THELYPTERIDACEAE (R. E. Holttum, Kew)


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.

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Fig. 1. Sphaerostephanos penniger (H. K.) Holttum. a. Whole frond, × ½; 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. Mesopheleion crassifolium (Bl.) Holttum, × 4; l. Coryphopteris viscosa (Bak.) Holttum, × 4; m. Metathelypteris dayi (Bedd.) Holttum, × 3.—Sporangia, × 33: n. Pronephrion repandum (Fée) Holttum; o. P. rubicundum (v. A. v. R.) Holttum; p. Christella dentata (Forssk.) Brownsey & Jermy; q Sphaerostephanos heterocarpus (Bl.) Holttum; r. Cyclossorus 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 trininate fronds with free veins, abundant superficial glands much as in Coryphopteris and trilette 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 Hypomatazium, 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 (Pneumatopteris of the present work) is the absence of a sinus-membrane, but such a condition is not invariably 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 Pseudophygopteris) also have veins terminating within the margin (Fig. 1m) and adaxial surface of rachises and costae not grooved, both conditions shared by Metathelypteris and Phegoropteris; 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 Pneumatopteris) 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 pinnales 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 clairborniana 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 Pronephiurn 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.

Sporophytes 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.

**Cyto-logy.** 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 PIČI 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.

**Taxomy.** 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 triplicatum*, 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 *Nephroodium*, 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 *Nephroodium*, 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*, *Nephroodium* and *Polystichum*. BLUME in 1828 included all indusiate *Thelypteridaceae* in *Aspidium*, exindusiate ones in *Meniscium*, *Gymnogramme* and *Polypodium*; he established *Sextonogramma* for a species with elongate exindusiate sori and anastomosing veins.

SCHOTT'S 'Genera Filicium', published in 1834, contained twenty beautifully engraved plates showing details of as many genera; these included a plate illustrating *Nephroodium* 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 'Epimelieae 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. FEE produced his 'Genera Filicum' (1852), in which his arrangement is more elaborate. He placed the majority of Thelypteridaceae in Polypodioideae, 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 Polypodiaceae, 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" Aspidieae, 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 Hand- book (1883) and its Supplement (1892) he included also species of the Malay Peninsula, and owing to a lack of critical study of Malayan 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 Alderwervlet Van Rosenugh 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 Pronephiurn 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 Gonioperis, 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. Sphaeropteryis 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. Coryhopteris and Trigonomspora).

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.

**CONSPICUS 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
   2. Macrothelypteris

3. Scales thickened at base; perispore minutely complex

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

7. No reduced pinnae at base of frond; subtendrillae 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

10. On rocks by streams, S.E. Asia and W. Malesia

7. Trigonospora

8. Group of 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 sporangia-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. Phlebion

13. Fronds proliferous; forked hairs present

11. Ampelopteris

14. Veins anastomosing, with long sinus-membrane

Group of CHINGIA

14. Veins free; sinus-membrane short; decurrent obliquely towards costa

13. Pleioneuron

7. Reduced pinnae usually present at base of frond; species without such pinnae mostly having broad subtendrillae.

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

19. Scales on base of stipe narrow, hairy on surface; spherical glands on setae usually present on sporangia.

17. Sphaerostephanos

19. Reduced pinnae normally present

17. Sphaerostephanos

20. Reduced pinnae lacking.

21. Pinnate rarely to 20 pairs; veins anastomosing

18. Pronephrium

21. Pinnate to 30 pairs, not over 2.5 cm long

19. Nannothelypteris

20. Sori always elongate along veins; pinnae mostly adnate; sporangia always setiferous

20. Stegnothelypteris

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 invariably 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.

Pseudophygeopteris and Macrothelypteris have bipinnate fronds approaching those of Cyathea in size but differ in their mainly adnate pinnales; 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 Plagiogryia 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 Sphaeroestephanos; I maintain these two genera partly for convenience and partly because many members of Pronephrium do form a group distinct from typical Sphaeroestephanos. 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 Sphaeroestephanos 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 Love, Love 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 unacellular ................................................................. 1. Pseudophegopteris
4. Fronds simply pinnate.
5. Sori indusiate ................................................................. 3. Metathelypteris
6. Sori exindusiate ................................................................. 1. Pseudophegopteris
7. Stipe-scales bearing superficial hairs; rachis-wing, if present, narrow and of even width.
8. Stipe-scales with marginal hairs only; pinnae connected by wings along the rachis forming semicircular lobes between pinnae ................................................................. 4. Phegopteris
9. Sori not sepctate; pinnae not decrescent (small basal pinnae inconstantly present in Amphineuron).
10. Spores trilette; caudex short, erect; on rocks by streams ................................................................. 7. Trigonospora
11. Rhizome long-creeping in wet ground; broad flat scales present on lower surface of costae.
12. Veins free ................................................................. 8. Thelypteris
14. Fronds not proliferous; sori indusiate ................................................................. 11. Ampelopteris
15. Fronds proliferous; sori exindusiate .................................................................
16. Not this combination of characters.
17. Caudex erect; sporangia unstalked, lacking hairs and glands; some sessile resinous glands on lower surface in most species; plants of mountain ridges ................................................................. 5. Coryphopteris
18. Not this combination of characters.
19. Caudex massive, erect; scales narrow, rigid, brittle; sori close to costules, exindusiate or with very small indusia ................................................................. 12. Chingla
20. Sori elongate along veins, exindusiate; sporangia bearing slender straight setae .................................................................
21. Sori round, or if elongate and exindusiate the sporangia bearing hooked hairs or none.
22. Fronds free. ................................................................. 9. Mesopheribion
23. 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 .................................................................
24. Basal basiscopic vein of each group not always thus arising; hairs on sporangium-stalk otherwise.
25. Rhizome long-creeping; no glands nor hairs on sporangia.
26. Rhizome slender; pinnae rarely over 6 cm long ................................................................. 6. Parathelypteris
27. Rhizome 5–7 mm diameter; pinnae 10 cm or more long ................................................................. 22. Christella
28. Rhizome not long-creeping; sporangia in some cases with glands or hairs.
29. Bases of lower pinnae not greatly narrowed.
30. Pinnae rigid, commonly at least 10 × 1 cm ................................................................. 13. Plesioneuropod
31. Pinnae thin, to 3 cm long, rarely 1 cm wide.
20. Sporangia bearing glands.
21. Pinnae c. 7 pairs; glands present .......................... 18. Pronephrium
20. Sporangia lacking glands ..................................... 22. Christella
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 acrosopic 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.
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. Pseudocyclusorus
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

I. PSEUDOPHEGOPTERIS

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-lobes, × 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, v 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 toresiana* 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*

2. Pinnae to c. 6 cm long, nearly all adnate to rachis, lobed not more than 1 to costa
   2. *P. rectangularis*

   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*

5. Pinnae on largest pinnae almost free, lobed almost to costa.
   5. Lower surface of costa pale; lobes of largest pinnae almost entire
   6. *P. sumatrensis*

5. Pinnae on largest pinnae all broadly adnate to pinna-rachis, lobed not more than half-way to costa
   5. *P. kinabaluensis*

6. Lower surface of costa glabrous; lobes of largest pinnae almost entire
   7. *P. paludosa*

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*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 costa; 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,
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Price 836, Mt San Cristobal), Papua New Guinea (several coll.).

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


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


Caudex short, suberect. Stipe to 25 cm long, dark purplish, bearing short sparse spreading hairs, scarcely near base. Lamina to 30 x 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 x 1.5 cm, narrowed evenly from base to apex, lobed up to ± to costa at base, lobes entire, rounded; veins in basal pinna-lobes 5 or more pairs; rachis, costa 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.


Caudex unknown. Stipe castaneous, glossy. Largest pinnae 33 cm long, subpinnae; pinnales lobed, all broadly adnate and connected by a narrow wing on pinna-rachis, basal basiscopic pinnule 7 x 1.6 cm, conspicuously longer than next; lower surface of pinna-rachis and of costa 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.


Caudex branching; branches short, suberect. Stipe to 60 cm long, dark purplish brown, scaly and hairy near base, scales 6 x 1 mm. Lamina to 80 cm or more long, basal pinnae reduced; largest pinnae to 20 cm long, narrowly deltoid; pinnales all broadly adnate to pinna-rachis, lowest pair almost free, basiscopic one to 4.5 x 1.4 cm, acroscopic to 3.5 x 1.2 cm, lobed ± to costa; next pair of pinnales c. 4 and 2.5 cm long, rest of pinna evenly narrowed towards apex, middle pinnales 7–8 mm wide; veins pinnae in lobes of pinnales; acicular hairs present on lower surface of pinna-rachis at least near its apex, also on costa of pinnales and near margin. Sori medial on veins, globose or nearly so; sporangia copiously setose.

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

5. Pseudophyogopteris 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 pinnales 2.5–3.5 cm apart, adnate slightly to rachis on acroscopic side; largest pinnales 10 x 3 cm, at base lobed almost to costa; costules to 6 mm apart, lobes incised up to halfway to costule; lower surface of costa of pinnales 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. Pseudophyogopteris sumatranana 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; pinnales on basiscopic side longer than on acroscopic; largest pinnales 7.5 x 1.7 cm, acuminate, partly adnate at base to pinna-rachis, lobed ± towards costa, lobes subentire with rounded apices, costules 3–6 mm apart, veins mostly forked; lower surface of rachis, costa 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.


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


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 indium 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 oligoleblia* (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 sect. Thelypteris but the scales of the latter (here ranked as a genus) are different, also the chromosome number.

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


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


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 x 50 cm, deeply tripinnatifid, pinnae 12–15 pairs, sub-basal ones longest; largest pinnae 20 x 9 cm, deltoid, pinnate with all pinnae but lowest adinate to a narrowly green-winged pinna-rachis; pinnae oblique to pinna-rachis, largest 5–8 x 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.

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


Chelaniites gigantea Cesati, Rendic. Ac. Sci. Nap. 16 (1877) 25. — Polypodium chelanioides 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 chelanioides (Bak.) V.A.V.R. Handb. (1908) 494. — Type: Beccari, Mt. Arfak, W. New Guinea (Fl.; K). — Fig. 2k-m.

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 (sparingly) 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 10×5.5 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 sepatate hairs; tertiary leaflets at right angles to costa, larger ones deeply lobed, capitate hairs on lower surface. Sorus small, on an acroscopic branch of a vein; indusium small, with capitate hairs; sporangia with capitate hairs.

Dist. 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 polypondioi (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. polypondioi (which he named Dryopteris leucolepis) and M. forrestiana (which he named D. setigera).


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.

Dist. 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 Kinaa Bu.
3. METATHELYPTERIS


*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, × 1/2; 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 s.n.; d–f Matthew s.n.; h M. G. Price 3368).
Thelypteridaceae (Holttum)

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.

Cytop. 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
   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
   4. M. singalanensis

4. Lower surface of costae and costules bearing copious capitulate hairs.

5. Texture thin, drying dark green; veins conspicuously branched
   4b. M. singalanensis var. surbeckii
   5. Texture firm, drying yellow-green; veins forked near tips, branches little diverging

4. Lower surfaces of costae and costules bearing sparse acicular hairs
   5. M. dayi


Athyrium benguetense CHRIST, Phil. 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 sublaxa HAYATA, Icon. Pl. Formos. (1914) 183, f. 122. — Type: HAYATA, Mt Arisan, Taiwan, Jan. 1912 (TI, seen by IWAT SUKI).

Dryopteris arisanensis ROSENST. Hedwigia 56 (1915) 340. — Type: FAURIE 389, Mt Arisan, Taiwan (isotype KY seen by IWAT SUKI). — 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 basicspicic base. Largest pinnae of type 7.5 × 1.4 cm, of type of Neithrophylacium 9 × 2.0 cm, short-accuminate, 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 aciculare and capitulate 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.

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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; costa 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 costa 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 besides roads where forest has been cleared at Cameron Highlands and on Taiping Hills; these plants have short hairs on the lower surface of costa as in some plants found by MANTON in Ceylon.


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

Caudex short-creeping; stipe 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 costa, 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.


*Dryopteris media* v.A.V.R. Bull. Jard. Bot. BISS 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, costa, 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 costa bearing copious acicular hairs 0.2 mm long, hairs on costules minute. *Sori* on acroscopic branches of veins; indusia bearing many short capitate hairs.


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

b. var. *surbeckii* HOLT TUM, var. nov.

A typo speciei differt: pinnae in sicco brunneo-virentibus, firmioribus; venis saepe simplicibus versus apicem tantum breviter furcatis; pagina inferiore inter venas pilis capitatis destituta.

— Type: SURBECK 1193, Sibutan-Zuid, Sumatra, 1700 m (L). Also ALSTON 14974, Siidikalang (BM).

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

4. PHEGOPTERIS


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 capitulate 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 capitulate 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.


Lastre 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 1-1

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 W. L. D. 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 Lastre 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


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 acrosopic 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 septic; 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 septic. *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 septic 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.) HOLTUM. a. Lower and upper surface of pinna-lobes, showing glands, hairs and uniseriate scales, ×8. — *C. unidentata* (BEDD.) HOLTUM. b. Middle lobes of basal pinna, ×3. — *C. hirsutipes* (CLARKE) HOLTUM. c. Base of stipe, ×8 and part of one hair, ×32. — *C. multisora* (C. CHR.) HOLTUM. d. Rachis and base of pinna, lower surface, showing septate hairs, ×8. — *C. habbemensis* (COPEL.) HOLTUM. e. One pinna, ×1.5. — *C. klossii* (RIDL.) HOLTUM. f. One pinna-lobe, ×6. — *C. badia* (v.A.V.R.) HOLTUM. 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.).
1. Base of stipe bearing pale, firmly cylindrical multisepitate 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
3. Stipe above base and abaxial surface of rachis less densely hairy with few septate hairs.
4. Indusium glandular; scales at base of stipe to 10 × 3 mm. 2. C. multisora
5. Indusia bearing acicular hairs; scales at base of stipe much smaller. 3. C. hirsutipes
6. Base of stipe not bearing such hairs.
7. Sessile glands or/acicular hairs abundant between veins on upper surface.
8. Scales on lower surface of costae at most 2 cells wide at base.
9. Stipe-scales thin, less than 1 mm wide above base; lower surface of costae bearing many acicular hairs.
10. Pinnae to 2.5 cm long, nearly all deflexed. 4. C. plumosa
11. Pinnae to 5.5 cm long, a few basal ones deflexed.
12. Pinnae to 25 pairs or more; pinna-lobes mostly entire. 5a. C. viscosa var. viscosa
13. Pinnae 12–18 pairs; pinna-lobes mostly crenate. 5b. C. viscosa var. poensis
14. Stipe-scales firm, 1 mm or more wide; lower surface of costae bearing short capitate hairs and glands, acicular hairs lacking or very few.
15. Upper surface of pinnae lacking acicular hairs between veins. 6a. C. gymnopoda var. gymnopoda
16. Upper surface of pinnae bearing acicular hairs between veins.
17. Lower surface between veins, and indusia, lacking acicular hairs. 6b. C. gymnopoda var. bintangensis
5. Scales on lower surface of costae widened at base.
6. Upper surface of pinnae lacking acicular hairs between veins.
7. Indusia bearing copious acicular hairs. 7. C. klossii
8. Indusia bearing acicular hairs; stipe-scales 3 × 0.8 mm, firm, with many spherical outgrowths on dorsal surface. 8. C. iwatsukii
9. Indusia lacking acicular hairs; stipe-scales to 7 × 1.5 mm, thin, smooth dorsally. 9. C. atjehensis
10. 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
16. Sori median to inframedial. 12. C. habbemensis
17. At most one free pinnule present at base of largest pinnae.
18. Many septate hairs present on upper surface of rachis and costae.
19. Septate hairs on upper surface of rachis and costae less than 0.5 mm long; stipe-scales 3 mm long. 13. C. arthrotricha
20. Septate hairs on upper surface of rachis and costae 1 mm or more long; stipe-scales much longer.
21. Stipe-scales to 10 × 3 mm, thin; hairs on upper surface of rachis and costae commonly 1–1.5 mm long. 2. C. multisora
22. Stipe-scales to 7 × 1 mm, rigid, hair-pointed; hairs on upper surface of rachis and costae not over 1 mm long. 14. C. tahianensis
23. Septate hairs absent or rare on upper surface of rachis and costae.
24. Sori mainly along one side of a vein, rarely reniform. 15. C. athyroides
25. Sori mainly reniform, distal ones sometimes ± athyroid.
26. All pinna-lobes entire.
27. Pinnae thin, copiously hairy on costae beneath; costal scales few.
28. Hairs on lower surface of costae unicellular. 16. C. pectiniformis
29. 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
30. 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
31. Hairs on lower surface of costae to 1.5 mm long, septate. 16b. C. pectiniformis var. hirsuta
32. Pinnae rigid; costae sparsely hairy beneath and bearing many small scales. 17. C. andersonii
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21. At least basal acroscopic lobes of middle pinnae dentate.
25. Lamina to 15 cm long; largest pinnae 3.0 × 0.8 cm
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
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
29. C. squamipes
28. Fertile pinnae to 8.5 × 1.7 cm, stipe-scales 1 mm wide
30. C. borealis
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
31. Lamina to 40 cm long; pinnae to 20 pairs
32. C. pubirachis var. pubirachis
31. Lamina to 40 cm long; pinnae to 20 pairs
32. 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
32a. C. pubirachis var. philippinensis
32. Basal pinnae to 6 × 1.2 cm; most pinna-lobes dentate or crenate
32b. 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
33. 23. C. athyricarpa
34. Pinnae to 25 pairs; lower surface of pinna-rachis bearing acicular hairs; no hairs between veins on upper surface
33. 5c. C. viscosa var. borneensis
35. 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
36. Indusia present.
37. Several pairs of free pinnules on lower pinnae
37. At most basal lobes free.
38. Upper surface bearing hairs between veins.
38. Hairs on upper surface between veins acicular.
40. Stipe bearing copious hairs 1 mm long
40. Stipe bearing hairs 0.5 mm long in groove only
40. Stipe bearing hairs 0.5 mm long in groove only
40. Stipe bearing hairs 0.5 mm long in groove only
38. 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 sejate
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
44. Texture thin; pinnae to 6.5 cm long; hairs on lower surface of rachis 0.2 mm long
32. C. horizontalis
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
46. Sori medial or inframedial; stipe-scales not over 5 mm long.
47. Sori mostly atyrioid; pinnae to 2.5 cm long
36. C. ledermannii
47. Sori mostly not atheniroid; pinnae longer.
48. Cauldex erect.
49. Pinnae thin; no tangled hairs at base of stipe.
50. Veins 3–4 pairs; pinna-lobes entire except basal acrosopic ones
51. Pinnae caudate-acuminate
52. Pinnae short-acuminate
53. Pinnae thick; tangled hairs often present at base of stipe
54. Cauldix slender, long-creeping

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Stipe to 60 cm long, bearing throughout spreading septate hairs 1 mm or more long; basal scales 10–15×1.5 mm. *Lamina* to 80 cm long; pinnae c. 25 pairs; basal pinnae narrowed at base, basal acrosopic 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; costae 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 capitulate hairs or glands.


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*.

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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. 4e.

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 7–15 x 1.5 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 separtate; 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 separtate, slender unicellular hairs often present between veins. Sori medially or inframedially; indusia hairy, hairs sometimes separtate.

Distr. S. Japan, Ryukyu Islands, Taiwan, S. China to NE. 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 separtate 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 separtate hairs on lower surface.


a. var. viscosa

Stipe 15–20 cm long, dark at base, paler upwards, basal scales 4 x 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 3.5 x 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 capitulate hairs and glands; scales on costae 1–2 cells wide; glands abundant between veins; gland throughout upper surface. Sori medially, distal ones ± atyrioid; indusia thin, with a few glands.

Distr. Malesia: Malaya (Mt Ophir), Borneo (Mt Ophir).
b. var. poiensis HOLT T U M, 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 HOLT T U M, 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).


Dryopteris viscosa var. kamboranga C. CHR. Gard. Bull. Str. Settl. 7 (1934) 240. — HOLT T U M 25472, Mt Kinabalu 2130 m (BM; BO, K, SING).


a. var. gymnopoda

Stipe 15–20 cm long; scales 6–8×1–1.5 mm, dark, firm, bases not lifted. 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 subacuminate, lobes mostly crenate; costules 3–5 mm apart; veins 6–7 pairs; lower surface of rachis bearing some acicular hairs, of costae bearing many glands and capitata 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 aphyroid; indusia bearing short capitate hairs and glands.

Distr. Peninsular Thailand, in Malesia: Sabah (Mt Kinabalu, many collections), Sarawak; in Malayon 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 HOLT T U M, Blumea 23 (1976) 30. — Type: C. B. KLOSS, G. Bintang on Ketah-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 HOLT T U M, 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.


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 acrosopic 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 symmetrical.


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 acrosopic 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 costa dilated at base, lamina between veins bearing glands and minute erect hairs; upper surface of rachis and costae bearing uncinctorial acicular hairs, few on costules and veins, surface between veins with many glands. Sori medially; 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. IWATSKU 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 capitiate hairs.

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


Dryopteris supratillosa 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 acrosopic 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 capitiate hairs; scales on lower surface of costa tae widened at base; upper surface densely covered with short acicular hairs, some capitulate hairs or glands also present. Sori medial to inframedial, distal ones sometimes asymmetric where small; indusia bearing glands and capitulate hairs.


