov.* — *Nephrodium molle* (SW.) R. BR. Prodr. Fl. N. Holl. (1810) 149; RACIB. Fl. Btzg 1 (1898) 188, *p.p.?* — *Dryopteris mollis* (SW.) HIERON. Hedwigia 46 (1907) 348; v.A.v.R. Handb. Suppl. (1917) 183, *p.p.?* — Type: Cult. Vienna (W).

Dryopteris mindanaensis CHRIST, Philip. J. Sci. 2 (1907) Bot. 194. — *Cyclosorus mindanaensis* (CHRIST) COPEL. Gen. Fil. (1947) 143; Fern Fl. Philip. (1960) 363. — *Thelypteris mindanaensis* (CHRIST) REED, Phytologia 17 (1968) 293. — Type: COPELAND 607, Mindanao (MICH).

Dryopteris submollis v.A.v.R. Bull. Jard. Bot. Btzg III, 2 (1920) 152. — Type: LÖRZING 6040, Sumatra, Karo Plateau (BO; L).

Cyclosorus subpubescens sensu HOLTTUM, Rev. Fl. Malaya 2 (1955) 273, f. 157. — **Fig. 1p, 20a.**

Caudex short-creeping; *stipe* very variable, to 50 cm long, short-hairy, basal scales *c.* 8 mm long. *Lamina* to 90 cm long; pinnae 15–25 pairs; lower 2–4 pairs of pinnae gradually decrescent, lowest commonly 4–5 cm long, sometimes less, all strongly auricled on the acroscopic base, the auricles lobed with forked veins in the lobes. *Largest pinnae* commonly 8–10 × 1.5–1.8 cm (largest seen 23 × 2.2 cm, type of *Dryopteris mindanaensis*); apex acuminate; edges lobed 1/2–2/3 towards costa, lobes slightly oblique with rounded tips; costules commonly 4 mm apart; veins 8–9 pairs, basal ones anastomosing with excurrent vein to the sinus, next acroscopic vein (basiscopic sometimes also) passing to side of the short sinus-membrane; *lower surface* of rachis bearing slender pale hairs 0.2–0.4 mm long, hairs on costae and costules mostly 0.2 mm long with some longer ones, rarely to 0.5 mm long, distally on pinnae short hairs present on surface between veins; hairs on *upper surface* of costae to 0.5 mm or more long, scattered similar hairs on costules and veins, very short hairs between veins. *Sori* medial apart from lowest ones which sometimes touch those on veins from neighbouring costules; indusia thin, copiously short-hairy.

Distr. Throughout tropics and subtropics of the Old World, since 1930 adventive in various places in the Americas.

Ecol. In open or lightly shaded places, at 0–1500 m.

Notes. For a fuller synonymy, see HOLTTUM 1976. This is a very variable species which has greatly multiplied with the clearing of forest in the past 100 years. Plants examined from various sources have all been tetraploid; some experimental hybridization has been effected with *C. hispidula* (*q.v.*) and *C. parasitica*. It is probable that natural hybrids also occur; these are difficult to discriminate. Earlier authors did not distinguish between this species and its near allies, so that statements in literature are unreliable. Much more local study is needed.

12. Christella subpubescens (BL.) HOLTTUM, Webbia 30 (1976) 193; Kew Bull. 31 (1976) 323. — *Aspidium subpubescens* BL. En. Pl. Jav. (1828) 149. — *Dryopteris subpubescens* (BL.) C. CHR. Gard. Bull. Str. Settl. 4 (1929) 390; BACKER & POSTH. Varenfl. Java (1939) 65. — *Thelypteris subpubescens* (BL.) K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 173, *excl. syn. Aspidium jaculosum* CHRIST. — Type: BLUME, Java, river bank at Tanjong Krukot, Batavia (L, *n.* 910, 327–113, large sheet collection).

Aspidium subpubescens BL. *var. B.* BL. En. Pl. Jav. (1828) 149. — Type: BLUME, Java, Noesa Kambangan (L, *n.* 922, 220–249, large sheet collection).