Note. There is variability in Sumatran specimens in abundance of glands or capitulate 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 capitulate hairs. The type of D. supratillosa is small (lamina 20 cm long) and has capitulate hairs between veins on lower surface.


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 acrosopic 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 costa, costules and veins, a few dark narrow scales on costa; upper surface of costules and veins with scattered hairs, no glands nor hairs between veins. Sori supramedially; indusia glabrous.


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


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, pinnae 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).


*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 8-16 mm, 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 capitulate 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 capitulate hairs. *Sori* medial; indusia small, bearing short capitulate 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 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.


a. var. pectiniformis

*Stipe* dark at base with thin setiforous 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 capitulate 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 capitulate hairs, sometimes a few acicular hairs.


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 Holtum, var. nov.  
A typo specie differt: pinnis minoribus (usque 4.2×0.8 cm); venis 3-fugatis; rhachidi et costis subitus pilis 0.1 mm longis vestitis; paleis stipitis 3 mm longis, 0.8 mm laitis. Type: J. Winkler s.n. 1912, Sumatra, Pea Radja, in Rosenst. Fil. sumatr. exsicc. n. 143 (P).  
Note. This was distributed as Dryopteris subviscosa Rosenst., a name not published (not D. subviscosa v.v.A.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.

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 acrosopic 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, symmetrical; indusia thick, glabrous.  
Distr. Malesia: Borneo (Sarawak: Mt Mulu), only known from type.

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 acrosopic 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 capitulate hairs.  
Distr. Malesia: Papua New Guinea (neighbourhood of Mt Kaindi, several collections; Ekuq Range 2200 m).

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 symmetrical; 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.

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 acrosopic lobes not enlarged. 

**Largest pinnae** 9 × 1.9 cm (stereile), 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.


**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 acrosopic 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 acrosopic 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** HOLTUM, 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** HOLTUM, Blumea 23 (1976) 37. — **Type**: RAMOS & EDANO 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** HOLTUM, 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 capitatre hairs.

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


**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 atrophic; indusia with a few glands, not hairs.

**Distr. Malesia**: Borneo (Sarawak; W. Kaimantan, 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* HOLTUM, 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 acrosopic 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 aciculair 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 capitae hairs.

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


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 aciculair 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.


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 basiscopie 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 inframedial; indusia small, thin, glabrous.


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


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 aciculair 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 aphyrioiid; indusia thin, short-hairy.

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

28. Coryphopteris microlepiga (ROSENST.) HOLLTTUM, 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 2–3 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 capitatiue 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 athyroïd; indusia glabrous.


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 Teymann on Mt Toena, Amboina (BO) is similar.


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 athyroïd; indusia bearing many capitate hairs and sometimes a few acicular ones.

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


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 thin, large, thin, short-hairy.

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


Dryopteris engleriavar. 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.


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 subessisile 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 athenioid; indusia thin, glabrous.

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


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 capitulate 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 capitulate hairs.

Distr. Malesia: West New Guinea, several collections.

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


Distr. Coryphopteris 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 red-dish, 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 costa; 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.


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 athenioid; indusia glabrous.

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

Ecol. Epiphyte in moss-forest.


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, orb-
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 acrosopic 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 costa. *Sori* near costules; indusia glabrous, sometimes a little atrhydoid.

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


**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 acrosopic 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 costa, very small filamentosus scales on costules and veins; still dark hairs on upper surface of rachis and costa. *Sori* inframedial; indusia small, glabrous.

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

**Ecol.** On rocky banks of stream at 2200 m.


**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 acrosopic 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 costa, scales with widened base present on costa, uniseriate scales on costules; short acicular hairs on upper surface of rachis and costa. *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 L., 1000 m.

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


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


**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 acrosopic 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 costa and costules (a few acicular hairs on costa of type of *D. linealis*, Fig. 4h); upper surface of rachis and costa 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 HOLT TUM, sp. nov.
Caudex gracilis longe-repens; lamina usque 11.5 cm longa; pinnae usque 2.1 × 0.6 cm, lobis dentatis; costae subius pliis acicularius distinguat, eglandulosae, paleis linearibus praedictae; pagina superior pinnarium inter venas glabra; indusia glabra. — Type: J. R. CROFT, LAE 65849, Telefomin Subdist., 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 acrosopic 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 subacutely 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 acrosopic side of costa, 2 on basiscopic side; lower surface of rachis and pinnae lacking hairs of any kind, glands also absent, scales on costa 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


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 acrosopic 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. bed domei; n = 32 or 31 (P. simulata (DAVENP.) NIEUWL.).

Taxon. In his original list of species, CHING included several which I have separated as Cory phopteris, also Aspidium immersum BL. (Amphineuron immersum HOLT TUM). 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* DAVENPI., which is very similar to the type species *P. glanduligera* and has been made the type of a new genus *Wagneriopteris* by LOVE and LOVE, 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*
2. Basal pinnae, at most 2 pairs, slightly reduced.
3. Pinnae to 7.5 cm long; basal pinnae much narrowed at base
   1. *P. glanduligera*
4. Pinnae to 2.0 cm long; basal pinnae not narrowed at base
   1. *P. grammitoides*


**KEY TO THE VARIETIES**

1. Rhizome long-creeping; septate hairs many on lower surface.
2. Pinnae commonly 3–5 cm long
   a. *var. beddomei* — Fig. 5a–b.
   1. Rhizome long-creeping, 2.5 mm diameter, bearing fronds 2–4 cm apart; scales broad, entire, with superficial capitulate hairs only, Stipe 5–10 cm long, green; rachis with capitulate hairs on lower surface only.
   b. *var. eugracilis*

   a. *var. beddomei* — Fig. 5a–b.
   1. Rhizome long-creeping, 2.5 mm diameter, bearing fronds 2–4 cm apart; scales broad, entire, with superficial capitulate hairs only, Stipe 5–10 cm long, green; rachis with capitulate hairs on lower surface only.


   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, *combined nov.* — Dryopteris brassii C. CHR. Brittonia 2 (1937)
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Fig. 5. Parathelypteris beddomei (BAK.) CHING. a. Rhizome and frond, ×\(\frac{1}{3}\); b. pinna-lobe, ×12. — Trigonospora ciliata (BENTH.) HOLTUM. c. One pinna, ×1.5; d. 2. pinna-lobes, ×8; e. spore, ×650. — T. calcarata (BL.) HOLTUM. f. One pinna, ×2. — Thelypteris confluens (THUNB.) MORTON. g. One pinna, ×2; h. part of fertile pinna, ×8 (a–b HOLTUM 26217, c–e HOLTUM 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).

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


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.


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 cm long, 1.3-1.5 cm wide, acuminate, lobed to 0.5 mm from costa; lobes entire, subacuminate, falcate; costules 2-3 mm apart; veins to 8 pairs, usually simple; lower surface of rachis and costa 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.


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


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 costa bearing scattered slender hairs of mixed length to 1 mm long, glands present on and between veins; hairs on upper surface of costa 0.5 mm long, few hairs on costules. Sori supramedial to medial; indusia small, thin, with rather long slender hairs and a few glands.


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. cryptopteroides (EATON) CHING in Japan and the northern Ryukyu Islands is also closely related.

7. TRIGONOSPORA


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.

**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 inesura. 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 capitulate 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 *Nephrodictis calcarata*; 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. calcarata* and *N. falcilobum*.

**Thelypteris khampatorum** 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*
3. Pinnae to 8 × 2 cm, basal acroscopic lobe not much elongate; pinna-lobes widest 1/3 from their apices ........................................... 2. *T. koordersii*
3. Edges of pinnae lobed to 1.5-2 mm from costa; lobes wider than sinuses between them; indusia hairy ........................................... 3. *T. ciliata*

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3. **Stipe** 8-20 cm long, dark at base, glabrescent except in groove. *Lamina* 10-20 cm long; pinnae to 16 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, costa 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.


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.


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.


8. THELYPTERIS


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 capitae 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 its 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 Mesophlebon; from these three Thelypteris differs in (a) capitae 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 Cochín 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 calcara var. 
Fig. 6. *Mesophlebion oligodictyon* (BAK.) HOLTUM. a. Whole plant, × 3; b. venation of sterile frond, × 4. — *M. trichopodum* (C. CHR.) HOLTUM. c. Rachis and basal pinna, × 3; d. two pinna-lobes, hairs omitted, × 4; e. costa, costule and sorus, × 24. — *M. beccarianum* (CESATI) HOLTUM. f. Suprabasal pinna, × 3; g. venation and sori, × 8. — *M. enderti* (C. CHR.) HOLTUM. h. One pinna, × 1 (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 Pseudocyclorus.

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


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 acrosopic 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


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 capitulate) 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, papilllose without a wing in *M. beccarianum* and *M. chlamydophorum*.

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


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

Cytol. Base chromosome number 36; *M. crassifolium* and *M. trichopodum* both tetraploid in Malaya (MANTON in HOLTJTTUM 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 HOLTJTTUM in 1955. In 1963 CHING established the genus *Mesoneuron* for them, but as *Mesoneuron* 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* (HOO.) HOLTJTTUM) to which RIDLEY referred specimens of *M. trichopodum*.
7. Pinnae much longer.
8. Largest pinnae with several pairs of pinnules
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
12. Pinnae 14–18 pairs; young fronds not red
13. Pinnae to 6.5 cm wide, lower ones with stalks 3–4 cm long
14. Pinnae not more than 4 cm wide, lower ones with stalks to 1.5 cm long.
15. Hairs on lower surface of costae and costules c. 1 mm long.
16. All pinnae distinctly stalked; copious short hairs and glands between veins on lower surface
17. Pinnae sessile; sparse erect hairs 0.5 mm long and no glands between veins on lower surface
18. m. trichopodum
19. Hairs on lower surface of costae and costules not over 0.3 mm long.
20. Indusia firm, glabrous, covering the sorus almost to maturity; fertile pinnae lobed to 1–1½ mm from costa
21. m. beccarianum
22. Indusia small, not covering developing sori, or ± hairy; fertile pinnae lobed less deeply.
23. Fertile pinnae lobed to 2 mm from costa; indusia small, firm, glabrous.
24. m. rufescens
25. Fertile pinnae lobed less deeply; indusia usually with some hairs, thin and almost obscured by sporangia if small.
26. Fronds rarely dimorphic; pinnae thin, rarely more than 2 cm wide; indusia always conspicuous, firm, bearing a variable number of short hairs
27. m. chlamydomphorum
28. Fronds usually dimorphic; pinnae rigid, fertile to 3 cm wide; indusia varied in size, thin and shrivelling when dried
29. m. crassifolium


Stipe 35–40 cm long, densely scaly; scales medium brown, to 8 × 2 mm, with thick persistent bases; similar scales on rachis. Lamina 30 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).

tologia 17 (1968) 281. — Type: HALLIER 3204, Amat Ambit, W. Kalimantan (P. B.O.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 costa; 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.


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 costa; 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.


Nephrodium crinitus sensu RUT. J. Mal. Br. K. 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 basal side of largest sterile lobe, to 18 on fertile lobes (to 15 on acroscopic side), basal basiscopic vein arising from costa far from its costa, 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, Malay, Sumatra.

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

Notes. Specimens from Malay 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.


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 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.


Caudeu 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* median; 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.


Caudeu 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* median, 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 of 1.3 × 0.5 cm.


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 pinnales c. 1.5 cm apart, then some separately adnate lobes, distal part of pinnae deeply pinnatifid; basal pinnales very unequal (basiscopic 2 cm, acroscopic 4 cm long); *largest pinnales* 5 × 1 cm, in basal half lobed halfway to costule; veins to 23 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.


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.

Ecot. In forest, at 0–1200 m.

Notes. The type of Dryopteris visoniscarpa 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 HOLT T TUM, sp. nov.

Frondes dimorphae; pinnae usque 18-jugatae, inferiores stipitatae, steriles usque 14 × 2.5 cm, fertiles usque 11.5 × 1.7 cm, omnes dimidio costam versus lobatae, lobis falcatis; venae infinae 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 HOLT T TUM, 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 dultense HOLT T TUM, 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, 0.5 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 inframedially 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.


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 lower 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. teusneri and M. arenicola; the latter are much smaller plants, growing apparently in a different kind of habitat.


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 (stipe 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.


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. chlamydomphorum, 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 x 1 mm, distal part of stipe short-hairy. Lamina 42 cm long, texture firm, red-brown when dry; pinnate 12 pairs, mostly opposite; basal pinnate with stalks 10 mm long, basal pair of lobes much reduced; fourth pair of pinnate truncate to full width at base. Largest pinnae 12 x 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. Sorti 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 1 and Geelvink Bay, SCHÖNIAN s.n. 1929 in B).

**Ecol.** In forest at 300 m.


**Lastrea nephroidoides** 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-growing, 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; pinnate 15–20 pairs, lower pinnate with stalks 2–3 mm or sometimes longer, 1–3 pairs of basal lobes reduced. **Largest pinnae** commonly 15 x 2 cm, to 20 x 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. **Sorti** 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.


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

**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).


**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; pinnate to 20 pairs, subopposite, rather widely spaced; basal pinnate with stalks 3-15 mm long, basal 1–3 pairs of lobes reduced. **Largest fertile pinnae** 15 x 3 cm (sterile to 25 x 4.5 cm), apex acuminate and sometimes caduate; 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; Holtttum, Sen & Mittra, Blumea 18 (1970) 200, 212; Holtttum, Blumea 19 (1971) 27; Allertonia 1 (1977) 181; of most other authors p.p. min. — Fig. 1r, 7a–e.

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, × 1 (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.

Ecotol. 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 *Amphlopertis* (see HOLLTTUM, 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.


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


*Hypolepis propiniquoides* BORY, ibid. Lc. — Type: BÉLANGER, Java (not seen).


**Stipe to c. 45 cm long, lightly flushed with red or orange above dark base, glabrescent. Lamina commonly 30–50 cm long; pinnae 20–25 pairs; several pairs lower pinna 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 ciliate 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 glandular scattered on costules and veins, broad 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; if dusia thin, bearing short acicular hairs and sometimes capitate hairs.**

Distr. Tropics and subtropics.

Notes. It seems probable that *Aspidium*
11. AMPELOPTERIS


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 glochial gland; spores similar to those of Cyclosorus.

Type species: Ampelopiteris elegans KUNZE = A. prolifera (RETTZ.) COPEL.


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. Ampelopiteris 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.


Goniopteris meniscioides FEE, Gen. Fil. (1852) 253. — Type: CUMING 168 (P; FI-W, G, K, LE). — Fig. 7d-4.

Primary pinnae to 20 x 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 x 0.8 cm.
Fig. 8. *Chingia ferox* (BL.) HOLTUM. a. Rachis with terete scales and base of a pinna bearing coalescent sori, ×4; b. two old sori, ×12. — *C. sakayensis* (ZEILLER) HOLTUM. c. Two pinna-lobes, ×2; d. part of a pinna showing glands and position of sori, ×4; e. one sorus, ×10. — *C. pricei* HOLTUM. f. Two pinna-lobes, showing venation and position of sori, ×4; g. one sorus, ×16. — *C. christii* (COPEL.) HOLTUM. h. Two pinna-lobes, ×4. — *C. clavipilosa* HOLTUM var. javanica HOLTUM. 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).
Thelypteridaceae

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


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 20 or more pairs, closer together.
4. Sori all elongate; veins not prominent on lower surface
   3. C. muricata
5. At most basal sori elongate; veins rather thick and prominent beneath.

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 auriculate. 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.


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 costa 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.


Stipe 45 cm long, densely covered with spines 1–2 mm long and scales; scales to 24 × 1 mm, hairpointed, bearing short setae, grading in distal part of stipe to terete hairy spines 8 mm long. Lamina c. 100 cm long; pinnate 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 1/3–1/5 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. 11 pairs anastomosing, 2 pairs to sides of sinus-membrane; lower surface of rachis with slender terete bristles to 8 mm long, of pinnate glabrous apart from a few hairs on sinus-membrane and edges. Sori all somewhat elongate (elliptic in outline), distal ones near costa, lower ones a little divergent, exindusiate; no glands on sporangia.


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


Goniophyton barbata Fée, Gen. Fil. (1852) 252.—Phegopteris barbata (Fée) Mett. Farnatt. IV (1858) 24.—Polyodium barbatum (Fée) Hook. Spec. Fil. 5 (1864) 10.—Type: Cuming 172, Luzon (orig. ill; 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 costa, 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 basiscopisc one, not elongate; sporangia of Java specimens lacking glands, small red glands present on some specimens from Moluccas and Philippines.


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.

Guinea (Fl. Herb. Becc. 12668).


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 2/3–3/5 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 acrosoric 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 11–2 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.


Cyclosorus ferox sensu HOLTTUM, Rev. Fl. Malaya 2 (1955) 265, f. 151, quoad pl. Malay. tantium. — 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 x 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 x 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 costa (at least distally) and costules bearing ± abundant slender spreading hairs to 1.5 mm long; on costa, costules and veins abundant small capitate hairs, on surface between veins short capitate hairs and very small sessile glands; upper surface of costa 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 x 1 cm) with more copious acicular hairs on lower surface.

b. var. javanica HOLTTUM, var. nov., ab var. clavipilosa differt: costis costulis venisque subitus glandulis sessilibus vel subsessilibus praeditis, glandulis inter venas nullis; sporangis immunis glandulis pallidibus minutis praeditis.—Type: 1221 Herb. Bog., Tjibeureum, G. Gedeh, Java (BO).—Fig. 81.

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 bewanensis 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 x 1.8 cm, vix 1/4 costam versus lobatae, subitus 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 x 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, 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 costa, very short capitate hairs also present on and between veins; upper surface of costa bearing thicker hairs, shorter ones also on costules and veins. Sori all close to costules, not elongate, exindusiata; no glands on sporangia.

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

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 x 1.8 cm, vix 1/4 costam versus lobatae, subitus 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 x 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, 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 costa, very short capitate hairs also present on and between veins; upper surface of costa bearing thicker hairs, shorter ones also on costules and veins. Sori all close to costules, not elongate, exindusiata; no glands on sporangia.

Distr. Malesia: N.E. Sumatra; known from the type and SURBECK 814, from Sibuanan.
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 small capitate hairs on both surfaces and on sporangia. The largest pinna is 24 × 2.1 cm, in shape and venation like the type.


Stipe to 200 cm long (ELMERT), 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.


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.


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 subtruncated; apex narrowly attenuate; edges lobed 2½ 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 costa pale, 0.8 mm long. Sori all near costules, not elongate; indusia small, with a few small glands or short hairs.


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.


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 of 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 ... 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 (Mt Talama and Kerintji), at 2200–2750 m.


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 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 Jiang mountains in East Java have fewer acicular 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 (Tenger MtS) has a seta on a few sporangia, capitate hairs on others.


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 Oomis Range, is smaller than the type, with fertile pinnae 12.5 × 1.4 cm, rather less deeply lobed.


Caudeix 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, infinia vel ad basin membranae sinus junctae vel ibi conniventes non junctae, vena acroscopic a 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 deciduous be-
Fig. 9. Plesioneuron marattioides (ALSTON) HOLTUM. a. Base of stipe, × \(\frac{1}{2}\); with scale and spine, × 2; b. lower pinna, × \(\frac{1}{2}\); c. one pinna-lobe, × 1. — P. tuberculatum (CESATI) HOLTUM. d. Lower pinna, × \(\frac{1}{2}\); e. one pinna-lobe, × 3; f. sori (one with indusium removed), × 16. — P. savaiense (BAK.) HOLTUM. g. Basal pinna, × 1; h. one pinna-lobe, × 3; i. sorus, × 16 (a–c MILLAR & HOLTUM 15996, d FLOYD 5595, e–f BRASS 27112, g–i PRICE 2605).
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


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 (CESÁTI) HOLTTUM.

Distr. Malesia & Pacific: Borneo (2 spp.); Moluccas (Tidore, Batjan, Buru, Ambonina, 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. opihura) 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 \textit{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 \textit{Dryopteris subg. Steiropoteris} C. \textit{CHR.} (Monogr. Dryopt. 1, 1913, 161), a group of species in the American tropics. These species differ from \textit{Plesioneuron} as follows: rhizome wide-creeping; sepaline 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 \textit{Plesioneuron}). Two aberrant species included with doubt by \textit{CHRISTENSEN in subg. Steiropoteris} are more similar to \textit{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
4. Sori exindusiate.
5. Sporangia bearing several long setae
7. Pinnae of well-grown plants much larger; basal veins both ending beside sinus-membrane.
8. Stipe-scales terete at base and apex, less than 0.5 mm wide in middle; pinnae to 4.5 cm wide
9. Stipe-scales flat except at base, largest at least 1 mm wide; pinnae rarely more than 3 cm wide
10. Pinnae lobes not thus auricled.
11. Pinnae lobes almost to costae; lobes not separately adnate
12. Pinna-lobes in basal half of pinnae separately adnate to costa
13. Sporangia bearing several long setae.
14. Stipe-scales overlapping margin; basal acroscopic lobe of lower pinnae elongate with forked veins
15. Indusia overlapping margin; basal acroscopic lobe of lower pinnae not enlarged
16. Indusia not overlapping margin; basal acroscopic lobe of lower pinnae not enlarged
17. Both basal lobes on basal pinnae free and short-stalked
18. P. bipinnatum

1. \textit{P. pullul}
2. \textit{P. fuchsii}
3. \textit{P. medusella}
4. \textit{P. woodlarkense}
5. \textit{P. dryopteroideum}
6. \textit{P. varievestitum}
7. \textit{P. notabile}
8. \textit{P. septempeda}
9. \textit{P. marattioides}
10. \textit{P. fulgens}
11. \textit{P. belense}
12. \textit{P. warieense}
13. \textit{P. royenii}
14. \textit{P. cystodioleous}
15. \textit{P. subterminale}
16. \textit{P. bipinnatum}
17. Basal lobes of basal pinnae not free
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. 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. Hairs on lower surface of rachis and costae 0.3 mm long, on upper surface between veins short-erect
18. Pinna-lobes not conspicuously falcate on both sides of costa.
21. Basal 10–12 pairs of pinna-lobes separately adnate to costa
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
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. 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. Lower surface quite glabrous.
27. Pinnae c. 11 × 2 cm; basal acroscopic lobe of basal pinnae reduced
28. Pinnae c. 22 × 3 cm; basal acroscopic lobe of basal pinnae elongate
29. Pinnae lobed to 0.5 mm from costa
30. Pinnae lobed to 1–2 mm from costa
31. Basal pinnae sessile or nearly so.
32. Pinnae to 6 cm long; lobes on basiscopic side strongly falcate, on acroscopic side almost straight
33. 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
35. Some sporangia lacking setae, glands usually present
36. Aerophores pale, slender, 1 mm long; sori near costules

1. Plesioneuron pullei Holttum, Blumea 22 (1975) 236.—Type: PULLE 905, W. New Guinea, Mt Hellwig, 2600 m (L; BM).
2. Cauldex 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 coriaceous; 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, Kabor Range, at 3450 m, differs as follows: pinnae 18–20 pairs on a frond 30 cm long, costaules 3-4 mm apart; veins 6-7 pairs; a very small hairy indument present. The plant was on a steep bank near a rock-face in moss-forest, the fronds pendulous.


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 4.5–5 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 costa; 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: Borneo (Sarawak: Mt Mulu 1500 m), only known from the type.

Ecol. "In Pandanus zone over limestone pinacles; 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.

3. Plesioneuron medusella Holttum, sp. nov.

Caudex erectus, tenuis; stipes usque 25 cm longus, cum rachi omnino paleis angustis usque 8 mm longis vestitis; pinnae usque 9 × 1.2 cm, profunde lobatae; venae 6–7–jugatae, infimae ambae ad marginem terminatae; costae subus sublis 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 pinacles; 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.


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 black spines on lower surface, on upper surface 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 red scales...
dish hairs 1 mm long, shorter hairs scattered on veins and surface between them. Sori near costules, exindusiata; 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.


**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. dryopteroides
   1. Stipe-scales to 18 mm long; acicular hairs on lower surface of costae 1 mm long
   c. var. pilosum
   a. var. dryopteroides
      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 sub sessile 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, exindusiata; sporangia bearing neither setae nor glands; spores dark, spinulose.


b. var. buruense HOLTUM, var. nov.
   A typo speciei differt: rachi costisque subtus pilis brevibus capitis capitatis solum vestitis. —Type: STREEMANN 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 HOLTUM, var. nov.
   A typo speciei differt: paleis stipitis usque 18 mm longis; costis costulisque subtus pilis 1 mm longis copiosae 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.


**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 costa 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.


Notes. Christensen and Copeland failed to see the indusia, which are partly obscured by the developing sporangia. As in _P dryopteroides_, the small glands on pinnae are sometimes swollen and yellow, perhaps through infection by a fungus.

b. var. obtusilobum HOLTtUM, var. nov.

A typo speciei differt: rachi costisque subitus pilis 0.1 mm longis vel capitatis vel obtusi praedita; pagina inferiore pinnarum inter venas pilis acicularibus brevibus pilis brevioribus capitatis interni mixtis 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 supraspingina_. They appear to develop a waxing covering of their tips when old.


Caudex not known. Stipe and frond together 3–4 cm 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 costa 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 (LedeRRMANN 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, 1, 8, f. 11.—Type: L. E. Chees-MAN 1383, W. New Guinea, Jalen 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 costa 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 (Jalen I), only known from the type.

9. Plesioneuron marattiioides (ALSTON) HOLTtUM, Blumea 22 (1975) 238.—Dryopteris marattiioides ALSTON, J. Bot. 78 (1940) 227; Nova Guinea n.s. 4 (1940) 110, pl. 7, f. 7, 8.—Type: CLEMEMS 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 sub-opposite, 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 3.5 cm, 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.


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

Mesioneuron wantiense sensu Holttum, Blumea 13 (1965) 134. — Fig. 1.

Caudex creeping, 4.5–5 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 pinna-like. 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 costa; 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.


Ecol. At 1300–2000 m, on steep banks of streams, sometimes among rocks, in forest.


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.


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 pinna-like. Largest pinnae 18–30 cm long, to 3.5 cm wide; apophores 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, colorless 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. wariente* in having sori near costules and small caducous indusia. The sori of the type of *P. wariente* are not quite mature.


**Caudex** short-creeping; stipe 40 cm long, basal scales 6 x 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 acrosopic 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 pubescent; 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 L.), only known from the type.

**Ecol.** In forest at 3 m altitude.


**Caudex** short, creeping or suberect; stipe 20–50 cm, ± short-hairy at least distally, basal scales to 12 x 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 acrosopic side), basal acrosopic lobe free or nearly so, sometimes with a toothed margin. **Largest pinnae** 10–12 x 2.0–2.5 cm; apex acuminate, sometimes with a short cauda; edges lobed to 1 mm from costa or more deeply, lobes on acrosopic 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 x 1.0 cm and very narrow scales 10 mm long. A Philippine specimen has much less hairy scales than any from New Guinea.


**Caudex** short-creeping, apical scales to 10 x 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 acrosopic lobe of basal pinnae little reduced, basal basiscopic lobe 12 mm long, apex of frond not pinna-like. **Largest pinnae** 21 x 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 acrosopic side of costa almost straight, those on basiscopic side rather strongly falcate but little shorter than acrosopic 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 cistidioides Holttum, sp. nov.

Pinnae usque 12×2.5 cm, subsessiles, fere ad costam lobatae, lobis acroscopicis et basiscopicis aequitale leviter falcatis, lobis infinis acroscopicis variabile elongatis; venae usque 15-fugatae; rachis costaeque subitus pilis 0.1 mm longis praedita; sori submarginales, indusia magna, marginem superantia; sporangia nec setifera nec glandulosa.—Type: T. Nakaika 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 costa, 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.


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 sinus 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.


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 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.


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; aero-phores 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 inframiedial; 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, omnina pilis erectis usque 1 mm longis vestitis; lamina c. 50 cm longa; pinnae 25-jugatae, usque 12 × 1.8 cm, lobi utrisque falcatis; venae 10-jugatae; rachis costaeque subitus pilis erectis varii usque 1 mm longis dense vestitae, venae subitus paginaque inter venas pilis multis tenuibus erectis praeditae; pagina superior pin- narum pilis adpressis 0.3 mm longis vestita; sori mediales, indusia parva, setosa; sporangia non setifera. — Type: KOSTERMANS & SOEDENG142, 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; aero-phores 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 inframiedial; 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 angiosensis HOLTTUM, sp. nov. Stipes 45 cm longus; laminae 55 cm longa; pin- nae 24-jugatae, usque 12 × 2.1 cm, sessiles; venae 12–13-jugatae; rachis costaeque subitus pilis 0.3 mm longis erectis vestitae; pagina superior inter venas pilis brevisus erectis praedita; sori inframiediales; indusia marginis 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-
cors' 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-acuminated; 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 acrosopic 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 sandisi 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 singulatis ad costam adnatis; rachis costaeque subius pilis brunneis erectis vestitae, costae etiam paleis angustis praeditae; sori inframediales; indusia firma, glabra; sporangia minutiis praedita.—Type: M. J. S. SANDS 2380 A, New Guinea, 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 acrosopic 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 acrosopic 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, pungent 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.


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, acrosopic 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 acrosopic 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 acrosopic 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.


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 acrosopic lobe of basal pinnae free, soi 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.—


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-haired, glabrescent, of costa ± 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 costa, 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.


Ec. in New Ireland and New Britain, in forest at 1100–1300 m, at lower altitudes in the Solomon Islands.


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 ± ciliate; 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.

Ec. in Castanopsis forest at 1050 m.


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 metentitibus, lobis omnibus acutis, lobis basiscopicis valde falcatis, lobo infimo acroscopicico pinnarum mediariurn usque 2.5 cm elongato, lobis inferioribus utroque laterer pinnarum superiorum redactis; sporangii glanduliferis, receptaculo sori pilis acicularibus multifidis praedito. —Type: L. E. CHEESEMAN 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 acuminated 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 4.5–5.5 mm apart; veins 3 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.


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 rachis not pinna-like. Largest pinna 8 × 1.6 cm; aerophores slightly swollen; apex acuminated 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 3.5–4.5 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 papilllose.

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.


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 acuminated; 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*.


*Caudex* short-creeping, 1.5 cm diameter; *stipe* 25–40 cm long, glabrescent, basal scales rather thin, apparently c. 3 x 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 acrosopic 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 costa, 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.


Note. Specimens from Japen Island have some setiferous sporangia, those from type locality only glands.


*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 acrosopic 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 x 2.5 cm; apex acuminate, not or little caudate; edges lobed to 1 mm from costa or more deeply; lobes on acrosopic 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.


Note. It is possible that this is connected by intermediates with *P. ophiura* and *P. costuliflorum*.


*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 x 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 acrosopic side almost straight, on basiscopic side shorter and falcate; costules 3–4 mm apart; veins 10–12 pairs, basal acrosopic 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.


*Caudex* short, thick, creeping; *stipe* to 26 cm long, minutely hairy; basal scales thick at base, thin distally, to 5 x 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 x 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 acrosopic 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 (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 acrosopic 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 12.5 × 2 cm on type (14 × 2.5 cm on Brass 28451); acropores slightly elongate; apex short-acuminate with entire cauda 10-15 mm long; edges lobed to 1.5 mm from costa; lobes slightly falcate, those on basiscopic side somewhat more oblique than those on acrosopic side; costules 3.5-4.5 mm apart; veins 10-12 pairs, slender and prominent both sides, basal acrosopic 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 5-5jugatae, suboppositae; pinnae infima sessiles, aerophoris tenuibus pallidis 1 mm longis praeditae, lobis infinis vix redactis; pinnae maximeae 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, acrosopic 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**


Caudex short to long-creeping; scales on stipe-base bearing acicular hairs, sometimes hooked; fronds drying dark-olivaceous, bearing short
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 indusiate; 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).


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.

15. PSEUDOCYCLOSORUS


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 (Sod.).

Cyotol. Chromosome numbers 35 and 36 both reported. P. tylodes, diploid (36, Ceylon and N. India); P. esquiriolii and P. repens, both diploid (35, N. & S. India); P. ochthodes, diploid (35 and 36 both reported from India). There are erroneous records in LOVE, LOVE & Pichi Sermoli, 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 HOLTUM, 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 (HOLTUM, Amer. Fern J. 63, 1973, 82).

Ind. Fil. (1858) 107; Bedd. Ferns S. India (1863) t. 107; Copel. Fern Fl. Philippine (1960) 330. — Nephr-

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. tyloides tantum. — Dryopteris luerssennii (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 truncate with basal acroscopic lobe ± elongate; apex caudate-acuminate; edges lobed to 1.5–2.2 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 (1.c. 1851, p. 244) that he intended the specific epithet to be tyloides (from the Greek tylos, meaning a hump or knob, referring to the aerophores); the name is also so written in the description of Aspidium ochnodes where the two species are compared. Mettenius, Hooker and Beddome all adopted this spelling. It seems to me certain that the spelling xyloides 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 xyloides by later authors as an error, to be corrected.

16. PNEUMATOPTERIS


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 sepaline 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 \( \pm \) quadrate wings, in a few species a \( \pm \) 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 c. 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. penigera* (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. Bt zg 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 costa; persistent 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 persistent 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 an astomosing 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*
5. Pinnae to 12 × 2 cm with cauda 1.5 cm; spores with wing and cross-wings... 2. *P. sibelana*
6. Indusia present.
7. Pinnae short-acuminate (Sumatra)...
8. Pinnae narrowly long-acuminate (Philippines)...

3. *P. dicranogramma*
4. *P. callosa*
5. *P. subappendiculata*
6. *P. superba*
7. *P. costata*
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, ×½; 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, ×½. — P. keysseriana (Rosenst.) Holttum. i. Basal pinna, ×½; 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.
14. Basal large pinnae narrowly cuneate at base on basiscopic side
15. Brown hairs on rachis both sides; pinnae to 8 cm long
16. Pinnae lobed 2/5–1/2 towards costa
17. Basal pinnae not auricled on acrosopic base.
18. Basal pinnae not or variably a little reduced.
19. Pinnae 4 cm or more wide, lobed less than 1/2
20. Basal pinnae acrosopic pairs, lower transition at 4–5 cm
21. Largest reduced pinnae and lower normal ones distinctly auricled at their bases
22. Pinnae lobed 1/2 way to costa; c. 12 pairs of reduced pinnae, largest 3 cm long
23. One pair basal pinnae reduced.
24. Reduced pinna 2 cm long; normal pinnae lobed more than 1/2
25. Reduced pinnae 1 mm long; normal pinnae lobed less than 1/2
26. Linnae 2–4 pairs, subequal
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
29. Pinnae 1/2–2/3; basal veins meeting at base of sinus-membrane
30. Indusia very small; lower surface bearing minute glands between veins
31. Pinnae lobed 2/3 or more deeply.
32. Pinnae lobed to 1.5 mm from costa, not pustular between veins when dried
33. Pinnae lobes dentate at ends of veins
34. Pinnae lobes entire
35. Pinnae lobed to 2.5 mm from costa; hairs present on all parts of lower surface
36. Pinnae lobed to 4 mm from costa; lower surfaces quite glabrous
37. Stipe-scales narrow, spreading
38. Pinnae commonly 2.5–3 cm wide; sporangia lacking glands
39. Veins in fertile pinnae 7–10 pairs or more; pinnae usually much longer.
40. Middle and upper pinnae very oblique, their bases asymmetric; apices of pinnae long and very narrow.
41. Lower pinnae reduced towards their bases and not auricled.
42. Pinnae lobed 1/2 way to costa; c. 12 pairs of reduced pinnae, largest 3 cm long
43. Reduced pinnae 1 mm long; normal pinnae lobed less than 1/2
44. At least 2 pairs of abruptly reduced pinnae or several pairs gradually reduced.
45. Pinnae to 2.5 cm wide, lobed more than 1/2
46. Reduced pinnae 2–4 pairs, subequal
47. Veins in fertile pinnae 2–5 pairs; pinnae in most cases not over 12 cm long.
48. Pinnae auricled on acrosopic base.
49. Basal pinnae narrowly cuneate at base on basiscopic side
50. Basal large pinnae truncate at base on basiscopic side.
51. Veins in fertile pinnae 2–5 pairs; pinnae in most cases not over 12 cm long.
52. Basal pinnae auricled on acrosopic base.
53. Basal pinnae not auricled on acrosopic base.
54. Basal pinnae auricled on acrosopic base.
55. Basal pinnae auricled on acrosopic base.
38. Pinnae not over 2 cm wide; sporangia bearing glands
36. Pinnae of well-grown plants lobed less than 1/2.
39. Pinnae commonly 20 x 2.5 cm, usually with some hairs on lower surface of costa, often also between veins
39. Pinnae not more than 2 cm wide; lower surface quite glabrous.
40. Pinna-lobes almost at right angles to costa; sporangia bearing glands
40. Pinna-lobes oblique; no glands on sporangia
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
41. Upper reduced pinnae as long as wide, not dilated at base nor lobed above base, strongly pustular between veins
38. P. kerintjensis

1. Veins free.
42. Largest pinnae less than 2 cm long, entire or slightly crenate; many pairs of lower pinnae gradually decrescent
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. versteeghi
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 x 4 cm; basal acroscopic lobe of middle pinnae not almost free
44. P. keysseriana
51. Pinnae c. 8 x 1.5 cm; basal acroscopic lobe of middle pinnae almost free
45. P. caudata
50. Sori mediinal; pinnae lobed to less than 1 mm from costa; basal veins from adjacent costules ending far apart at the margin.
52. Basal basiscopc lobes of middle pinnae equal to acroscopic lobes
46. P. deficiens
52. Basal basiscopc 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 costa
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

I. Pneumatopteris glabra (COPEL.) HOLT TTUM, Blumea 21 (1973) 301. — Cyclusor us glaber
Mt Masigait, 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 ciliate-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 short curved brown hairs, sparse minute hairs on costa, rest of surface glabrous; upper surface glabrous apart from rachis and costa. 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.


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 x 1.8 cm; base truncate; apex short-acuminate, serratte to tip; edges lobed 1/3–1/2 towards costa, lobes falcate, acute; costules 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 costa, rest glabrous; upper surface of rachis covered with brown hairs, of costa 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 HOLT TUM, Rev. Fl. Mal. 2 (1935) 267 is F. callosa.


Gonioperis lobbiania FEE, Gen. Fil. (1852) 251. — Type: LOBB, Java (orig.; isotypes BM, K).

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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 aerotheca 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 aerotheca at the base of each; veins c. 12 pairs, slender and prominent both sides, basal 1–2 pairs anastomosing, 3–4 pairs passing to sides of the prominent sinus-membrane; lower surface of rachis and costa 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 costa, 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 with orange; spores with many small wings.

Distr. Malesia: Western Malesia, Celebes, Lesser Sunda Is. (Flores) and Moluccas (Ceram).

Ecot. 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 multifurcatum, referring to Nephrodiium multifurcatum 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.


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 acrosopic base. Lamina excluding reduced pinnae to 90 cm long; pinnae c–16 pairs, opposite, with conical aerothecae at their bases; basal pinnae auricled on acrosopic 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-acuminete; 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 1–2 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 costa paler and more slender. SorI medial (distal ones inframedial); indusia thin, pale, with a few short hairs; sporangia lacking glands.


Note. It is not clear whether this is sharply distinct from P. superba.


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 acrosopic side), edges lobed up to 1/3 towards costa, more deeply on basiscopic than on acrosopic side; lobes with broad undulate cartilaginous edges; costules 6–7 mm apart; veins 10–16 pairs; basal sori not much divergent.


Ecot. In forest at 1700–2700 m.


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 decurrent, 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 sub sessile 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. WEILS and CHRISTENSEN confused P. costata with 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.


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 sub sessile 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 sub erect 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 egenolfoides 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 basescopic; apex narrowed, subtruncate with a small micro; 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.
Ecol. Limestone cliffs at 2200 m.


_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 on both sides, middle ones broadly triangular, opposite or not; _sori_ 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 loked 1/4 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 costa bearing a variable number of brown hairs, some short pale hairs also on costa, rather sparse large pustules on surface between veins; _upper surface_ of rachis covered with thick brown hairs to 1 mm long, hairs on costa 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).


Note. The type appeared to be very distinct, but later collections indicate a possible gradation to the condition of _P. jermyi_.

11. **Pneumatopteris cheesmaniae** HOLTUM, 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 1/2 or a little more deeply; lobes ± quadrate, apices subtruncated 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_ inframiderial, lowest not divergent, exindusiata; _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** HOLTUM, sp. nov. _Lamina_ 30 cm long; _pinnae_ 16–18-jugatae, infeories 6–7-jugatae sensim decrescentes; _pinnae maxime_ 3.0 × 1.0 cm, _marginibus_ creatis, _apicibus_ rotundatis, pagina inferiore fere glabra; _rachis supra pilis brunneis vestita_, _pinnae suprah_ _inter venas pilis erectis aciculatis 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 costa 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 costa 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.

Ecol. On limestone cliff in forest at 700 m altitude.

13. **Pneumatopteris angusticaudata** HOLTUM, Blumea 21 (1973) 308. — Type: BRASS 24984, New Guinea, Goodenough Island, 800 m, on a rock-face beside a stream (BM; LÆ).

_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 ful- 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.


**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×(5–)5 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 acrosopic side; apex acuminated, ± cuneate on largest pinnae; edges lobed ½ way to costa; lobes obliquely quadrated, ± 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.


**Caudex erect or suberect; stipe 20–50 cm long, *ile, glabrescent, basal scales appressed; base of *ipe to first large pinnae 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.


**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, 2| pairs anastomosing, 2|–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.


Caudex long-creeping, to 10 mm diameter; stipe c. 100 cm long, pale, glabrous, basal scales c. \(10 \times 4\) 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 pubescent; 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.


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 30 cm; reduced pinnae 3—5 pairs, transition to large ones gradual or subabrupt, lowest 5—10 mm long, all strongly auricled on acropodial 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 acropodial side, narrower and rounded on basipodial; 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 acropodial vein to sinus-membrane; lower surface quite glabrous, slightly pubescent; 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 acuticular or capitate hairs on edges; sporangia usually lacking glands. Chromosomes: \(n = 36\) (T. G. WALKER, plant cult. Kew).


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.


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 pinna 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 a 1100—1200 m (5 collections).

20. Pneumatosperis basicurtata HOLTUM, 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 acropodial 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 **BUNNEMEIER** 10296 19 × 2.7 cm; base truncate, slightly dilated both sides; apex short-acuminate; edges lobed a little more than 1 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 base pinnae is needed.

21. **Pneumatopteris microauriculata** HOLTUM, Blumea 21 (1973) 311. — **Type:** CLEMENS 27137, Mt Kinabalu, Sabah, 850 m (BM).

*Caude* 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 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 tapering 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, coxicolorous, prominent both sides, 1 pair anastomosing, 1–2 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.