Aspidium subpubescens BL. *var. C* BL. *l.c.* — Type: BLUME, W. Java, Kolleket (L).

Aspidium molle var. latipinna BENTH. Fl. Hongkong. (1861) 455. — *Nephrodium latipinna* HOOK. Syn. Fil. (1867) 292. — *Dryopteris latipinna* (BENTH.) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 217. — *Cyclosorus latipinna* (BENTH.) TARD. Notul. Syst. 7 (1938) 73; HOLTTUM, Rev. Fl. Malaya 2 (1955) 276, f. 159. — *Thelypteris latipinna* (BENTH.) K. IWATS. Acta Phytotax. Geobot. 21 (1865) 166; MORTON, Contr. U.S. Nat. Herb. 38 (1974) 361. — Lectotype (MORTON 1974): HANCE 135, Hong Kong (K).

Dryopteris sumatrana v.A.v.R. Handb. (1908) 227. — *Nephrodium molle var. major* BEDD. Handb. Suppl. (1892) 76, *quoad pl. Sumatr. tantum.* — *Dryopteris subpubescens var. major* C. CHR. Gard. Bull. Str. Settl. 4 (1929) 390. — *Cyclosorus sumatranus* (v.A.v.R.) CHING, Bull. Fan Mem. Inst. Biol. Bot. 10 (1941) 249; HOLTTUM, Rev. Fl. Malaya 2 (1955) 275, f. 158. — *Thelypteris sumatrana* (v.A.v.R.) TAGAWA & K. IWATS. Acta Phytotax. Geobot. 22 (1967) 101. — Lectotype (HOLTTUM 1955): C. MILLER *s.n.* 1778, Sumatra (BM).

Dryopteris pseudoamboinensis ROSENST. Meded. Rijksherb. *n.* 31 (1917) 7. — *Thelypteris pseudoamboinensis* (ROSENST.) PANIGRAHI, Phytologia 30 (1975) 410, pl. III. — Lectotype (PANIGRAHI 1975): KORTHALS 270, Sumatra (L).

Dryopteris acuminata ROSENST. Meded. Rijksherb. *n.* 31 (1917) 7, *non* WATTS 1916. — *Thelypteris blumei* PANIGRAHI, Phytologia 30 (1975) 409, *nom. nov.*; *op. cit.* 31 (1975) 369. — Type: ZOLLINGER 735, Java, Ufer des Tjidurians (L, *n.* 908, 333–35).

Aspidium amboinense sensu BL. En. Pl. Jav. (1828) 148; KUNZE, Bot. Zeit. 6 (1848) 261; METT. Farngatt. IV (1858) 105. — *Nephrodium molle var. amboinense* BEDD. Handb. (1883) 278, *p.p.* — **Fig. 20g.**

Caudex short-creeping or suberect; *stipe* short, minutely hairy. *Lamina* varying much in size; several pairs of lower pinnae gradually decrescent, their acroscopic auricles rather small, entire or slightly crenate; largest pinnae lobed less than 1/2 towards costa (in small plants 1/4); in small plants at least 1½ pairs of veins anastomosing and the next pair ending beside the sinus-membrane, in large plants 2–2½ pairs of veins anastomosing to form a zig-zag excurrent vein and ½–1 pair ending beside the sinus-membrane; *lower surface* of rachis, costae and costules bearing minute hairs (0.1 mm long or less), in some specimens also orange glandular hairs on costules and veins, surfaces between veins minutely hairy, usually with some very short capitate hairs; *upper*

surface of costae bearing hairs *c.* 0.3 mm long, scattered longer hairs sometimes present on costules and veins, minute suberect hairs usually present between veins. *Sori* medial; indusia rather large, thin, glabrous or minutely hairy; in a few cases, capitate hairs present on sporangia.

Distr. N.E. India to S.W. China; Burma, Thailand, Vietnam; throughout *Malesia*; N. Queensland, New Hebrides, Fiji.

Ecol. On stream-banks in moderate shade in forest, also in lightly shaded places elsewhere, in lowlands.

Notes. It would be possible to make a key distinguishing the types of the basionyms above cited, but I find it impossible to fit all other specimens into such a key. More field study, and experimental study of cultivated plants, are needed.

The types of *Aspidium subpubescens* BL. *var. C* and *Nephrodium latipinna* HOOK., also the specimens of BLUME and ZOLLINGER on which the misinterpretations of the name *Aspidium amboinense* WILLD. were based, were small fertile plants. I have seen such plants on the banks of small streams in the forest in Pahang, where the streams are subject to periodic flooding with swiftly-flowing water after a sudden storm. In such places, plants are washed away before they attain their full size; a plant from the Tahan river in Malaya, grown at Kew, is much larger than any on the river banks, and is very like BLUME's *var. B*, though less rigid in texture. Plants found growing spontaneously in and near the Botanic Garden in Singapore (also others growing similarly at Bogor) are very like the type of *A. subpubescens* BL. and differ from the fully-grown plants of stream-bank origin in having somewhat broader pinnae. I have no evidence that the Singapore and Bogor plants are fertile from an early age, and think that they are probably genetically different from stream-bank plants, but I cannot point to clear distinctions.

Thick orange glandular hairs are present on the lower surface of pinnae of most of the stream-bank plants from Malaya, and of the Java plants named *amboinense* by BLUME, KUNZE, METTENIUS and HOOKER. Such glands are absent from the type of *Nephrodium latipinna* HOOK. and other specimens from Hong Kong, also from the type of *A. subpubescens* BL. and similar specimens from Singapore and Bogor. But other specimens very similar to typical *A. subpubescens* have a few such glandular hairs, while on the other hand some stream-bank plants from northern Malaya are quite glandless like the type of *N. latipinna* from Hong Kong.

Some stream-bank plants from Malaya, also from Luzon, have small capitate hairs on some of their sporangia; I have not observed this character in any other specimens of *Christella*. The capitate hairs appear to be just like those on the lower surface of pinnae between veins.

13. Christella subdentata HOLTTUM, Kew Bull. 31 (1976) 335. — Type: VILLAFLORES 57, Mindoro, Lubang Island (MICH).

Caudex short, erect or suberect; *stipe* 25 cm long, minutely hairy, basal scales *c.* 10 × 1 mm. *Lamina* 50 cm long; pinnae 15 pairs; lowest 1–2 pairs of pinnae somewhat reduced (basal pinnae 5 cm long), not auricled on the acroscopic side. *Largest pinnae* 9.5 × 1.5 cm; base truncate; apex acuminate with cauda 2 cm long; edges lobed 2/5 towards costa; costules 3.5 mm apart; veins to 8 pairs, lowest pair anastomosing, second acroscopic veins passing to side of sinus-membrane; *lower surface* of rachis, costae and costules bearing hairs 0.1 mm long, similar hairs present between veins; *upper surface* of rachis covered with hairs 0.5 mm long, shorter hairs present on costae, sparse minute hairs between veins. *Sori* medial; indusia short-hairy.

Distr. *Malesia*: Philippines (Mindoro), only known from the type.

Note. This may be a hybrid.

14. Christella timorensis HOLTTUM, Kew Bull. 31 (1976) 316. — Type: BLOEMBERGEN 3364, Timor, Mt Timan (L; BO, K).

Caudex long-creeping, 5 mm diameter, bearing fronds 2–3 cm apart; *stipe* short-hairy, basal scales *c.* 6 × 1.5 mm, rigid. *Lamina* of type incomplete, probably 70 cm or more long with pinnae more than 20 pairs; 4–5 pairs of lower pinnae decrescent, with enlarged entire basal acroscopic lobes (to 2.0 cm long), lowest pinna seen 7.5 cm long. *Largest pinnae* 15 cm long, 2.2 cm wide above base; apex narrowly acuminate but not caudate; edges lobed 3/5–2/3 towards costa; lobes oblique, a little falcate, broadly pointed; costules 4.5–5 mm apart; veins to 12 pairs, basal 1–1½ pairs anastomosing, next acroscopic vein, or next pair, passing to side of sinus-membrane; *lower surface* of rachis bearing rather sparse hairs 0.7–1.0 mm long, costal hairs erect, to 0.7 mm, shorter hairs on costules and veins, sometimes also a few thick glandular hairs, slender erect hairs present between veins; hairs on *upper surface* of costae to 0.5 mm long, similar hairs scattered on costules and veins, no hairs between veins. *Sori* supramedial; indusia with short stiff hairs.