*Caude* 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. 1/5 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, lower 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 auctipina** HOLTUM, 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).


*Cau* 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, sinuor 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 costa 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 & Ambon), 900–2000 m.

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 acuminated 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.


Diffs 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.


*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 acuminated; 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 pale 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 capitale 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., N. Ireland).

27. Pneumatopteris japonensis HOLTNUM, sp. nov.

*Pinnae* basales redactae 12-jugatae, *superiores* 1.5 cm longae, auriculatae; *lamina* 100 cm long; *pinnae* maximae 24 × 2 cm, profunde lobatas; *tenues*; *venae* inferior *communi* excurrenti *perbrevi*; *pagina* inferior inter *venas* glandulas minus ferens; *indusia* para*-glabra.*—Type: AET & IDIAN 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 pinna 65 cm; *reduced pinnae* 12 pairs, upper ones *auriculatum*, 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 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 costae 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 erosive 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, serratate to tip; edges lobed to 4 mm from costa; lobes oblong, sub-truncate 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 few short hairs; sporangia bearing capitulate 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.


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 capitulate 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 sternes usque 17×2.8 cm, 2/3 costam versus lobatae, subtilis perfectae glabrae; venae 12-jugatae, infiniae 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.
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 symmetrical, edges lobed, tip acute, lowest c. 6.4 × 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 ciliate-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.

Dis. Malesia: Papua New Guinea (New Ireland), only known from the type.

Ecol. On mossy limestone boulder in forest at 630 m.


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 symmetrical, edges lobed, tip acute, lowest c. 6.4 × 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 ciliate-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.

Dis. Malesia: Papua New Guinea (New Ireland), only known from the type.

Ecol. On mossy limestone boulder in forest at 630 m.

33. Pneumatopteris micropaileata HOLTJUM, Blumea 21 (1973) 319.—Type: HOLTJUM 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 capitulate hairs; spores not seen (sporangia immature).

Distr. Malesia: Sabah (Mt Kinabalu), known from type only.

Ecol. On wet rocks near waterfall at 1800 m.


Dryopteris batacorum var. winkleri RONSTEN. Fedde Rep. 13 (1914) 217. — Type: J. WINKLER 158a, Sumatra, in terra Batakorum (S–PA).

*Cyclosorus lepidopus* C. CHR. & TARD. Notul. Syst. 7 (1938) 73; Fl. Gén. 1–C, 7, 2 (1941) 392, f. 45. — *Thelypteris lepidopa* (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. Bizg 1 (1898) 190, non (Gaud.) PRESL. — Fig. 11f–I.

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 narrower 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, 1–2 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 pubescent; *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 inferradial, 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 epiphet *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 GAUDCHAUD'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.


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.


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 michaelsi 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 acrosopic 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. I/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, I. 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.


Ecol. A common species at low altitudes, often near streams, sometimes in rather open places.


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 1/2 way to costa on small fronds, more than 1/2 on type; lobes slightly oblique, their apices almost rounded on largest pinnae, sub-truncate 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 acrosopic 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 costa 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.


Ecol. A common species at low altitudes, often near streams, sometimes in rather open places.

38. Pneumatopteris kerintjensis 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 11 pairs to sides of sinus-membrane; minute hairs present on lower surface of costa, costules and veins, surface between veins strongly pubustular; 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.


Ecol. In forest at 1150–1400 m; the type found in a tea estate.

Note. Troll's photograph and his data about mucilaginous 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.


*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 subcuneate, slightly auricled on acrosopic 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 acrosopic 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, exundisiate; sporangia bearing very small capitate hairs (sometimes 3); spores light brown with many small wings.


Ecol. On limestone, at 1700 m.


*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 acrosopic lobe longer than basiscopic; apex cuneate-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 pubustular; *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 (Talaul Is.).

Ecol. The smaller plants mostly on rocky stream-banks (once on the bank of a rice-paddy), the larger ones 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 meniscilcarpon). 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.


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 not more 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.


Note. This appears to be allied to P. costata. It is aberrant in the slender setae on sporangia, and needs further study.


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.


Ecol. In forest on steep rocky soil at 1100 m.

43. Pneumatopteris sunbawensis (C. CHR.) Holttum, Blumea 21 (1973) 323. — Dryopteris sunbawensis 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 costa, rest of pinna with sparse very short acicular and capitate hairs. Sori medial to supramedial, exindusiata; 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.


Dryopteris schlutzei Brause, Bot. Jahrb. 49 (August 1912) 19; v.a.v.R. Handb. Suppl. (1917) 156. — Type: L. Schultzze 253, Sepik District (B). — Fig. 111–J.

Caudex short-creeping with tufted stipes; stipe 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 3–6 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 pinnae glabrous. Sori supramedial; indusia small with short hairs; sporangia sometimes with capitae hairs; spores with many small wings. Chromosomes: n = 36 (T. G. WALKER).


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 schulzii differs chiefly in a greater abundance of hairs on the lower surface, some of them between veins.


Caudex short, 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 capitae hairs on costules and veins, surface between veins slightly pustular; upper surface of 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).


Note. This is certainly nearly allied to P. keysieriana and from a neighbouring locality, but plants of the two cultivated at Kew remained very distinct.


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 pinnae 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.


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; capitae hairs present on some sporangia; spores pale with many wings of irregular shape.

Pneumatopteris eburnea HOLT. sp. nov.

Lamina usque 35 cm longa; pinnae usque 18-jugatae, rigidae, maximae 6.5 x 1.6 cm, infimae leviter radiatae, inferiores plurijugatae basin versus angustatae, omnes profunde lobatae; venae liberae, subitas 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 x 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.


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 x 1.5 cm, of another collection 19 x 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.


Stipe not seen. Lamina 120 cm long including 0 pairs of deeply lobed basal pinnae 1-1.5 cm long and wide; texture firm. Largest pinnae 15 x 2.5 cm; base truncate, a little dilated, wider on acroscopic side; apex acuminate; edges lobed to 1 mm from costa; lobes 13 x 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 costa, 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.


Pneumatopteris bordinensis HOLT. sp. nov.

Pinnaae basales radiatae 6-jugatae, alternae, superma 3 x 1.3 cm, infima 0.9 cm longa; pinnae normales 17 x 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, tenuis, hirsuta. — Type: FOREMAN & VINAS LAB 60262, S.E. New Guinea, Port Moresby Subdistrict near Boridi village (K).

Caudex short-creeping; stipe 22 cm long, pale, glabrous; base of stipe to first normal pinna 35 cm; reduced pinnae 6 pairs, alternate, lowest 9 mm long and distinctly auricled, uppermost 3 x 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 x 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. Sor 

i 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, 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 acrosopic 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 acrosopic side; apex narrowly acuminate, serratate 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 pinnae; lower surfaces glabrous apart from a few short hairs distally on costae and on sinuses-membranes and margin; upper surface densely brown-hairy on rachis and costae, rest glabrous. Sor 

i small, somewhat inframedial, somewhat impressed on upper surface, exindusiate; sporangia of Guadalcanal specimen bearing short yellow capitulate hairs; spores with a rather narrow median wing and some cross-wings.

Distr. Solomon Is. (Guadalcanal) and E. Malesia: Moluccas (Halmahera & Amboina).

Note. The sor 

i of the type are young and the sporangia do not show glands; The Halmahera specimen (Pleyte 370) has old sor 

i with shrivelled glands on sporangia. The Guadalcanal specimen (Womersley & Whitmore BSIP 1038) is a little smaller than the type but otherwise very similar.


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 acrosopic 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 acrosopic 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 acrosopic vein ending beside sinus-membrane, basiscopic one at margin above base of sinus; lower surface of rachis copiously short-hairy, minute acicular and capitulate hairs on costae, costules and veins, surface between veins pubescent 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 capitulate hairs; spores pale with many small wings. Chromosomes: n = 36 (T. G. Walker).


Ecol. On wet rocks at c. 2000 m.

Note. This is related to P. latissquama; I found both near Edie Creek.

Doubtful


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


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 separte; 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. polycarpos (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 scendent 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. Lps. 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 (1903) Christensen retained the generic name Mesochlaena for M. polycarpos but transferred Beddome's N. larutense to Dryopteris. Van Alder-Verelst 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 sorus 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 Pronephirum. This matter is discussed under Pronephi- rum; 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, \( \times \frac{3}{2} \); b. venation and position of sori, \( \times 3 \); c. sorus, \( \times 12 \). — S. larutensis (BEDD.) C. CHR. d. Venation, sinus-membrane and sori, \( \times 3 \); e. sorus, \( \times 12 \). — S. norrisii (ROSENST.) HOLTTUM. f. Base of lower pinna, \( \times 1.5 \); g. venation and sori, \( \times 3 \); h. sorus, \( \times 12 \). — S. pilososquamatus (v.A.v.R.) HOLTTUM. i. Base of sterile pinna, \( \times 1.5 \); j. base of fertile pinna, \( \times 1.5 \); k. sorus, \( \times 12 \). — S. hispidifolius (v.A.v.R.) HOLTTUM. l. Middle pinna, \( \times 1 \); m. venation and sori, \( \times 8 \). — S. inconspicuus (COPEL.) HOLTTUM. n. Base of lower pinna, \( \times 2 \); o. upper pinna, \( \times 1.5 \); p. venation and sori, \( \times 4 \) (a–h 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-creeeping 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 sori; 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
3. Transition to reduced basal pinnae (if any) abrupt or subabrupt.
4. Basal reduced pinnae present.
5. Middle pinnae sessile
6. Middle pinnae with stalks 3-10 mm long
7. Sori not elongate.
8. Sori exindusiate.
9. Basal veins quite free
11. Pinnae to 10 × 1.5 cm; reduced pinnae at least 5 pairs
12. Pinnae to 21 × 2.5 cm; reduced pinnae 2-3 pairs
13. S. debilis
14. S. sudesticus
15. S. polycarpus
16. S. trimetralis
17. S. eminens
18. S. flavoviridis
19. S. williamsii
20. S. stenodontus
Fig. 13. *Sphaerostephanos alatellus* (CHRIST) HOLTUM. a. Base of fertile pinna, × 1; b. base of sterile pinna, × 1; c. fertile pinna-lobes, × 4. — *S. archboldii* (C. CHR.) HOLTUM. d. Base of frond, × 1; e. pinna-lobes, × 6. — *S. baramensis* (C. CHR.) HOLTUM. f. Base of pinna, × 1; g. lobes of fertile pinna, × 3. — *S. batacorum* (ROSENST.) HOLTUM. h. Base of frond, × 1; 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 HOLTUM 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. 1-2 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 ½ ............................................ 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. vestigiatus
22. Pinnae to 8 cm long; sinus-membrane distally not widened nor translucent 20. S. lamii
19. Pinnae lobed at least ½ towards costa.
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.
30. S. productus
31. Pinnae lobed ½ towards costa, lower ones auricled on acroscopic base 27. S. solutus
31. Pinnae lobed not over ½, 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
31. Pinnae to 7 cm wide, deeply lobed, lobes narrowly acute .......................... 31. S. penniger
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. carril

39. Not this combination of characters.

40. Sori exindusiate.

41. Pinnae c. 12 × 1.5 cm, lobed over ⅓; reduced pinnae 15 pairs

35. S. exindusius

41. Pinnae c. 6 × 1.8 cm, lobed less than ⅓; 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 ⅓ way to costa.

46. Pinnae c. 12 pairs, 12.5 × 2.4 cm

39. S. grandescens


47. Pinnae to 21 × 2.5 cm

40. S. magnus

47. Pinnae to 16 × 1.5 cm

41. S. santomasi

45. Pinnae lobed about ⅓ 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 pinna-ends

43. S. adenostepli

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. aquatillis

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. urdanensis

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
70. Pinnae to 14×2.5 cm, abruptly short-acuminate; lower surface of costae densely covered with appressed hairs

57. S. latebrosus 58. S. porphyricola

68. Reduced pinnae all very small.
70. Lower surface of rachis and costae almost glabrous
71. Lower surface of rachis and costae bearing hairs to 1 mm long.
72. Largest pinnae commonly 15–20 cm long; hairs on rachis pale
73. Largest pinnae 7×1.5 cm; hairs on rachis brown

21. S. hirsutus 60. S. reconditus

67. Pinnae lobed conspicuously more than \( \frac{1}{2} \) way to costa.
72. Hairs on lower surface of costules antrorse appressed.
73. Sori supramedial; pinnae to 2.5 cm wide.
74. Basal normal pinnae not narrowed at base
75. Several pairs of lower pinnae much narrowed at their bases
76. Sori inframedial; pinnae to 1.5 cm wide
77. Hairs on lower surface of costules not antrorse.
78. Reduced pinnae all conspicuous, lowest 5 mm long
79. Reduced pinnae all small, uppermost 5 mm long.
80. Dark hairs on both sides of rachis
81. Pallid hairs on both sides of rachis.
82. Lowest pinnae little narrowed at base; reduced pinnae evident
83. Lower pinnae much narrowed at base; all reduced pinnae minute

66. S. ellipticus 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
81. Sori indusiate; sporangia glandular, rarely with a seta.
82. Lowest normal pinnae narrowed at base
83. Pinnae thin, lobed to 2 mm from costa
84. Pinnae subcoriaceous, lobed little more than \( \frac{1}{2} \)

68. S. indrapurae 62. S. baramensis 69. S. batacorum

80. 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
86. Reduced pinnae without distinct lamina; costules 4 mm apart
87. Pinnae to 2.5 cm long; dark hairs on upper surface of rachis
88. Not this combination of characters.
89. Reduced pinnae all very small.
90. Largest pinnae c. 6 cm long
91. Fertile pinnae to 16×2 cm, lobed at most \( \frac{1}{2} \)
92. Pinnae lobed to a depth of 2 mm

77. S. lobangensis 78. S. gymnorachis 79. S. pullenii
92. Pinnae lobed at least $\frac{1}{3}$ way to costa.

88. Lower surface of rachis and costae hairy throughout.

93. Pinnae crenate.

94. Pinnae not more than 4.5 x 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 x 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 x 3.5 cm 82. S. pilososquamosus

96. Fronds not or little dimorphous, pinnae not over 2.5 cm wide.

97. Pinnae to 9.5 x 0.8-0.9 cm 83. S. angustifolius

97. Pinnae proportionally 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 $\frac{1}{2}$ way to costa 84. S. efogensis

100. Pinnae lobed more than $\frac{1}{2}$ 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. nakaii

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. woitapecsis

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 85. 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 x 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 x 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 $\frac{1}{3}$ 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
119. Pinnae widened distally.
120. Caudex short-creeping; pinnae lobed c. \( \frac{1}{3} \) towards costa.
121. Fronds not dimorphous; sori supramedial.
122. Pinnae 3.5 × 1.4 cm, narrowed evenly to apex
123. Pinnae larger, abruptly short-acute-acuminate
124. Fronds dimorphous; sori medial
125. Caudex slender, erect; pinnae crenate
126. Pinnae lobed at least 2/5 towards costa.
127. Reduced pinnae 20–30 pairs; normal pinnae lobed less than \( \frac{1}{3} \) way to costa.
128. Reduced pinnae more than \( \frac{1}{3} \) to costa.
129. Pinnae lobed \( \frac{1}{3} \) to costa.
130. Fronds anastomosing; upper reduced pinnae 12 mm long
131. Basal veins free; upper reduced pinnae 3 mm long
132. Pinnae lobed about \( \frac{1}{3} \) to costa.
133. Pinnae c. 6.5 × 1.3 cm, lowest narrowed at base; indusia glabrous
134. Pinnae c. 11 × 2 cm, lowest not narrowed at base; indusia bearing long hairs
135. Pinnae not over 12 pairs, not overlapping.
136. Sori supramedial.
137. Pinnae lobed more than \( \frac{1}{3} \).
138. Sori indusiate; sporangia setiferous
139. Largest reduced pinna 7 mm long; hairs on lower surface of costa not appressed
140. Pinnae exindusiate; sporangia setiferous
141. Pinnae crenate or lobed less than \( \frac{1}{3} \).
142. Pinnae not over 1 cm wide; indusia very small or lacking
143. Apex of frond pinna-like, crenate to base
144. Pinnae more than 1 cm wide; indusia all distinct.
145. Some hairs on lower surface of rachis and costa 1 mm or more long.
146. Pinnae commonly more than 2 cm wide, crenate to a depth of 1 mm.
147. Apex of frond pinna-like, crenate to base
148. Apex of frond deeply lobed at base
149. Pinnae to 1.7 cm wide, distinctly lobed
150. Hairs on lower surface of rachis and costa all very short.
151. Largest reduced pinnae 2 mm long
152. 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 ........................ 90. 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 ½ ............................... 98. S. pterosporus
155. Indusia large, firm ........................................... 114. S. plurifolius
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. posthumil
151. Aerophores not elongate.
158. Pinnae 15–20 pairs; reduced pinnae 4–7 pairs .................. 117. S. inconspicuos
159. 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
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 x 1.0 cm; veins 3–4 pairs .......................... 119. S. mjobergii
163. Pinnae to 10 x 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 x 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 ½ ........................................... 124. S. irayensa
169. Pinnae lobed less than ½ ........................................... 95. S. norrisi
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. lithophyllum
170. Sori medial or inframedial.
172. Pinnae crenate ........................................... 109. S. spencerii
172. Pinnae lobed at least ½ ........................................... 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 $\frac{1}{3}$.
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 $\frac{1}{3}$.
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 $\frac{1}{3}$-1; hairs on lower surface of costules antrorse 
130. S. suboppositus
182. Pinnae to 17 × 2.8 cm, lobed more than $\frac{1}{3}$; 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 $\frac{1}{4}$ 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. muliensis
183. Pinnae lobed at most $\frac{1}{3}$; 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 $\frac{1}{3}$; 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. invisis
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 1/2 way to costa or more deeply.

201. Reduced pinnae 20 pairs, all very small
202. Caused short, erect; pinnae lobed 1/2
203. Pinnae to 3.5 cm long, slightly crenate
204. Stipe 40–50 cm long; reduced pinnae 3 pairs, small

200. Pinnae lobed less than 1/2 way to costa.
203. Pinnae to 3.5 cm long, slightly crenate
205. Pinnae in most cases larger, deeply crenate or lobed.
206. Caused erect; largest fertile pinnae 17×2.5 cm
207. Stipe scales 1 mm long; pinnae to 4×1 cm
208. Stipe scales 7 mm; pinnae to 12×2 cm

lobatae, utrinque pilis minutis erectis glandulisque praeditae; venae 9-jugatae, basales solum anastosomantes; sori mediales, inferiores praeertum elongati, indusius tenuibus breviter hirsutis et glandulosis tecti; sporangia setifera. — Type: BRASS 27772, Sudent Island, Louisiáda 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, aeroephores 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 costa 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 costa 0.2 mm long, scattered hairs 0.5 mm long on costules and veins, very short erect hairs and glands between veins. Sori mediol, almost all elongate, lower ones longest; indusia very thin, rather large, bearing sparse short hairs and several glands; sporangia bearing 1–2 short setae.


Ecol. In New Guinea on rocks by river at 100 m.

Note. The New Guinea specimens (KANE-HIRA & HATUSIMA 12837) have lamina 30 cm long with 30 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 costa.

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


S. unijugus COPEL. Philip. J. Sci. 60 (1936) 109, t. 15. — Type: BRASS 2692, Solomon Is., San Cristobal (UC; BRI, MICH). — Fig. 12a-e.

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 x 1.8 cm, largest seen 35 x 2.5 cm; base rather asymmetric, basal acroscopic lobe often elongate; edges lobed more than 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 specimens 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 perakensse 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.

Mesochaena 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. Sphaeroestephanos 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).


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 1 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 1–11 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. talamaensis* 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.


**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 narrow 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 acuminata; 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, exindusiata; 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.


**Caudex** not known; base of stipe lacking. **Reduced pinnae** at least 5 pairs, lowest 3–4 mm long; transition to normal pinnae subruptur. **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 pressed hairs and a few glands between veins. **Sori** medial, lacking indusia, basal ones not divergent; sporangia bearing glands.

**Distr. Malesia:** Philippines (Panay), on known from the type.

7. **Sphaerostephanos flavoviridis** HOLT-TUM, sp. nov.

**Pinnae** redactae 2-3-jugatae, superiores 1–2 cm longae; lamina 120 cm longa; pinnae inferioris basi angustatae; pinnae maxima 21 × 2.5 cm, profunde lobatae; venae 12–14-jugatae, infimae anastomosantes; costae subus pilis minus praediae; pagina inter venas utrinque copiosa glandulosa; sorii medias, exindusiata; stiplies sporangiorum pilis glanduliferis praediti. — Type: JERMY 3694, N.E. New Guinea, Butembo, 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 HOLTUM, sp. nov.

Caudex erectus, brevis; stipes 10 cm longus, e basi stipitis usque pinna normalis infima 150 cm; pinnae redactae 30-jugatae, late triangulares; laminae 150 cm longae; pinnae maxime 14 × 1.3 cm, crenatae; venae 6–7-jugatae; rachis costaeque subtus pilis 0.2 mm longis adpressis praedita; pagina inter venas utrinque glandulosa; sori mediales, indusia pilis brevis et glandulis praedita; sporangia glandulifera. — Type: HOOGLAND 3391, Papua, Lake Koen (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, 2 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 anthrose 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.


Ecol. Near shore of lake, in marshy vegetation of tall grasses and sedges, alt. 10 m.