Distr. *Malesia*: Lesser Sunda Is. (Timor), only known from type.

Ecol. In grassland along stream at 1300 m.

15. Christella parasitica (L.) LÉV. Fl. Kouytchéou (1915) 475; HOLTTUM, Kew Bull. 31 (1976) 309. — *Polypodium parasiticum* L. Sp. Pl. (1753) 1090. — *Dryopteris parasitica* (L.) O. KTZE, Rev. Gen. Pl. 2 (1891) 811; C. CHR. Ark. Bot. 9, *n.* 11 (1910) 26, f. 4. — *Cyclosorus parasiticus* (L.) FARW. Amer. Midl. Nat. 12 (1929) 259; HOLTTUM, Rev. Fl. Malaya 2 (1955) 281, f. 162. — *Thelypteris parasitica* (L.) K. IWATS. Mem. Coll.

Sci. Univ. Kyoto B, 31 (1965) 172. — Type: OSBECK, Canton (S-PA in Herb. Swartz).

Aspidium procurrens METT. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 231. — *Dryopteris procurrens* (METT.) O. KTZE, Rev. Gen. Pl. 2 (1891) 813; v.A.v.R. Handb. (1908) 211, 819, *p.p.* — *Cyclosorus procurrens* (METT.) COPEL. Fern Fl. Philip. (1960) 340, *nomen tantum*. — *Thelypteris procurrens* (METT.) REED, Phytologia 17 (1968) 306. — Type: ZIPPELIUS, Java (L, *n.* 908, 335–152).

Nephrodium didymosorum PARISH *ex* BEDD. Ferns Br. India (1866) t. 200. — *N. molle var. didymosorum* BEDD. Handb. (1883) 279. — *Dryopteris didymosora* (BEDD.) C. CHR. Ind. Fil. (1905) 262; v.A.v.R. Handb. (1908) 225. — Type: PARISH, Burma, Moulmein (not found in Herb. Bedd. at K).

Nephrodium tectum BEDD. Handb. Suppl. (1892) 79, *excl.* KING 8757. — Lectotype (HOLTTUM 1976): WALLICH 394, Singapore (K-W).

Dryopteris albociliata COPEL. J. Arn. Arb. 10 (1929) 177. — *Thelypteris albociliata* (COPEL.) REED, Phytologia 17 (1968) 259. — Type: BRASS 566, E. New Guinea, Basiatibu (GH; UC).

Cyclosorus benguetensis COPEL. Philip. J. Sci. 81 (1952) 28; Fern Fl. Philip. (1960) 341. — *Thelypteris benguetensis* (COPEL.) REED, Phytologia 17 (1968) 263. — Type: MERRILL 7679, Luzon, Benguet Subprov. (MICH) — **Fig. 20f.**

Caudex short- to long-creeping; *stipe* to 40 cm long, copiously hairy. *Lamina* to 40 cm long, texture thin; pinnae *c.* 20 pairs, closely placed; basal pinnae (as dried for herbaria) deflexed, not widely spaced, not or little reduced, auricled at the acroscopic base, auricle curved towards the rachis, sometimes dentate. *Largest pinnae* commonly 16 × 2 cm, short-acuminate, lobed 2/3–3/4 towards costa, lobes slightly oblique; costules *c.* 4 mm apart; veins 8–10 pairs, basal pair anastomosing, next pair passing to margin above base of sinus or sometimes the second acroscopic vein touching the sinus-membrane; *lower surface* typically covered with slender erect hairs to 1 mm long, thick orange glandular hairs usually present on veins in the lobes; hairs on *upper surface* of costae thicker than on lower, similar hairs scattered on costules and veins, very short hairs between veins. *Sori* medial, lower ones divergent; indusia hairy.