Cyclosorus heterocarpus sensu HOLTUM & 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 narrow 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 4.5–5.5 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) HOLTUM in the Philippines (Fern Fl. Philip. 341) and with Dryopteris logavenis ROSENST. (Amphineuron pseudostenobasis (COPEL.) HOLTUM) in New Guinea. HOLTUM and ROY misidentified a cultivated plant as Cyclosorus heterocarpus and reported a chromosome count 2n = 72.

10. Sphaerostephanos daymanianus HOLTUM, 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; laminae 150 cm longae; pinnae maxime 25 × 2 cm vel majores, usque 13 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 glandulis praeditae. — Type: BRASS 23557, Papua, Milne Bay District, Mt Dayman (BM; A. L. LÆ).

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 23236 36 × 2.4 cm), base subtruncate, apex caudate-acuminate (cauda 3–4 cm), lobed 1½–2½ to costa, lobes slightly falcate; costules 4.5 mm apart (to 6 mm in BRASS 23226) at more than 60°; veins to 9 pairs, 1½–2 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.


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 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.


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, 1–2 pairs anastomosing, 1 pair to sides of sinus-membrane; dense spreading hairs to 0.5 mm long on lower surface of rachis and costa; indusia densely hairy or with many glands and fewer hairs; sporangia copiously setiferous.

Distr. Malesia: Sumatra (Padang Highlands).


Goniopteris asymmetrica Fée, Gen. Fil. (1852) 253. — Thelypteris asymmetrica (Fée) Rees, 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 basiscoic 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 acrosopic vein to sinus-membrane; *lower surface* of rachis and costae bearing short erect aciculair 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:** 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.


*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 cacute-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.

**Notes.** 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, subinaugae; venae 4–5-jugae; 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.
17. Sphaeroestephanos kalkmanii HOLTTUM, sp. nov.

Caudea erectus; pinnae redactae 4-jugatae, omnes minute; pinnae normales 18-jugatae, usque 3.5 x 1.0 cm, crenatae, costae costulaeque subtus pilis minutis appressis glandulisque praeditae; indusia parva vel nulla; sporanica nec glandulis nec setis instructa. —Type: KALKMAN 4070, W. New Guinea, Orion Mts, Tennera Valley, 1500 m (BM; LAE, L, SING).

Caudea erecta, to at least 15 cm tall. Stipe 4-5 cm long, dark, sparsely short-hairy, basal scales c. 4 x 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 rachi 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, 1/2 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. Sorii 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.


Type: BROOKS 281, Sumatra, Lebong Tandai, Benkoeoen (BO).

D. perglandulifera var. firmior v.A.v.R. IC —Type: DOCTERS van LEEUWEN-REYNVAAN 3284, Sumatra, Haboko (BO).


Caudea 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 x 7 mm, upper ones to 1.5 x 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 x 1.7 cm (on small plants, fertile, 7 x 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 excriment 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 costa minute, glands throughout lower surface; hairs on upper surface of rachis pale, 1 mm long, on costa less than 0.5 mm, copious glands between veins. Sorii 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. pengiger, but appears to be distinct in its erect caudea (seen on several specimens) and narrow crenate pinnae; the stream-bed habitat is recorded for several specimens.


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 acrosopic side), crenate. Lamina 50-90 cm or more long; basal pinnae not narrowed at base; aereophores 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, curled, 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.


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. Sphaeroestephanos lamii Holttt, sp. nov.

Caudex brevis, repens vel suberectus; stipes 20 cm longus; pinnae reductae 5-jugatae, superiores 10 mm longae; lamina 30 cm longa, pinnae 12-15-jugatae, dimorphae; pinnae sterile usque 8.5×1.8 cm, crenatae, pagina utrinque glandulifera; pinnae fertiles usque 6.0×1.2 cm; sori inframediales; indusia para, 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; aereophores 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.


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. cetelebus

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 aereophore 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; aereophores to 1 mm long. Largest pinnae commonly 12-20×1.5-2.2 cm (to 30×2.5 cm, testa 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-
cated 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** HOLT T U M, var. nov.

A typo speciei differt: pinnis usque 15 × 1.4 cm; pagina inferiori inter venas pilis tiliuis adpressis vestitia; indusiis nullis vel minusitis; sporangii 3–4 setis ornatis.—Type: POSTHUMUS 2743, S.W. Celebes, G. Bonthain, 1500 m (BO).


**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).


**Caudex** erect, not or little branched at the base. Base of stippe 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 ls. (Sumba, Timor), Central & S.E. Celebes, Philippines (Bohol, Mindanao, Guimaras), Molucas (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. Sphaerochesthanos melanorachis HOLTUM, sp. nov.

Stipes rachisque atrobrunneus; stipes 7 cm longus; pinnae rectae 10-jugatae, superiores usque 1.7 x 1.5 cm; lamina 55 mm longa; pinnae dimorphae, sterile usque 13 x 1.9 cm, fertiles minores, omnes c. 1/3 costam versus lobatae; venae 8-jugatae, 2-jugatae anastomosantes; rachis costaeque subitus pilis brevibus anortris vestita; pagina inter venas untrinque 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 x 1.5 cm, triangular with asymmetric base, crenate, slightly deflexed, lowest 4-5 mm long. Lamina 55 mm 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 costa 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.


Caudex erect, rarely very tall, usually with several branches from base. Stipe 3 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 costa 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 costa 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 costa. Sori medial, lower ones not divergent; indusia firm, usually with a few short hairs and glands; sporangia with glands near annulus.
**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 acrosopic vein usually touching side of sinus-membrane.

   **typical form**

3. Fertile pinnae not over 1.5 cm wide; costules 3 mm apart; second acrosopic vein always to margin (Dryopteris suprastrigosa ROSENST.) . . . . . . New Guinea.

4. 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.
6. Glands lacking on upper surface; appressed hairs variable, never dense.
7. Pinnae lobed distinctly more than 1/2; second acrosopic vein to margin.

   7. Pinnae to 16 x 1.6 cm; costules almost at right angles to costa; pinnae more than 20 pairs; sori supramedial . . . . . Mindanao.
8. Pinnae to 10 x 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 acrosopic 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 EDANO 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 (Amboi) 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 (i.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 x 2.0 cm. profunde lobatae; venae 12-jugatae, infimae anastomosantes; costae subtils pilis erectis minutis vestitae; pagina inter venas utrinque glandulosa; industria parva, glandulifera. —Type: FLENLEY, ANU 2062, Papua New Guinea, W. Highlands, Lal 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 x 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 HOLTTLUM, sp. nov.

Pinnae redactae usque 12-jugatae, superiores 2.5–3.0 cm longae; aerophori non elongati; pinnae normales 27 × 2.5 cm, dimidio costam versus lobatae; venae 8–10-jugatae, infinmæ solum Anastomosantes; costae costulæque subitus glanduliferæ, glandulæ inter venas paucæ; 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 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 (7) glands; glands present on body of some sporangia, more commonly sessile on stalks of sporangia; spores not seen (sori old).


Ecol. In forest at 650–700 m.


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, 1–½ 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 SPANOGEHE. A. hispidulum DECNE (P) = Christella hispidula.

28. Sphaerostephanos hernezi HOLTTLUM, 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 angustatæ, dimidio costam versus lobatæ; costulae 7 mm inter se distantes; venae 9-jugatae; pagina utrinque pilis erectis brevisibus glandulisque praedita; sori medullæ, indusia pilis brevisibus vestita. —Type: M. G. PRICE & B. E. HERNEZ 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 HOLT TUM, sp. nov.

S. pennigero affinis, ab eo differt: fronde minore; pinnis redactis 3–5-jugatis, omnibus parsis; pinnis normalibus 7–12-jugatis, fertilibus usque 15 x 2.1 cm; venis 2½-jugatis anastomosantibus; sporangii nec setiferi nec glanduliferas. — Type: MOSELEY s.n. Challenger Exp., Aru Islands (K; BM).

Caudex short-creeping; stipe 20–35 cm long, basal scales 7 x 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 30 cm long; pinnae 7–12 pairs. Largest fertile pinnae 15 x 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 Kobroor 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 x 2.7 cm, with 13–14 pairs of veins but only 2½ pairs anastomosing, 2 or 3 pairs passing to a long sinus-membrane.


Dryopteris luzonica var. puberula CHRIST, Philip. J. Sci. 2 (1907) Bot. 197. — Type: BOSTER 175, Luzon (P).


Dryopteris pseudohirsuta ROSENST. Meded. Rijksherb. n. 31 (1917) 7. — Thelypteris pseudohirsuta (ROSENST.) REED, Phytologia 17 (1968) 306. — Type: CUMING 82, partim (L).


S. punctatus HOLT TUM, Kalikasan 4 (1975) 60. — Type: ELMER 16642, Luzon, Mt Bulusan (US; K, L, G, BO, NSW).


Caudex short-creeping, branched. Size of fronds very variable, with pinnae from 10 x 1 to 30 x 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 create 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 1 pair anastomosing and 1 pair to sinus-membrane; hairs on lower surface of costa 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 costa 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 ALDERWERELDT 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.


Aspidium abortivum sensu METT. Farnagt. 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 costa.
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. karoeensis
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; acrophores 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, 3–5 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. Soris 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 Filicium 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 *Polyodium 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 *Polyodium pennigerum* Forst. for the New Zealand fern, which is exindustiate.

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.


**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 pleonemiod, 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 type speciei differ: fronde minore; pinnis redactis 5-jugatis; pinnis evolutis 7-jugatis, usque 13×2.7 cm, in infinis basin versus valde angustatis; sporangii setiferis, non glanduliferis.—Type: MOLESWORTH ALLEN 2407, Sumatra, Prapat by Lake Toba (K).

**Distr.** *Malesia*: N. Sumatra, only known from the type.


*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; *upper 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.** Micronesica (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.) 

*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 of 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-cuspitate; 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 recurrent 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 carrilii* 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, vir usque 1/3 costam versus lobatae; lamina inter venas subitus glandulosa, supra glabra eglandulosa; indusia tenua, pilis brevibus glandulisque praedita; sporangia setiferae. — 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, 2² pairs anastomosing; 1-11 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.


35. *Sphaerostephanos exindusiatus* HOLTTUM, sp nov.

*Pinnae* redactae 15-jugatae, superiores vix 10 mm longae; lamina 60 cm longa; aerophora 2 mm longa; pinnae maxime 12 × 1.5 cm, 3/5 costam versus lobatae; *setiferous*. *Costae* subitus pilis erectis 0.5 mm longis praedita, lamina inter venas glandulosa; pagina superior omnino pilis appressis vestita; *sori* exindusiati, sporangia setiferae. — 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 1.5 mm long, scattered similar hairs on costules and veins, whole surface covered with slender appressed hairs. *Sori* inframedial, exindusiati; 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, maxime 6 × 1.8 cm, 1/3-2/5 costam versus lobatae; *setiferous*. *Costae* subitus pilis usque 1 mm longis vestitae, pagina inter venas pilis erectis glandulisque praedita; pagina superior pilis appressis vestita; *sori* exindusiati; sporangia setiferae. — Type: M. G. PRICE 2720A, Luzon, Mt Bana- 

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, exindusiata; 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 Copeland in Mindanao, which 1 have transferred to Promephirium. 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.


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.


38. Sphaerostephanos polyotis (C. Chr.) Holttum, comb. nov.—Dryopteris polyotis C. Chr. Bot. Jahrb. 66 (1933) 46. —Thelypteris polyotis (C. Chr.) Reed, Phytophila 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; indusium bearing short hairs and sometimes a few glands; sporangia bearing glands and sometimes setae.


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 subitus inter venas sparsim glandulifera, supra omnino pilis appressis vestitia; undiusa pilis brevibus paucis praeedita, 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, antorse 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.


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.


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 antorse 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 maximeae 13 × 1.7 cm, dimidio costam versus lobatae; rachis costaeque subitus pilis multis usque 1.5 mm longis vestita, pagina inter venas pilis erectis glandulosis praedita; undiusa 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 1/3 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).
N. 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.

Pro nephrium 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 4–4.5 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, 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.


Ecological. At low altitude by streams in flood zone. Note. Possibly not distinct from S. mutabilis.


Nephrodium hispidulum (non Decene) Bak.—Christ, Ann. Jard. Bot. Btgz 20 (1906) 107. — Fig. 121–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 acrosopic, apex acuminate, edges lobed \( \frac{1}{2} \) way to costa (or more deeply in largest pinnae), lobes oblique; costules 3 mm apart, at 45° to costa; veins 3–4 pairs, basal acrosopic vein ending exactly at 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. Sphaeroestephano us uniauriculatus (COPEL.) HOLTUM, 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 costa 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.


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.


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.


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, ½ pairs anastomosing, next pair to sinus-membrane; _lower surface_ of rachis, costa 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.


_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, subitus ubique glanduliferae, supra pilis adpressis vestitate; sori mediales; indusia magna, glandulis pilisque brevibus praedita; sporangia copiosae glanduliferae. — *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 amphila 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, costa covered sparingly 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.


_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 ⅓ 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 costa and costules, glands on surface between veins; scattered long hairs on _upper surface_ of costa, 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 cataractus_ (WAGN. & GRETH.) HOLTTUM, comb. nov. — _Cyclosorus cataractus_ 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 1/2 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.


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. Sphaeroestephanos menadensis HOLT TTUM, sp. nov.

Pinnae redactae 2-jugatae, minutae; lamina 20 cm longa, pars apicalis angusta 10 cm longa; pinnae 6-jugatae, infimae basis versus valde angustatae, mediolae 5.5 × 1.6 cm, dimitio costam versus lobatae; costae subus pilis minutiis vestitae; pagina inter venas subus 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 1/2 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. Sphaeroestephanos subcordatus HOLT T TUM, sp. nov.

Pinnae redactae unijugatae, parvae; frondes dimorphae; pinnae usque 8-jugatae, sterilis 3 × 1.2 cm, fertiles 1.7 × 0.9 cm, usque 1/3 costam versus lobatae; costae subus 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.


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; aerenhores to 1 mm long. Pinnae somewhat dimorphous, sterile to 10×1.7 cm, fertile to 7.5×1.2 cm; base truncate, basal acrosopic 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 acrosopic 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. Sphaeroestephanos 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 Dist. 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
      e. 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; aerenhores 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, 1 pairs anastomosing. 1–11 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.


b. var. vinkii Holttum, var. nov.
   A typo specie differt: caudice breve; pinnis 13 costam versus lobatis; costis subitus 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).


   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.


   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. Sphaeroestephanos 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 Dist., 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.

Ecot. 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.


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 costa usually glabrous at base with very short antrorse hairs distally, in some cases very short hairs and a few somewhat longer throughout; costules as costa but with shorter hairs (if any); rest of lower surface usually quite glabrous with many glands; upper surface with long hairs on costa, 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.

Ecot. 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 sagit-tifoliioides 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 cadox of S. latebrosus, large upper reduced pinnae and broad base of lowest normal pinnae seem distinctive.


Cadox 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 (stereile to 15 × 3 cm), base sub-truncate, 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 sinuses-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 closely allied to S. laterebrosus; more field observations are needed.

59. Sphaeroestephos caulescens HOLTUM, sp. nov. — Dryopteris porphyricola (non COPEL.) C. CHR. Gard. Bull. Str. Settl. 7 (1934) 244.

Cadox erect; stipes 5 cm longus; pinnae redactae usque 8–jugatae, omnes minutiae; aerophora 1 mm longa; pinnae majores 13.5 × 1.5–2.0 cm, dimidio costam versus lobatae; rachis subitus 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).

Cadox 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 1/ way to costa; costules c. 3.5 mm apart, at 60°; veins c. 7 pairs, 1 pair anastomosing, next pair to sides of sinuses-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. Sphaeroestephos reconditus HOLTUM, 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 subitus 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).

Cadox short, erect or suberect; stipe 5 cm long; base of stipe to first normal pinna 30 cm:
Reduction in 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-acuteaminate; 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 microscopic vein or pair passing to sinus-membrane; lower surface of costae bearing pale antorse hairs which are pressed 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 small fronds covered with mucilage.

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, antorse, 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.

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 ciliate-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 antorse 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 antorse 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 subitus pilis brevisuphis 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 cm 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. Sorî 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.


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, e. 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. Sorî 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?).


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, e. 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 costa 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 costa less than 1 mm long, scattered similar hairs on costules and veins at least distally on pinna-lubes, surface between veins bearing a variable number of fine appressed hairs. Sorî 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.

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(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 to 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 costa 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 costa 1 mm long, similar or shorter hairs scattered on costa, just 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 specie typica differ: pinna 3/5 costam versus lobatis; venis semper anastomosibus; rachidi subitus fere glabra; costis subitus 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. Sphaeroestephanos foxworthyi Holttum, sp. nov.

S. elliptico (Rosenst.) Holttum affinis, differ: pinnae redactae omnibus minutis; pinnae evolutis inferioribus basin versus valde angustatis.—Type: Foxworthy BS 2441, Luzon, Tayabas Prov., Mt Banajao (K).

Caudex short, creeping. Stipe 12 cm long, glutinous to resinous; 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 truncate; 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 costa near base bearing erect hairs 0.1–0.2 mm long, distally hairs to 0.4 mm, antrorse curved, not appressed, hairs on costules few, between veins many glands, not hairs; upper surface of costa bearing antrorse hairs less than 1 mm long, rest of surface covered with fine appressed hairs 0.2–0.3 mm long. Sori median, 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. Sphaeroestephanos 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 lobatis; rachis subitus glabra, costis 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 one 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 costa and costules covered with fine closely appressed hairs 0.2–0.4 mm long, surface between veins bearing glands; hairs on upper surface of costa 0.5 mm long, sparse very short ones on costules, no others. Sori median, lower ones a little divergent; indusia glabrous; sporangia bearing glands.

Distr. Malesia: Central Sumatra (Mt Kerinci), 1500 m, only known from the type.

69. Sphaeroestephanos batacorum (Rosenst.)
HOLTTUM, comb. nov.—Dryopteris batacorum
ROSENST. Fedde Rep. 13 (1914) 217, excl. var. winklei; v.A.N.R. Handb. Suppl. 117 (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.N.R. Bull. Jard. Bot. Tzg 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. Malesea: 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, exindusiatis; 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, exindusiatis; neither glands nor setae on sporangia; spores minutely spinulose.

Distr. Malesea: Central Celebes, only known from the type.

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 ½ 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, costa 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.


Ecol. At 1700 m, “a large clump-fern common in rain-forest gullies”.

73. Sphaerostephanos novae-britanniae HOLT TUM, sp. nov.

Caudex erectus; pinnae redactae 7-jugatae, superiores 7 mm longae; pinnae normales opposi-
tae, usque 8 × 1.2 cm, 2/3 costam versus lobatae; venae infima raro anastomosantes; costae subius pilis erectis praedae; pagina inter venae subius glandulifera, supra pilis brevibus suberectis praedae; 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 HOLT TUM, sp. nou.

Pinnae redactae 4–5-jugatae, omnes parvae; aerophora non elongata; pinnae usque 6.5 × 1.3 cm, 3/5 costam versus lobatae; venae infima coninentes, non anastomosantes; costae subius pilis erectis usque 1 mm longis praedae; pagina inter venae utrinque pilis brevibus erectis praedae, subitus 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 sinus 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 costa and costules erect, as on rachis but shorter, surface between veins bearing many short erect hairs and glands; hairs on upper surface of costa 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.


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 pressed, 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.

Ecot. 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 NEE in Guam. Specimens of the same species were also collected there by HÄNKE, 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.


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; indusia always hairy. Distr. Polynesia (Samoa, Fiji, Tonga), Micronesia (Palau), and Malesia: New Guinea, Moluc- cas, 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 multilinéatum 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. invius*.

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 type speciei differt: costulis venisque subtus eglandulosis; pagina subtus inter venas ommino minute papillifera.—Type: Hoogland 9084, N.E. New Guinea, Huon Peninsula, 1320 m (K).


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.


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 anomomosing 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.


Notes. The type of *D. astrophiiplina* 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. as also 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. Sphaeroestephanos lobangensis (C. Chr.) Holttum, comb. nov. — Dryopteris lobangensis C. Chr. Gard.- Bull. Str. Settill. 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 anomomosing, next acrosopic 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 spin "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. Sphaeroestephanos gymnorachis Holttum, sp. nov.

Caudex erect; pinnae redactae usque 8–10 jugatae, superiores 3 mm longae; pinnae normales fertiles usque 16 × 1.9 cm, 1/2–5/8 costam versus lobatæ; rachis subtus glabra, costae costulaque 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 (stere 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 ⅓ 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 costa near base covered with hairs 0.1–0.2 mm long, near apex 0.3–0.4 mm, antronse 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 costa 0.5 mm); hairs on upper surface of costa 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 Tenomopok, 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-fugatae vel ultra, omnes parvae; pinnae normales 26 × 3.0 cm, 3/4–4/5 costam versus lobatae; rachis costaeque subitus glabra vel pilis minutis paucis praedita; pagina subitus inter venas glandulosa, supra pilis erectis brevibus praedita; indusia parva, glandulifera, sporangia nec glandulis nec seits instruxa.—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 costa near base with sparse minute hairs, somewhat longer hairs distally, costules similar; copious glands between veins; hairs on upper surface of costa 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.


Ecol. In *Nothofagus* forest at 2000 m.


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 costa 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.

(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.


Note. Allied to S. spenceri, differing in little but much smaller size.


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. 121–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, 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.


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 1/4 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, Zambeles 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 efogenis HOLTJTM, sp. nov.

S. conferto (Brause) affinis, differt: membranis sinuum brevibus; costis subitus pilis usque 1 mm longis vestitis; costulis subtus glanduliferis; soris supramedialis, 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. Sorti 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.


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 acrosopic 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. Sorti median, 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 HOLTJTM, 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 infinae anastomosantes vel ad basin sinus con- niventes; costae subitus pilis erectis brevibus vesti- tae; pagina inter venas subtus glandulifer a, supra pilis appressis vestita; indusia glandulifer a, sporangia non glandulifer a. — Type: T. NAKAIKE 358, E. New Guinea, Mt Wilhelm 2500–3500 m (K; TNS).

Caudex “massive or ascending” (NAKAIKE). Stipe 20 cm long, short-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 acrosopic 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 woltpensis HOLT TUM, sp nou.

* S. naka ike o affinis, dif fer: pinnae minoribus, brevi stipitatis, inferioribus sensim decrescentibus; lobis pinnarum dissectilaterr dentatis; venis infimis semper anasto mos antibus.—Type: NAKAIKE 576, Papua, Central Dist., Wotape (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; areophores 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 HOLT TUM, sp. nou.

* 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 subitus pilis paucis praeditae, pagina inferior pinnarum cetera glabra, glandulifera, glandulis inter venas paucis; sori inframediales; indusia tenuia, glandulis multis ornata; sporangia nee setis nec glandulis praedita.—Type: B. S. PARRIS & J. P. CROXALL 6022, N.E. New Guinea, Morobe Dist., 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 acrosopic auricle 3 mm long; two pairs of pinnae of intermediate length present between reduced and normal pinnae. Laminae 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 HOLT TUM, sp. nou.

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 subitus 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 acrosopic 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, leitier lobatae, rigidae, lobis cucullatis; costa costulaeque subitus patentis-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 costa 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 costa densely hairy, similar hairs more sparse on costules and veins, some erect hairs between veins. Soli medial; indusia small, bearing glands and short hairs; sporangia setiferous; spores with many small wings.

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.


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 costa 0.1–0.2 mm long, slender, appressed, similar hairs on costules and veins, also sometimes a few glands; hairs on upper surface of costa 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;? Ambon, Brooks 18102) and widely in New Guinea.

Ecol. In forest at altitudes to 2000 m.

Note. The type of *D. sepakensis* 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. — *Theleyteris archboldii* (C. Chr.) Reed, Phytologia 17 (1968) 260. — Type: Brass 4873, Papua, Mt Tafa, valley forest, 2400 m (BM; BRI).


*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 × 10 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, antorose 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.


*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 2½ 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.


*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; aero- phores 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 apressed 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 apressed hairs between the veins on the upper surface, specimens from Borneo and Mindanao have shorter suberect hairs.

**96. Sphaerostephanos semimetrallis Holtttum sp. nov.**

*S. arfakianus affinis, differt: frondibus minoribus; pinnis redactis 2–3-jugatis, minutis; pinnis fertilibus usque 5 × 1.2 cm; costis costullisque subtus pilis sparsis suberectis instructis.—Type: PULLEN 518, W. New Guinea, Perameles MtS, 1100 m, on limestone (L).**

*Caudex* erect, slender, 50 cm tall. *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; aero- phores 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 over- lapping rachis, acroscopic truncate or slightly cordate; apex acuminate; edges irregularly sinu- ous 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 sparse 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).

**97. Sphaerostephanos semicordatus Holtttum, sp. nov.**

*Pinnae redactae 8-jugatae, omnes minutae; lamina 35 cm longa; pinnae 10–12-jugatae, omnes oppositae, subintegrae; costulae subus 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; aero- phores 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 over- lapping rachis, acroscopic truncate or slightly cordate; apex acuminate; edges irregularly sinu- ous 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 sparse 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.)

*Dryopteris bungoensis* C. CHI. Dansk Bot. Ark. 9, 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*
   b. *var. atilobus*
3. Pinnae crenate

**a. var. pterosporus**

*Caudex* short, erect. *Stipe* 3–10 cm long, basal scales 8 x 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 x 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 costa 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 costa 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 x 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. atilobus HOLTUM, var. nov.**

*A typo speciei differt: pinnis maximis sterilibus usque 14 x 2.6 cm, fertilibus 10 x 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: KUNTSLER 6345, at 750–900 m, “pinnae dark green”.

**Distr. Malesia:** Malaya.

c. *var. crenatus* HOLTUM, var. nov.

*A typo speciei differt: pinnis crenatis; venis 1/3-jugatis anastomosantibus, vena sequente acroscopica ad membranam sinus terminata; pinnis fertilibus usque 10 x 1.5 cm.*—Type: JERMY 13870, Sarawak, G. Mulu National Park, by Tapin River (BM). Also M. HOTTA 13809, Brunei, along Sungei Laqcan, 50–300 m (Brunei).

**Distr. Malesia:** Borneo (Sarawak; Brunei).


*Caudex* short, massive, decumbent or suberect; young fronds covered with slime. *Stipe* 15 cm long; scales (ide RACIBORSKI) 4 x 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 x 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, 1/2 pairs anastomosing, 2–2 1/2 pairs to sides of sinus-membrane; hairs on lower surface of costa 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 costa 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.C.R. (Handb. Suppl. 182) reported specimens from New Guinea; I did not find these in Herb. Bog.

S. polysti affinis, differt: pinnas c. 2/5 costam versus lobatis; venis inferioribus 2–3-jugatis vel anastomosantibus vel ad membranam sinus conve nivintibus; aerophor 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. polystis, 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, 11 pairs anastomosing, 12 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 HOLTUM, 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 venaque 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 acrosopic 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.


Ecol. Type locality at 2500–2750 m, and Mt Wilhelm at 3300–3500 m (NAKAIKE 274).


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 1/2 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 acrosopic 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 hoakensis HOLTUM, sp. nov.—Dryopteris ceramica ROENST. 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, costulæ pilis brevioribus glandulisque praeditæ; 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 acrosopic 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-accumulate; edges lobed c. 1/4 way to costa, lobes oblique, slightly falcate; costules 3 mm apart, at more than 60°; veins 9 pairs, 1) pairs anastomosing, next acrosopic 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. Sorî 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.


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, acumenate with costa 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, 1-2 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 antorse hairs, on costules and veins much shorter hairs with scattered long ones, surface between veins glabrous or with suberect hairs. Sorî 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.


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 2.5-5 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 4.4-5.5 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

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Thelypteridaceae (Holttum)
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.


Ecol. In mountain forest, 1500–2000 m; smaller specimens apparently from stream sides in open places.


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 HOLT-TUM, 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 subulati pilis erectis usque 0.5 mm longis vestitae, costulæ venaque pilis sparris glandulisque praeditæ; pagina superior inter venas pilis brevibus subrectis instructa; sori exinducti; 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 oppressed. 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 costae and veins more sparse and shorter spreading 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 subacute hairs. Sori medial; indusia lacking; sporangia copiously setose; spores with many small wings.

Distr. Malesia: Moluccas (Buru), 1400 m.


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; costes 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 excurreny 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 COPEL. In Sp. Fil. vol. 5 HOOKER misidentified a specimen of the exindusiata Pronephrium beccarianum (from Fiji) with the present species, for which reason he transferred the latter to *Polypodium.*


*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 4–5 mm apart, at 60°; veins 7–8 pairs, prominent on lower surface, 2–2 pairs anastomosing to form a zig-zag excurrent vein, 2–2 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:** Papua New Guinea (New Brit., only the type.

Ecol. In *Castanopsis* forest, 900 m.


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 hairs or 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. Sorus medinal; indusia with many short stiff hairs; sporangia bearing several setae, sometimes also a gland; spores minutely papillose.


Note. Many collections from eastern New Guinea, none from west except Waigeo.


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, 3–3 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.


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 3), 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. Sorus medinal; indusia firm, with a few glands; sporangia bearing glands; spores finely spinulose.


Ecol. In forest at 1000–1700 m.

114. *Sphaerostephanos plurifolius* (v. A. V. R.) Holttum, comb. nov.— *Dryopteris plurifolia*
Bull. 17 (1968) 305. — Type: LORIZING 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 (stereile 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.


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. Sphaeroestephanos hendersonii HOLTJTM, sp. nov.

Pinnae redactae c. 8-jugatae, usque 6 mm longae; pinnae normales usque 14 × 2.3 cm, 3/5 costam versus lobatae, basi aerophorise longis praeditae, subtus eglandulosae; venae 10-jugatae, infima solum anastomosantes; rachis, costae costulaequae subtus pilis adpressis vestita; 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 apressed 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. Sphaeroestephanos posthumus HOLTJTM, sp. nov.

Pinnae redactae c. 10-jugatae, usque 4 mm longae; pinnae normales usque 12.5 × 1.5 cm, basi aerophorise 1 mm longis praeditae, profunde lobatae; venae infima prope sinum comminetes, 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 codaute; edges lobed to 1.5–2 mm from costa, lobes slightly falcate; costules 3–3.5 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.

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 ca 8 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 x 0.8 to 6.0 x 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 costa 0.2-0.3 mm long, pale, appressed, fewer on costules, sometimes with rudimentary scales which have a glandelar tip, sessile spherical glands usually lacking; hairs on upper surface of costa less than 0.5 mm long, no others. Sori medialis; 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.


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 costa 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 eolatibus 27-jugatis, usque 3.6 x 1.0 cm metentibus, ad alam 0.5 mm latam lobatis; venis infinis omnibus ad marginem supra basin sinuum terminatis; costis substis pilis patentibus vestitis. — Type: E. MIÖBERG 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 x 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 inframedian; 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.


Caudex short, erect. Stipe 5-8 cm long, reddish, glabrous; scales c. 2 x 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 x 0.3 cm (to 8.5 x 0.5 cm, fide BRAUSE); base and apex narrowly attenuate, edges entire; costules 1.5 mm apart, very oblique, forked or simple, without anastomosis; upper surface quite glabrous; upper surface hairy in grove 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 normalaes 12-jugatae, superiores plures non liberae; pinnae liberae subintegratae, basi auriculatae; costae substis pilis erectis 0.1-0.2 mm longis vestitis, pagina inferior cetera pilis brevioribus praedita, eglandulosa; sori elongati; indusia parva (vel nulla?); sporangia interdum glandulae 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 sinuose; 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.


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 cuate 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 costa densely covered with hairs 0.2–0.3 mm long, hairs on costa more sparse and somewhat antrorse, sparse minute erect hairs present between veins, no glands; upper surface of costa 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.


Nephorium urophyllum sensu Racib. Fl. Btng 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 cuate-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 costa 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 Pronephiium lineatum (Bl.) Presl. It seems uniform over a wide area, and may be a tetraploid of hybrid origin.


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. tracyensis* resembles species of *Plesioneuron* in aspect, texture and surface, but its glands (on sporangia), and venation and sinus-characters are unlike that genus.


*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.


*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 1/2 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.—Dryopteris bresis, repens; pinnae redactae 20–30-jugatae, aerophorls 3 mm longis constitutis; pinnae 10-jugatae, fertiles usque 30 × 5.5 cm; venae 18–20-jugatae; pagina inferior pinnae 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 aérophores 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 aérophores 1 mm; base rounded to broadly cuneate; apex acuminated 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), recurrent 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, Sattelle; 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; aérophora elongata; costae costulaque subitus pili appressis vestitae, eglandulosae; pagina superior pinnarum pili 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 aérophores. Lamina 40 cm long; pinnae 16 pairs, 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-acute; 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 sinuses-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 costa 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).


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; aérophores 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 costa 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 Gede), 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. Gede (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 *Haplotichium heterophyllum* Presl., for which reason Ching transferred this species to *Haplotichium*.


Pinnae redactae 9-jugatae, superiores 5 mm longae; pinnae normales usque 11 cm longae, ad basin auriculatam 2.5 cm latae, suboppositae, 3/5–2/3 costam versus lobatae, inimiae basi leviter angustatae; costa claspulaeque subtus pilis antrorse non appressis vestitae, eglandulosae; pagina suprerioris pilis appressa vestita; sporangia setifera. — Type: ALSTON 15744, Celebes, Mina-hassa, 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 acrosopic vein or pair to sinus-membrane; *lower surface* of costa 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 of veins; *upper surface* of costa 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.

*Distri. Malesia*: N. Celebes at 1100–1400 m.


*Type*: BO, Celebes, bit. 498.

*Caudex* erectus; *stipes* 7 cm longus; *pinnae redactae* c. 9-jugatae, omnes parvae; *lamina* 100 cm longa; *pinnae inferiores plurimae basi versus valde angustatae; pinnae omnes profunde lobatae, apicem versus abrupte caudatae; *rachis* costaeque subtus pilis brevis 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 acrosopic vein sometimes to sinus-membrane; hairs on lower surface of costa 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. Sphaeroestephanos muluensis HOLTUM, sp. nov.

Pinnae redactae 8-jugatae, omnes parvae; aerophori leviter elongati; pinnae normales usque 15 x 2.5 cm, profunde lobatae; venae 11-12-jugatae, inimiae non anastomosantes; pagina inferior pinnarum eglandulosa; costulae et pagina inter venas subtus pilis adpressis vestitae; sori supramedaedae; indusia pilosa; sporangia interdum setifera.—Type: B. S. PARRIS 6729, Sarawak, Gunung 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 x 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 supramedaed; 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. Sphaeroestephanos teleformicus HOLTUM, sp. nov.

S. roemerianus (ROSENST.) HOLTUM affinis, ab ea differt: caudice tenue, erecto vel scandente; lamina longiore, pinnis 20-jugatis constata; pinnis distaliter solum creatis; pagina supra et subtus pilis adpressis vestita.—Type: W. R. BARKER & J. R. CROFT LAE 67649, N.E. New Guinea, W. Sepik Distr., Telefomin Subdist. (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, isomorphic; basal 2-3 pairs slightly and gradually reduced, smallest 1.2 cm long, subessicular, base unequally cuneate, not auricled; apical lamina not pinna-like. Largest pinnae 3.0 x 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.
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 normalis usque 4.5 × 0.9 cm, crenatae, eglandulose, costae costulaeque subitus pilis erectis brunneis 0.5–0.6 mm longis vestitae; sori mediales, indisia 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; aero- phores c. 0.5 mm long; apex short-acute; edges crenate to a depth of 1 mm or a little more deeply; costulae 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; indisia small, thin, with a few short hairs; sporangia not setiferous, no glands seen on them._

**Distr. Malesia:** W. New Guinea (Mt Hellwig), 2600 m.


_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 1 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; indinium small, bearing short hairs; sporangia with neither glands nor setae; spores dark, minutely papillate._

**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._


_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; aero- phores 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, 1–2 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; indisia 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.

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; aereophores 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 acuminated with cauda to 1.5 cm; edges lobed a little less than 1/2 way to costa, lobes oblique, narrowed to obtuse tips; costules 4–4.5 mm apart, at 60°; veins to 8 pairs, basal 1/2 pairs anastomosing, 1–11/2 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 papilose.

Distr. Malesia: Borneo (Sabah & P. Balambangan).

Ecol. In forest at low altitudes.


KEY TO THE VARIETIES
1. Lower surface of rachis and costae bearing thick reddish hairs . . . . . a. var. rudis
2. 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 aereophores. Lamina 50 cm long; apex pinna-like; pinnae to 40 pairs, dimorphous, lower 10–12 pairs gradually reduced, lower ones narrowly triangular with ± hasteate base, lowest 7–15 mm long; aereophores 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 acuminated; 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, 2–21/2 pairs anastomosing and 1 pair to sides of sinus-membrane; both surfaces of pinnae quite glabrous. Fertile pinnae 7–14 cm long, 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, exindustiate; sporangia bearing neither glands nor setae.


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.


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 ± hasteate base, lowest 7–15 mm long; aereophores 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 acuminated; 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, 2–21/2 pairs anastomosing and 1 pair to sides of sinus-membrane; both surfaces of pinnae quite glabrous. Fertile pinnae 7–14 cm long, 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, exindustiate; sporangia bearing neither glands nor setae.


1981] THELYPETIDACEAE (HOLTUM) 501
0.7-1.2 cm wide; edges entire as sterile, orcrete
(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 papil-
lose.
Distr. Malesia: Eastern New Guinea, in forest
at 1200-2000 m, many collections.

142. Sphaeroestephanos potamios HOLTJTM, sp.
nov. Caudex erectus, c. 20 cm altus; frondes dimor-
phae, omnes pinnae reductis 6-8-jugatis praeditae;
pinnae steriles 15 × 1.6 cm, fertiles usque 8.0 ×
0.8 cm, non ultra 1/4 costam versus lobatae, subitus
eglanulolae; rachis pilis brunneis vestita; sori
duplicate; 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 Subdist. 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 fer-
tile frond 6–8 pairs, not opposite, uppermost
1.5 cm long with basal acrosopic 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; aero-
phores 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 acrosopic, pale and prominent on lower surface,
reddish on upper, basal l–l pairs anastomosing,
1–1 pairs passing to the rather long sinus-mem-
brane; 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 open or lightly shaded places, some-
times in wet ground, at low altitudes.

144. Sphaeroestephanos austerus (BRAUSE) HOLTJTM,
comb. nov. — Dryopteris auster BRAUSE, Bot.
Jahrb. 56 (1920) 108. — Cyclosorus austerus
(BRAUSE) COPEL. Phyl. J. Sci. 78
(1951) 446. — Thelypteris auster (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 acrosopic 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 1/2 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 short appressed hairs. Sori slightly inframedial, exindusiata; sporangia with a few setae; spores minutely spinulose.

Distr. Malesia: Papua New Guinea (Sekip), only known from type.


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 x 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, all pairs anastomosing; all hairs on lower surfaces minute; on upper surface short hairs on costae only or a few between veins near margin. Sori exindusiata, 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 KEYS-ER 43, from the type locality, named D. obtusi-folia by ROSENSTOCK; this is probably an error for BAMLER 43 (ROSENSTOCK was describing specimens from both collectors). Also from Sattelberg is Rosenst. Fil. Novoguin. excis. 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.


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 x 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, all pairs anastomosing; all hairs on lower surfaces minute; on upper surface short hairs on costae only or a few between veins near margin. Sori exindusiata, 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 KEYS-ER 43, from the type locality, named D. obtusi-folia by ROSENSTOCK; this is probably an error for BAMLER 43 (ROSENSTOCK was describing specimens from both collectors). Also from Sattelberg is Rosenst. Fil. Novoguin. excis. 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 HOLTHTUM, sp. nov.

Pinnae redactae plurimae, 1.5 cm inter se di-stantes, aerophoris timidus tantum constituete; lamina 80 cm longa; pinnae 35-jugatae, maximae 15 x 1.5 cm, 3/5 costam versus lobatae, eglan-dulosa; pagina utroque latera inter venas pilis adpressis vestita; industria parva brevi-pilosa; sporangia setiferoides. —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 mm. 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 triangularae, *crenatae*; *pinnae* evolutae usque 16.5 × 2.3 cm, *dimidia* costam versus lobatae; *costae* costulaeque *subtus pilis erectis vestitae*, *sglandulosae*; *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* and veins and surface between them covered with slender appressed hairs 0.3 mm long. *Sori* a little in-framedial, 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, *subintegres*; *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, lower 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, 1 pair 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 *costae* and *costules* 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 pairs of reduced basal *pinnae*.


*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,
stere 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,
2–3 pairs anastomosing, 2–3 pairs to sides of
sinus-membrane; lower surface of costae densely
covered with short hairs as rachis, hairs on cos-
tules 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
media, lower ones not divergent; indusia reduced
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. con-
ferus 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.)
HOLTUM, comb. nov.—Dryopteris albosetosa
—
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 21435,
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; tran-
sition 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
2 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. Lar-
gest pinnae 4.0 × 1.0 cm; base truncate on acros-
copic side, rounded on basiscopic; apex abruptly
narrowed to obtuse tip; edges lobed to a depth of
1.5–2 mm, lobes strongly concave beneath (spe-
cimen 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 median; 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 HOLTUM, sp.
nov.

Pinnae redactae usque 9-jugatae, infinnae 5 ×
4 mm, superiores 1.4 × 1.0 cm, triangulares; pinnae
evoluetae usque 12 × 2.0 cm, 2/5 costam versus
lobatae; rachis utrinque pilis patentiis brunnescet
1 mm vel ultra-longis pilisque brevioribus vestita;
costae costulae venaeque subitus pilis pallidis
1 mm longis praeditae, elguloludae; indusia
magna, tenuia, pilis brevibus instructa; sporangia
setiferus.—Type: T. NAKAIKE 96, N.E. New
Guinea, Morobe Distr., Wau, Mt Misim 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 elon-
gate. 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, ½ pairs anastomosing and 1 pair
to sinus-membrane; lower surface of costae bear-
ing 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, ×1; b. venation and position of sori in apical lamina, ×3. — P. heterophyllum (PR.) HOLTTUM. c. Fertile and sterile fronds, ×3; d. venation of part of apical lamina, ×3. — P. micropinnatum HOLTTUM. e. Frond, ×1; f. part of apical lamina, ×4. — P. asperum (PR.) HOLTTUM. g. One pinna, ×1; h. venation and position of sori, ×2; i. one sorus, ×16 (a NAKAIKE 69, b BRASS 31670, c–d PRICE & HERNAEZ 162, e–f cult. Kew, g–i HENDERSON 21863).
18. PRONEPHRIUM


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.