Distr. Wetter parts of tropics and subtropics of Asia; throughout Malesia; Queensland; in the Pacific to Tahiti and Hawaii; E. Africa (Uganda, Kenya); St Helena (introduced?).

Ecol. In open places, mainly at low altitudes but also to 1500 m; apparently nowhere abundant.

Notes. The type was discovered by CHRISTENSEN (1910); previously the name was used confusedly. In Kwangtung (source of the type) almost all plants have a rather short-creeping caudex and many glandular hairs on veins, but some have a longer rhizomatous caudex and few or no glands. The type of *Aspidium procurrens* METT. lacks glands. BEDDOME at first used the name *procurrens* for a mixture of species which had in common a creeping rhizome; v.A.v.R. also used the name confusedly. Under *Cyclosorus procurrens* COPELAND described a fern with narrow pinnae lobed half-way to the costa; I have not seen specimens. Some specimens have the frond-form of this species but short hairs; some agree in hairs and glands but have some reduced basal pinnae (type of *Cyclosorus benguetensis*); some such specimens are probably hybrids. MANTON found that *C. parasitica* in Ceylon is tetraploid and her co-workers produced hybrids with the diploid *C. hispidula* and with other tetraploids. In breeding, the absence of glandular hairs is recessive to their presence.

16. Christella acuminata (HOUTT.) LÉV. Fl. Kouy-tchéou (1915) 476; HOLTTUM, Kew Bull. 31 (1976) 333. — *Polypodium acuminatum* HOUTT. Nat. Hist. 14 (1783) 181, pl. 99, f. 2. — *Thelypteris acuminata* (HOUTT.) MORTON, Amer. Fern J. 48 (1958) 139; K. IWATS. Mem. Coll. Sci. Univ. Kyoto B, 31 (1965) 186. — Type: THUNBERG, Japan (UPS).

Polypodium unitum THUNB. Fl. Jap. (1784) 336, *non* LINN. — *Polypodium sophoroides* THUNB. Tr. Linn. Soc. 2 (1794) 341, *nom. nov.* — *Nephrodium sophoroides* (THUNB.) DESV. Mém. Soc. Linn. Paris 6 (1827) 256; BAK. Syn. Fil. (1867) 289. — Type: as for *P. acuminatum* HOUTT.

Caudex long-creeping, slender; *stipe* 25 cm or more long, sparsely hairy. *Lamina* to 60 cm long, texture firm; lower pinnae more widely spaced than the rest but not or little reduced. *Largest pinnae* to 9 × 1.5 cm (fertile), 15 × 2 cm (sterile), lobed a little less than half-way to costa; lobes acute, basal acroscopic lobe enlarged, ± curved towards the rachis, with some forked veins; costules 3.5–4.5 mm apart; veins commonly 7 pairs (to 10), pale and prominent on both surfaces, basal pair anastomosing, next pair ending beside sinus-membrane; *lower surface* of costae and costules bearing a variable number of short erect hairs and a few longer ones, sparse short hairs present on and between veins, glandular hairs lacking; *upper surface* of costae bearing hairs to 0.5 mm long, similar hairs often scattered on costules and veins, a variable number of very short hairs between veins. *Sori* medial or a little supramedial; indusia large, copiously short-hairy.

Distr. Southern China and southern Japan, in *Malesia*: Philippines (Babuyan Is. and N. Luzon).

Notes. For a fuller synonymy, see CHING 1938 and IWATSUKI 1965. The specific epithet *sophoroides* is used in most of the older literature. In general aspect this species is similar to *C. arida* but lacks reduced basal pinnae and glandular hairs; the larger pinnae of *C. acuminata* are also rather strongly auricled.