Ecot. 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.) HOLTUM. a. Lower pinnae, ×1. — P. celebicum (BAK.) HOLTUM. b. Sterile pinna, ×1.5; c. fertile pinna, ×1.5; d. two indusia, ×100. — P. hewittii (COPEL.) HOLTUM. e. Middle sterile pinna, ×1.5; f. basal sterile pinna, ×1.5; g. fertile pinna, ×1.5; h. venation of sterile pinna, ×4; i. sori, ×16. — P. rhombeum (CHRIST) HOLTUM. j. Fertile frond, ×1; k. sterile frond, ×1; l. soro, ×16. — P. granulosum (PR.) HOLTUM. m. Fertile frond, ×1; n. soro, ×24 (a from photo of type, b DRANSFIELD 3776, c–d CURTIS 431, e–l 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. rhombenum*; 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. FEE 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**


The following species, included here in 1972, are now transferred to other sections: the non-Malesian *P. lukhipurens* and allied species, also the Malesian *P. nitidum*, *P. repandum* and *P. acanthocarpum*, to sect. *Menisciopsis*; *P. aquatiloides* and *P. menisciicarp* 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. gymnopteridfrons* 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. simplicijolit* 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, ×1; 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, ×1; f. bud at base of a pinna, ×8. — Sporangia, ×35, and spores, ×235; g–h. P. nitidum Holttum; i–l. P. repandum (FEE) 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 *Goniopeltis 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. euryphillum*
3. Glands lacking on lower surface of pinnae.
   3a. Pinnae 2–3 pairs; glands present on indusia or sporangia or both ............ 2. *P. lineatum*
   3b. Pinnae to at least 7 pairs; no glands on indusia and sporangia ......... 6. *P. womersleyi*
4. Pinnae to 30 × 5 cm; spores with a median wing and cross-wings ......... 3. *P. asperum*
5. Pinnae to 15 × 2.5 cm; spores with many separate small wings .......... 4. *P. gymnopteridifrons*
6. Free pinnae present on adult plants.
   6a. Apical lamina much larger than pinnae, or fronds simple ................. 5. *P. beccarianum*
   6b. Apical lamina to 20 × 3.5 cm; midrib of apical lamina and rachis glabrous on lower surface 6. *P. womersleyi*
7. Sporangia bearing glands near annulus.
   7a. Apical lamina to 6 × 1.7 cm; hairs present on lower surface of midrib of apical lamina and rachis 7. *P. melanophlebium*
   7b. Apical lamina to 1.5 × 0.5 cm; hairs absent on lower surface of midrib of apical lamina and rachis 11. *P. micropinnatum*
8. Terminal lamina lobed 1/4–1/3 towards midrib; pinnae to at least 1 cm long. ...
   8a. Pinnae 4–8 cm long ........................................................................ 8. *P. pentaphillum*
   8b. Pinnae not over 2 cm long ......................................................... 9. *P. brauseanum*
   9a. No glands on lower surface ...................................................... 10. *P. diminutum*
   9b. Glands present on lower surface .................................................. 11. *P. micropinnatum*
   10a. Apical lamina crenate; pinnae 2–5 mm long .................................... 11. *P. micropinnatum*
   10b. Apical lamina entire; pinnae 6–10 cm long ................................. 12. *P. bulusanicum*
   11a. Apical lamina widest near its base; pinnae 1 pair ........................ 12. *P. bulusanicum*
   11b. Apical lamina not widest near its base; pinnae 3 pairs, decreasing downwards 13. *P. heterophyllum*
   12a. Veins in basal part of apical lamina forked, their branches anastomosing ......... 13. *P. heterophyllum*
   12b. Veins in apical lamina not forked ................................................. 14. *P. bakeri*

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**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, costa 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.** Materia: 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
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.


Meniscium kennedyi F.V.M. Fragm. 4 (1864) 165.—Goniopistera kennedyi (F.V.M.) BALDIE, Handb. Queensl. Ferns (1874) 41, f. 31.—Type: DALLACHY & KENNEDY, Rockingham Bay, Queensland (MEL; K).


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 SPN 15303, Trengganu, Kuala Telumong (SING; K).

Aspidium repandum sensu BL. Enum. Pl. Jav. (1826) 144, excl. syn.—Nephrodium glandulosum sensu J. SM. in Hook. J. Bot. 3 (1843) 411 (misidentification of Cuming 16); DIELS in E. & P. NAT. FL. 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
tandum; Mett. Farragatt. IV (1858) 111, quoad syn. Abacopteris philippinarum Fée tantum.


Caudes 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 veinslet usually not free; sinus-membrane short but distinct; lower surface of costa, 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 median, 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) HOLTUM), the present species also with Nepridiophyllum latifolium Presl (= Pronephrium meniscicarpum) and Aspidium glandulosum Bl. (Pronephrium glandulosum); under the last named Mettenius also cited specimens of Sphaerostephanos peltochlamys (C. Chr.) Holttum (Zollinger 2008, 2920). Specimens from New Guinea and Queensland often have 1-2 short setae on sporangia.


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.


Goniopteris simplificolia (J. Sm. ex Hook.) Carr. var. viitensis Carr. in Seem. Fl. Vitensis (1893) 366. — Type: Seemann 736, Fiji (K).


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 veinslets mostly not free; lower surface between veins pustulose; sparsely 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. Sporoindusia, spreading along veins, those on connective veins often joining, sori rarely extending a little along excurrent veinslets; sporangia bearing small
glands and sometimes a short seta; spores pale with rather broad minutely erose translucent wing and a few cross-wings.


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.


Diffs. 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 areolae; 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.).


Dryopteris canescens var. subsimplicifolia CHRIST, Philip. J. Sci. 2 (1907) Bot. 199. — Type: WHITFORD 784, LUIZON (not seen).

In habit similar to P. womersleyi but much smaller. Stipe 2–3 cm (sterile), to 8 cm (tertile), 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, exudisiate, those on connivent veins sometimes meeting; sporangia bearing glands.

Distr. Malesia: Philippines (Negros, Mindanao (ELMER 10784, Mt Apo), (2) 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.


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, 1–2 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, 1.2–2.5 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).


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.


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, 1/2 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 entolate, exindusiate; sporangia copiously setose. 

Distr. Malesia: Eastern New Guinea at 1100-1700 m, in forest (5 collections).


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 hairs to 1 mm long, shorter hairs on veins with a few glands, slender erect hairs and a few glans 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.


Note. COPELAND made 2 collections at San Ramon, one earlier than the type (1907). The only other collection is by M. G. PRICE (n. 27206) 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.


Caudex short, suberect. Stipe to 6 cm long, minutely hairy on abaxial side, hairs in axadial 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 1/2 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 entolate, 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.


Ecol. On shaded river bank (type) and sandstone walls of river gorge, at 30-200 m.


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, 1/2 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 imbricated; 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).


Aspidium canescens (BL.) Christ var.; Christ, Farnk. 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 x 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. bulsananicum; base of lamina more deeply lobed, with transition to 2-3 pairs of pinnae close below it; hairs and glands as in P. bulsananicum. Fertile fronds. Stipe 7 cm long; terminal lamina 13 x 1.6 cm, acuminate, lobed less deep 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.


Ecol. On rocks in stream-beds at 200-350 m (M. G. Price).


Aspidium canescens (BL.) Christ var. sensu Christ, Farnk. 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 x 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. bulbamicum; pinnae opposite or not, to 10 x 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.


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


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 acrosopic 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
4. Upper surface glabrous; sori not elongate
5. Pinnae longer on mature plants.
6. Pinnae 2 mm wide
7. Pinnae 2–3 cm wide
8. Pinnae not over 1 cm wide
9. Pinnae not over 1 cm wide
10. Surfaces both short-hairy between veins.
11. Pinnae c. 15 pairs
12. Pinnae 2–3 pairs
14. Fronds simple, 10–20 cm long with cordate base
15. Fronds pinnate or, if simple, smaller and sterile.
16. Lower surface between and/or on veins bearing sessile spherical glands.
17. Veins free
18. Veins anastomosing.
19. Free pinnae not over 7 pairs, not over 2.0 cm wide.
20. Free pinnae more numerous or wider.
21. Lower pinnae with stalks 1–2 mm long
22. Lower pinnae sessile.
23. Hairs on lower surface of costules and on upper surface of veins not appressed
24. Hairs on lower surface of costules and on upper surface appressed.
25. Indusium bearing glands
26. Indusium bearing hairs
27. Free pinnae more numerous or wider.
28. Lower pinnae with stalks 1–2 mm long
29. Lower pinnae sessile.
30. Hairs on lower surface of costae and costules erect
31. Hairs on lower surface of costae and costules slender, appressed.
32. Sterile and fertile pinnae both 8–9 cm long
33. Sterile and fertile pinnae dimensions, smaller.
34. Sterile pinnae c. 4.5 × 1.4 cm; rachis almost glabrous on abaxial surface
35. Sterile pinnae c. 2.0 × 0.8 cm; rachis bearing copious erect hairs on abaxial surface
36. Glands present on sporangia, in some cases setae also.

**KEY TO THE SPECIES**

1. Sori exindusiate.
2. Pinnae not more than 3 cm long.
3. Upper surface short-appressed-hairy; sori elongate
4. Upper surface glabrous; sori not elongate
5. Pinnae longer on mature plants.
6. Sporangia setiferous
7. Sporangia not setiferous.
8. Pinnae 2–3 cm wide
9. Pinnae not over 1 cm wide
10. Surfaces between veins glabrous.
11. Surfaces both short-hairy between veins.
12. Pinnae c. 15 pairs
13. Pinnae 2–3 pairs
15. Fronds simple, 10–20 cm long with cordate base
16. Fronds pinnate or, if simple, smaller and sterile.
17. Lower surface between and/or on veins bearing sessile spherical glands.
18. Veins free
19. Veins anastomosing.
20. Free pinnae not over 7 pairs, not over 2.0 cm wide.
21. Free pinnae more numerous or wider.
22. Lower pinnae with stalks 1–2 mm long
23. Lower pinnae sessile.
24. Hairs on lower surface of costules and on upper surface appressed.
25. Indusium bearing glands
26. Indusium bearing hairs
27. Free pinnae more numerous or wider.
28. Lower pinnae with stalks 1–2 mm long
29. Lower pinnae sessile.
30. Hairs on lower surface of costae and costules erect
31. Hairs on lower surface of costae and costules slender, appressed.
32. Sterile and fertile pinnae both 8–9 cm long
33. Sterile and fertile pinnae dimensions, smaller.
34. Sterile pinnae c. 4.5 × 1.4 cm; rachis almost glabrous on abaxial surface
35. Sterile pinnae c. 2.0 × 0.8 cm; rachis bearing copious erect hairs on abaxial surface
36. Glands present on sporangia, in some cases setae also.

**KEY TO THE SPECIES**

1. Sori exindusiate.
2. Pinnae not more than 3 cm long.
3. Upper surface short-appressed-hairy; sori elongate
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6. Sporangia setiferous
7. Sporangia not setiferous.
8. Pinnae 2–3 cm wide
9. Pinnae not over 1 cm wide
10. Surfaces between veins glabrous.
11. Surfaces both short-hairy between veins.
12. Pinnae c. 15 pairs
13. Pinnae 2–3 pairs
15. Fronds simple, 10–20 cm long with cordate base
16. Fronds pinnate or, if simple, smaller and sterile.
17. Lower surface between and/or on veins bearing sessile spherical glands.
18. Veins free
19. Veins anastomosing.
20. Free pinnae not over 7 pairs, not over 2.0 cm wide.
21. Free pinnae more numerous or wider.
22. Lower pinnae with stalks 1–2 mm long
23. Lower pinnae sessile.
24. Hairs on lower surface of costules and on upper surface appressed.
25. Indusium bearing glands
26. Indusium bearing hairs
27. Free pinnae more numerous or wider.
28. Lower pinnae with stalks 1–2 mm long
29. Lower pinnae sessile.
30. Hairs on lower surface of costae and costules erect
31. Hairs on lower surface of costae and costules slender, appressed.
32. Sterile and fertile pinnae both 8–9 cm long
33. Sterile and fertile pinnae dimensions, smaller.
34. Sterile pinnae c. 4.5 × 1.4 cm; rachis almost glabrous on abaxial surface
35. Sterile pinnae c. 2.0 × 0.8 cm; rachis bearing copious erect hairs on abaxial surface
36. Glands present on sporangia, in some cases setae also.
20. Fertile pinnae 3–4 mm wide; sterile to 10 mm wide
21. Pinnae 6–10 pairs; sporangia bearing small glands only.
22. Pinnae 2–3 cm wide
23. Pinnae not over 1 cm wide
24. Pinnae 3–4 pairs; sporangia often with both glands and setae
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
24. Pinnae and/or frond-apex on both young and adult plants ± dilated and irregularly lobed distally
25. Pinnae not thus dilated nor irregularly lobed.
20. Sterile pinnae barely 1 cm wide
21. Sterile pinnae commonly 2 cm or more wide.
22. Sterile pinnae entire, to 13 × 4 cm
23. Sterile pinnae crenate, to 11 × 2.5 cm
24. Sterile pinnae crenate, at least distally
25. Sterile pinnae entire
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, acrosopic 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, ½ 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.
Eccl. 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 auriculate base. Middle pinnate 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.


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 pinnate 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).


Pronephrium palopense HOLT-TUM, 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 pinnate c. 5.0×1.3 cm (sterile), to 6.0×1.1 cm (fertile); base truncate and slightly auriculated 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; 1–1½ 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.


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 setiforous 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 palopense; 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.


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 sinuose; costes 3.5–4.5 mm apart, at less than 60°; veins 5–7 pairs, prominent on both surfaces, almost 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 antorse (not appressed) hairs, many such hairs on Kinabalu specimens, rest glabrous, surface between veins pubescent; 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.) Holt-tum, Blumea 20 (1972) 108. — Dryopteris aquati-
oides Copel. Philip. J. Sci. 7 (1912) Bot. 59; v.A.V.R. Handb. Suppl. (1917) 177. — Thelypteris a-
quatiloides (Copel.) Reed, Phytologia 17 (1968) 260. — Type: Brooks 9, Sarawak, Bongo Range (MICH; BM, L).


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, pin-
nae 6–8 pairs; basal pinnae narrowed towards base both sides, with stalks to 4 mm long. Middle pin-
nae 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 excur-
rent vein, slightly prominent; hairs on lower sur-
face of rachis thick, brown, curved, 0.5 mm long, on costae same length, slender, antrorsely ap-
pressed, 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.


Ecol. On rocks by streams in forest at 300–1000 m.

21. Pronephrium simillimum (C. Chr.) Holt-
tum, Blumea 20 (1972) 116. — Dryopteris sim-

Caudex short-creeping to suberect; fronds hardly dimorphp, Stipe 12–25–(45) cm long, minu-
tenly 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 trun-
cate and distincty 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, round-
ed, 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, 1–2 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, exindusiata; 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, cos-
tules 5 mm apart, pinna-lubes 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 Hulttum, sp. nov.

Pinnae paucijugatae, inferiores leviter redactae auriculatae stipitataeque, pinnae majors 5 cm longae, 1.5 cm latae, vir dimorphae; pagina inter venas utraque pilis brevibus vestita; sori exindusiata, 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

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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 HULTTUM, 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 amphi trichum HULTTUM, sp. nov.

P. clemensiae (COPEL.) Hulttum affinis, differt: pinnis multo minoribus; pilis costarum costularumque subitus patentibus, pilis inter venas paginae superioris non appressis; soris venarum inferiorum elongatis.—Type: EDANO 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 narrower 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.


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) HOLTNTM, comb. nov. — Dryopteris canecens var. degenera
CHRIST, Philipp. J. Sci. 2 (1907) Bot. 199. — Phe-
gopteris canecens var. degenera (CHRIST) v.A.v.R.
Handb. (1908) 507. — Cylcosorus degener (CHRIST)
COPEL. Fern Fl. Philip. (1960) 356. — Thelypteris
degenera (CHRIST) REED, Phytologia 17 (1968)
271. — Lectotype (HOLTNTM 1972); LOHER s.n.
March 1906, Luzon, Montalban (P).

Differs from var. clemensiae: indua densely
setose; sporangia bearing glands or setae. Spores
have a complete translucent wing.

Distr. Malesia: Philippines, Luzon (C. B.
ROBINSON BS 9455, Tayabas Prov.;
RAMOS BS 1791, Rizal Prov.; M. G. PRICE 2824,
Zambales Prov., Mts above Palauiig at 1000 m).

Notes. PRICE’s specimen is much larger than
the others (pinnae to 8.5 x 2 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
any other syntype, also collected by LOHER, at Paris.

26. Pronephrium glandulosum (BL.) HOLTNTM,
Blumea 20 (1972) 118. — Aspidium glandulosum
BL. En. Pl. Jav. (1828) 144; METT. Farngart. IV
(1858) 111, quoad descrip. tantum. — Nephradium
glandulosum (BL.) J. SM. in Hook. J. Bot. 3 (1841)
411, nomen tantum; PRESL, Epim. Bot. (1851) 45,
syn. omn. praetra Bl.; RACIB. Fl. Btzg 1 (1898)
185. — Abacopteris glandulosa (BL.) FÉE, Gen.
Fil. (1852) 310. — Dryopteris glandulosa (BL.) O.
KTEZE, 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. — Cylcosorus glandulosus (BL.)
227; HOLTNTM, Rev. Fl. Malaya 2 (1955) 278, f.
160. — Thelypteris malayensis (C. CHR.) REED,
Phytologia 17 (1968) 291. — Type: BLumea s.n.,
W. Java (L, n. 908, 337-89).

— Thelypteris iridescens (v. A. v. R.) REED, Phy-
tologia 17 (1968) 285. — Type: MATTHEW 517,
Sumatra, Padang Panjang (BO).

Dryopteris extracps COPEL. Univ. Cal. Publ.
Bot. 14 (1929) 374. — Type: RAHMAT SI TROEES
142, Sumatra (UC; L).

Dryopteris bartletti COPEL. ibid. l.c. —
Thelypteris bartletti (COPEL.) REED, Phytologia
17 (1968) 263. — Type: BARTLETT 6692, Sumatra,
Asahan (UC).

Nephroadium 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 acrosopic side, with stalks 2 mm long. Lar-
gest pinnae commonly to 12 x 2.5 cm; base trunc-
ate, auricled on acrosopic side, apex abruptly
short-accumulate; 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 anastomos-
ing (according to depth of lobing), 1-2 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 0.2-0.3 mm long. Fertile fronds.
Stipe to 50 cm long; pinnae more widely spaced
than sterile, commonly to 7 x 1.5 cm, edges
shallowly crenate; sor obtusus, lower ones at least
somewhat elongate along veins; indusia thin bear-
ing 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 ster-
ile and fertile pinnae almost entire. A specimen
collected by KURZ on G. Salak (PR) has fertile
pinnae 7 x 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 spe-
cies; 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 BDDOMO confused it under the name
Nephroadium lineatum.

27. Pronephrium debile (BAK.) HOLTNTM,
Blumea 20 (1972) 118. — Nephradium 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, Phy-
tologia 17 (1968) 306. — Type: BECCARI 433,
Sumatra, G. Singgalaang 1700 m (K).

Nephradium pilosisculum RACIB. Fl. Btzg 1
(1898) 189. — Dryopteris pilosiscula (RACIB.) C.
CHR. Ind. Fil. (1905) 284; v.A.V.R. Handb. (1908)
215; BACKER & POSTH. Varenfl. Java (1939) 65,
excl. syn. Aspidium pilosisculum METT. —
Thelypteris pilosiscula (RACIB.) REED, Phy-
tologia 17 (1968) 304. — Type: RACIBORSKI, Java,
G. Salak, Tjiapoes (BO; K, L, P).

Caudex short-creeping; fronds slightly dimor-
phous. Stipe 15-20 cm long, glabrous except base
which is covered with minute hairs and firm seti-
ferous scales 2 x 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 pilosiasculum 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).


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, 1 pair 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 to 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 HOLTTOUM, 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.


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 serrat-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.


*Dryopteris maquiligenensis* 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: EDANO 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.


*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 acrosopic side, rounded on basiscopic; apex obusally 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.


Dryopteris diversiloba sensu CHRIST, Philip. J. Sci. 2 (1907) Bot. 199, excl. var. acrostichoides.


Plants with a frond-form intermediate between P. granulosum and P. rhomben, 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.


Notes. These plants look like a hybrid swarm, which needs experimental cytotoxiconomic 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. Pronephrum trachyphyllum HOLTTUM, sp. nov.

Stipes frondis fertilis 23 cm longus; lamina 14 cm longa pinnis 7-jugatis laminacea 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 tenua 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, 1 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. Pronephrum thysanoides HOLTTUM, sp. nov.

P. simillimo (C. Chr.) Holttum affinis, ab ea differt: frondibus minoribus; pinnis non auriculatis; rachide costisque subitus glabris; sori indusiatis, indusiis parvis, rigidis, setis brevibus
ciliatis. — Type: JERMY 14049, Sarawak, Gunong Mulu, Ulun Sungei Ai 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.


Meniscium proliferum sensu HOOK. 2 Cent. Ferns (1861) t. 15, quod 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 ± 2 short setae; spores pale, with longitudinal wing and cross-wings. Chromosomes: n = 36 (T. G. WALKER).


Ecol. On rocky stream-banks in forest, at low altitudes.


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 korthalsii ROSENST. Meded. Rijkssher. n. 31 (1917) 5. — Type: KORTHALS, Sumatra (L, K).


Dryopteris urophylla var. peraspera v.A.V.R.


_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 acrosopic 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 supramedian, 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 HOEKER 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. affinis_ _BL._


_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 acrosopic 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, 1–2 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.


_Gymnogramme macrotis_ _KUNZE_, Bot. Zeit. 6 (1848) 114.—_Dryopteris oxytis_ _ROSENST._ Meded. Rijksher. n. 31 (1917) 5, _nom._ _nov._ (not _D. macrotis_ (HOOK.) _O._ _KTZE._).—_Type:_ _ZOLLINGER_ 324z, _Java_ (L).

_Aspidium lineatum sensu_ _METT._ _FARGA._ IV (1858) 110, _quoad_ _syn._ _A._ _affinis_ _BL._ et _G._ _macrotis_
Pronephrium 


_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 a Sumatran specimen short-acuminatae; 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 3×0.7 cm, of others to 4×0.9 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 Alderweireld & 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.

pinnae slightly narrowed both sides towards auricled base. *Middle pinnae* 3.5 x 1.0 cm; base truncate, slightly auricled; apex short-acuminate (pinnae of type of *M. stenophyllum* to 2.0 x 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 costa, 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 (i.c. 1934) referred here specimens with thinner pustular pinnae and setiferous sporangia; these are now placed in *P. rhombum* and *P. peltatum*.


Diffs from 38. *P. hewittii* as follows: fertile pinnae to 2.7 x 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).


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 costa, sparse short hairs on costules and veins, surface between veins pustular; upper surface of rachis hairy as lower, hairs on costa 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 crossings.

**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. x xiphioides*.


*Dryopteris zippelii* Rosenst. Meded. Rijkenb. n. 31 (1917) 6. — Type: Zippen, Java (L).

*Dryopteris lineata* var. subacrostichoides
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. tenomopkense
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. persettiferum
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.


Diffs 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.


A var. tenomopkense 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 loc. p. 625).


A var. tenomopkense differt pinnis leviter crenatis, sporangis setis pluribus praeeditis.

Distr. Malesia: Borneo. Besides type, known from G. Mulu, Sarawak, in stream-bed at 1760 m.

e. var. aberrans HOLTTUM, var. nov.

A var. tenomopkense differt: frondibus pinnis inferioribus redactis usque 12-jugatis, aequiliter bilobatis (lobo usque 1.2 cm longis) praeeditis; pinnis normalibus sterilibus usque 12 × 2.5 cm, distaliter crenatis, fertileibus usque 7 × 1.7 cm; sporangii 0–2 setis praeeditis. — Type: CLEMENS “33702 & 32020”, Sabah. Mt Kinabalu, Colombo 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 Meniscioips HOLTTUM, subg. nov.

Pinnae subintegrae, plurivenosas, venis plerisque more generis Menisci Schreb. anastomosantibus; sori exindusiati, saepe elongati, interdum coalescentes; sporangia vel nudis vel pilis rectis vel hamatis praeedita.

Type species: Pronephrium lakhipurensense (ROSENST.) HOLTTUM, Blumea 20 (1972) 110.

Taxon. The type species, P. lakhipurensense, 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*
3. Pinnae 2.5–3.5 cm wide; edges entire or nearly so.
4. Excurent veinlets mostly free; sori close to costules .......................... 46. *P. rubidum*
5. Excurent veinlets mostly not free; sori not close to costules .......................... 47. *P. scopulorum*
7. Pinnae one pair, a bud at the base of each ........................................ 48. *P. acanthocarpum*
8. Pinnae several pairs on adult plant; no buds present.
9. Caudex long-creeping; veins very oblique; several acicular hairs on stalk of sporangium .......................... 49. *P. nitidum*
10. 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*


**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 degenerate; 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 red-dashed 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 prostrate, and this is also true of a plant he sent from the New Hebrides, cultivated at Kew.


Caudex short, subrect. 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 cuate-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 veillets 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 basicsopic 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 Holtttum, sp. nov.

A P. rubido differt: pinnis omnibus basi anguste inaequaliter cuneatis, pinnae basalius non stiptatis; venulis excurrentibus plerisque non liberis; sori costulas non contaminibus.—Type: Buwalda 5168, Ara 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; acrosopic base narrowed to attachment to rachis, lamina on basicsopic side ending 3–4 mm from rachis; apex narrowly cuate; 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 acrosopic 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.


Ecol. On steep limestone which carries little other vegetation.


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 veillets free; lower surface of midrib copiously minutely hairy (less than 0.1 mm), similar hairs sparse on main veins, surface between veins not pubescent; sori median 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 basicsopic side 4.5 cm wide at 1/3 length of pinna, acrosopic side 3 cm; veins to 18 pairs on basicsopic 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.


Cyclusorus urophyllus sensu COPEL. Fern Fl. Philip. (1960) 373, excl. loc. Malacca. — Fig. 16g–h.

Caudex long-growing, 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. Sorî supra-medial, 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 sporangia; 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.


Goniotes dalhousiana FEE, 8e Mém. (1857) 92. — Type: Lady DALHOUSSIE, "Indes Orientales" (Herb. Graham, not seen; probable isotype, from Penang, K).


Polypodium pinwillii BAK. Ann. Bot. 5 (1891) 460. — Nephrodium urophyllum var. pinwillii BEECH. Handb. Suppl. (1892) 72. — Type: PINWILL, Malacca (K). — Fig. 11, 16–j.

Caudex short-growing, 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 cuate-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 (6 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.


4. Section Grypothrix

HOLTUM, Blumea 19 (1971) 36.

Type species: Pronephrium cuspidatum (BL.) HOLTUM.

Taxon. See discussion under subg. Meniscioptus. 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. Meniscioptus.

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. Fee 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
      3. Pinnae 2–6 pairs, distal ones small and adnate, rest with variable asymmetry
      4. Pinnae not all narrowly cuneate at base, fertile ones commonly 1 cm wide; hooked hairs lacking on lamina and sporangia
      5. Pinnae I–3 pairs; no buds at their bases.
   5. Pinnae all narrow opposite; fertile pinnae with undulate margins; hooked hairs present on basal scales and on sporangia
   6. Pinnae not always opposite; fertile pinnae sharply serrate-crenate distally; no hooked hairs on scales nor on sporangia
   7. Pinnae of well-grown plants more than 3 pairs; a bud always present at base of uppermost pinna.
   8. Bud confined to base of uppermost pinna; pinnae widest in basal half; hydathodes on upper surface conspicuous
   9. Buds present at bases of several pinnae; pinnae usually widest above middle; hydathodes not conspicuous
   10. Hooked hairs present on sporangia
   11. Hooked hairs lacking on sporangia


Meniscium cumingii FEE, 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 sparingly hairy, hairs as caudex. Lamina consisting of an apical section and one pair of opposite pinnae attached 0.5–2 cm below it. Sterile apical lamina 10–18 cm long, 2.5–4 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 pubescent 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 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 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). 

Ecil. Low altitudes in light shade, sometimes abundant under fruit trees or palms in villages; few collections from Philippines and New Guinea.


Caudex long-creeping, 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: Malayia (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.


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 dimorphic, 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 flood-water; in form they closely resemble the pinnae of Dipteris lobbiana (Hook.) Moore, which grows in similar habitats.


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 acrosopic; 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. Malesia: Peninsular Thailand, in Malesia: Sumatra, Malaya.

Ecol. In primary forest at 0–800 m, not on stream-banks.


Differs from P. rubicundum as follows: scales on rhyzone 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 through axis, edges of fertile pinnae strongly crenate-serrate distally, of sterile ones less strongly; sorus 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.


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 acrosopic 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 veinslets mostly free and ending in a conspicuous hyathode 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.


*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 hyathodes present at apices of excurrent veinslets; *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. — Dryopteris maritima* (CHRIST) BACKER, *sensu* ALSTON 16551, N. Celebes, G. Manembro-nemo (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.) HOLTUM.

**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 indusiate; pinnae less than 2 cm long ........................................... 3. *N. nervosa*
   1. Sori exindusiate; pinnae to 3 cm long .................................................. 2. *N. camarinensis*


**Stipe** 3–12 cm long (longest in fertile fronds), short-hairy; *lamin* to 20 cm long; pinnae to 25 pairs. **Sterile pinnae** to 1.7 × 0.6 cm; base slightly to distinctly auricled on acrosopic side, rounded on basiscopic; apex obtusely pointed to rounded; edges crenate to lobed, more deeply on acrosopic 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** HOLTUM, 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 costa 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** (FEE) HOLTUM, Kalikasan 2 (1973) 66.—*Phegopteris nervosa* FEE, Gen. Fil. (1852) 244; 6e Mém. (1853) 13, t. 2,


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 4.5 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 F. Fee under his var. a. If transferred to Thelypteris, N. nervosa will need another specific epithet, as T. nervosa (Klotzsch) Tryon represents another species.


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.


*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 mudsprings in open place in forest.

## 20. STEGNOGRAMMA


*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
which (Haplogramma and Dictyoclone) 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) ........................................oman. 1. S. aspidioides

1. S. aspidioides
2. Pinnae to 7.5 x 1.6 cm or larger; lower surface of costae bearing many hairs, short ones more abundant than longer ........................................oman. 2. S. pozoi var. petiolata
3. 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.
4. Pinnae not over 1.5 cm long, only basal ones lobed; sporangia sparsely setose 3. S. gymnocarpa
5. Pinnae longer, several pairs lobed; sporangia all freely setose.
6. Pinnae proportionately wider with short entire apex.

3. S. gymnocarpa
4. Pinnae to 5.0 x 0.8 cm with narrowly triangular apex 10 mm long 4. S. subcalcarata
5. Pinnae to 5.0 x 0.8 cm with short entire apex.

4. S. subcalcarata
6. Fronds to 30 cm long; basal pinnae lobed more than half-way towards costa 5. S. dissitifolia
7. Fronds c. 16 cm long; basal pinnae less deeply lobed 6. S. celebica


logia 17 (1968) 466. — Type: BLUME, Java.


Stipe to 40 cm long, dark, bearing long pale hairs mixed with short ones; basal scales c. 6 x 1 mm; hairs on rachis to 2 mm long. Lamina commonly 35 mm 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 x 3 cm (to 13 x 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 recurrent 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 Khasaya and Ceylon by Hooker and BEDDOME.


LICHI”), Ceylon (PE).


Stipe 15—30 cm long; basal scales c. 5 x 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 x 1.6 cm; base subequally truncate; apex entire, triangular, 8 x 3.5 mm; edges lobed almost half-way to costa, lobes oblique, hardly falcate, entire; costules 4.5—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. Sorii 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. pozoii, 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 sorii not extending to the bases of veins. Plants named S. pozoii occur throughout Africa; they are variable and no chromosome counts have been made. BLUME's type has pinnae to 4.0 x 1.3 cm, and all pinnae above the basal ones are adnate; BACKER & POSTHUMUS report plants with fronds to 50 x 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 WALLICHI, but it was surely G. WALL, who collected ferns in Cey- 

lon, not WALLICHI.


tantum. — Leptogramma gymnocarpa (COPEL.) CHING, Acta Phytotax. Sinica 8 (1963) 318. — Thelepyriteris gymnocarpa (COPEL.) MORTON. Amer. Fern J. 56 (1966) 179. — Type: ELMER 11508, Mt Apo, Falls of Cat Creek, 1750 m, Min- 

dano (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 subcalcarea (V.A.V.R.) HOLTTUM, comb. nov. — Phegopteris totta var. subcalcarea V.A.V.R. Handb. Suppl. (1917) 515. — Type: BECCARI 430, G. Singgaling, 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 2.5–3.5 mm long, almost free, stalks 1.5–2.2 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 acroscopic 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).


Stipes usque 18 cm longus; lamina usque 30 cm longa; pinnae liberae usque 12-jugatae, inferiores 6-jugatae stipitate, maxime 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 truncate 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. pozozi on Orchid Island (near the south of Taiwan) have pinnae 5 cm long.


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, acroscopic 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

HOLTUM, 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. subattenuatam; spores usually dark, irregularly rugose or with irregular thick ± branched ridges.

Type species: Amphineuron opulentum (KAULF.) HOLTUM.

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


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 glabrous to pyriform, on indusia spherical, resinous

10. A. klaueanum


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 reduced somewhat, rarely very small, always distinctly narrowed at their bases; apex of frond usually pinna-like but variable. Largest pinnae commonly 17-20 x 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, sub sessile 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.


Caudex short, erect; stipe to at least 70 cm long, pale, 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 costa 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 costa 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 stoutened 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 (SP-A?; 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 costa 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 capitately hair; spores pale, with highly prominent thick ridges.


Ecol. In somewhat exposed places near streams in forest.


*Nephrodium conioneurum* FEE, Gen. Fil. (1852) 308. — *Aspidium conioneurum* (FEE) METT. Farn.-gatt. IV (1858) 102. — Type: GARDNER, Ceylon (Isotype W).

*Aspidium nephrodioides* HOOK. Spec. Fil. 4 (1862) 162, t. 235, non KLOTZSCH 1847. — *Aspi-
dium 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 capitately 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 HOLTZM 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.


*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, exundisulate; 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.


Caenostachis 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 uncurred tips passing to sides of sinuncus membrane; rarely joining just below the membrane; lower surface of costae and costules bearing scattered minute capitate hairs, between veins slender short acicular hairs rarely 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.


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.


Note. The type of Phegopteris ceramicum 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.

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.


**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 acrosopic 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, Kiu, 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

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 acrosopic 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. nymphae 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) HOLTUM. b. Two pinna-lobes, × 4; c. upper surface of costa and base of costule, showing aciculate and capitate hairs, × 18. — C. papilio (HOPE) HOLTUM. 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.) HOLTUM. g. Venation and sori, × 4. — C. harveyi (METT.) HOLTUM. 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 HOLTUM 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

   4. Pinnae c. 6 pairs, lowest only slightly reduced

   5. Pinnae c. 6 pairs, lowest only slightly reduced

   6. Pinnae c. 6 pairs, lowest only slightly reduced

   1. Pinnae to 27 pairs, 5–7 lower ones gradually reduced

   2. Pinnae c. 6 pairs, lowest only slightly reduced

   3. Pinnae c. 6 pairs, lowest only slightly reduced

   4. Pinnae c. 6 pairs, lowest only slightly reduced

   5. Pinnae c. 6 pairs, lowest only slightly reduced

   6. Pinnae c. 6 pairs, lowest only slightly reduced

   7. Pinnae c. 6 pairs, lowest only slightly reduced

   8. Pinnae c. 6 pairs, lowest only slightly reduced

   9. Pinnae c. 6 pairs, lowest only slightly reduced

   10. Pinnae c. 6 pairs, lowest only slightly reduced

   11. Pinnae c. 6 pairs, lowest only slightly reduced

   12. Pinnae c. 6 pairs, lowest only slightly reduced

   13. Pinnae c. 6 pairs, lowest only slightly reduced

   14. Pinnae c. 6 pairs, lowest only slightly reduced

   15. Pinnae c. 6 pairs, lowest only slightly reduced

   16. Pinnae c. 6 pairs, lowest only slightly reduced

   17. Pinnae c. 6 pairs, lowest only slightly reduced

   18. Pinnae c. 6 pairs, lowest only slightly reduced

   19. Pinnae c. 6 pairs, lowest only slightly reduced

   20. Pinnae c. 6 pairs, lowest only slightly reduced

   21. Pinnae c. 6 pairs, lowest only slightly reduced

   22. Pinnae c. 6 pairs, lowest only slightly reduced

   23. Pinnae c. 6 pairs, lowest only slightly reduced

   24. Pinnae c. 6 pairs, lowest only slightly reduced

   25. Pinnae c. 6 pairs, lowest only slightly reduced

   26. Pinnae c. 6 pairs, lowest only slightly reduced

   27. Pinnae c. 6 pairs, lowest only slightly reduced

   28. Pinnae c. 6 pairs, lowest only slightly reduced

   29. Pinnae c. 6 pairs, lowest only slightly reduced

   30. Pinnae c. 6 pairs, lowest only slightly reduced

   31. Pinnae c. 6 pairs, lowest only slightly reduced

   32. Pinnae c. 6 pairs, lowest only slightly reduced

   33. Pinnae c. 6 pairs, lowest only slightly reduced

   34. Pinnae c. 6 pairs, lowest only slightly reduced

   35. Pinnae c. 6 pairs, lowest only slightly reduced

   36. Pinnae c. 6 pairs, lowest only slightly reduced

   37. Pinnae c. 6 pairs, lowest only slightly reduced

   38. Pinnae c. 6 pairs, lowest only slightly reduced

   39. Pinnae c. 6 pairs, lowest only slightly reduced

   40. Pinnae c. 6 pairs, lowest only slightly reduced

   41. Pinnae c. 6 pairs, lowest only slightly reduced

   42. Pinnae c. 6 pairs, lowest only slightly reduced

   43. Pinnae c. 6 pairs, lowest only slightly reduced

   44. Pinnae c. 6 pairs, lowest only slightly reduced

   45. Pinnae c. 6 pairs, lowest only slightly reduced

   46. Pinnae c. 6 pairs, lowest only slightly reduced

   47. Pinnae c. 6 pairs, lowest only slightly reduced

   48. Pinnae c. 6 pairs, lowest only slightly reduced

   49. Pinnae c. 6 pairs, lowest only slightly reduced

   50. Pinnae c. 6 pairs, lowest only slightly reduced

   51. Pinnae c. 6 pairs, lowest only slightly reduced

   52. Pinnae c. 6 pairs, lowest only slightly reduced

   53. Pinnae c. 6 pairs, lowest only slightly reduced

   54. Pinnae c. 6 pairs, lowest only slightly reduced

   55. Pinnae c. 6 pairs, lowest only slightly reduced

   56. Pinnae c. 6 pairs, lowest only slightly reduced

   57. Pinnae c. 6 pairs, lowest only slightly reduced

   58. Pinnae c. 6 pairs, lowest only slightly reduced

   59. Pinnae c. 6 pairs, lowest only slightly reduced

   60. Pinnae c. 6 pairs, lowest only slightly reduced
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
19. Caudex not erect; basal pinnae not reduced
18. Pinnae lobed little more than 1/2; hairs on lower surface all less than 0.5 mm long


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 acrosopic lobe not elongate but with sometimes a sinuous margin; costules 2.5–3 mm apart; veins to 4 pairs, free, basal acrosopic 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 (Wai geo 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 acrosopic 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 acrosopic 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 acrosopic 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. pubescens.


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 acrosopic 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 acrosopic 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.


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. Kobroor "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. permorbus, not like that of any species of Prophrurnium, from which genus the species is here transferred. But the spores of the type need a careful re-examination; sporangia of the Kew type are immature.


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 acrosopic 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 acrosopic 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.


Ecol. In open places in forest at 0–1000 m.


Caudex probably long-creeping; stipe probably to 20 cm long, copiously short-hairy, basal scales not seen. Lamina 30–40 cm long; pinnae 18–22 pairs; basal pinnae slightly reduced, their basal pair of lobes almost free, the acrosopic 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.


Note. PEEKEL collected in the Bismarck Archipelago; the type was probably found in New Ireland. It is closely related to C. prolaxa (WILLD.) HOLTUM (Aspidium oblataquetum METT.) of New Caledonia, which also lacks glandular hairs on the lower surface of pinnae.


Dryopteris arida var. ebeneorachis COP. in Elmer, Leaf. Philip. Bot. 2 (1908) 390. — Type: ELMER 1044, Negrois (MICH; BO, G). — Fig. II.

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 1/4 towards costa, lobes with a short stiff point; costules 3-4 mm apart; veins to 10 pairs, prominent beneath, 1 1/2 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 inquisus and S. unius which have a similar habit (see Holttum in Alertonia, 1977). LOYAL found a plant in North India to be diploid; some specimens are possibly hybrids with C. subpubescens.


Nephrolepis 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 acrosopic 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, 1 1/2 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.


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.

Ecological in secondary swamp forest, low altitude.


Dryopteris hirtolopsa ROSENST. Meded. Rijksherb. n. 31 (1917) 7; G. M. PRICE, Kalikasan 2 (1973) 112. — Thelypteris hirtolopsa (ROSENST.) REED, Phytologia 17 (1968) 283. — Type: MERRILL 7671, Luzon (L; K).


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 decurrent with dentate acrosopic auricles, lowest commonly 3 cm long. Largest pinnae 8-12 (15) × 1.2-1.5(-2.0) cm; base truncate with basal acrosopic 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, unifying 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 capitulate 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 capitulate 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; Khasaya Hills southwards to Malay; throughout Malesia: Caroline Islands.

Ecological 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 including this species, see PANIGRAHI & MANTON 1955 (under Cyclosorus repandulus).

Only synonyms based on Malesian specimens are quoted 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 stiemenst (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.


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 costa 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 costa 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.

Ec. 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 last 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.


Aspidium subpubescens Bl. var. C Bl. l.c.—Type: BLUME, W. Java, Kolleket (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: ZÖLLINGER 735, Java, Ufer des Tijdurians (L, n. 908, 333–35), Aspidium amboinense sensu Bl. En. Pl. Jav. (1828) 148; KUNZE, Bot. Zeit. 6 (1848) 261; MÜTT. Farngart. IV (1858) 105.—Nephroidium molle var. amboinense BEDD. Handb. (1883) 278, p.p.—Fig. 20a.

Caudex short-creeping or subrecte; 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 1/2 pairs of veins anastomosing and the next pair ending beside the sinus-membrane, in large plants 2–3 pairs of veins anastomosing to form a zig-zag excurrent vein and 1/2 pair ending beside the sinus-membrane; lower surface of rachis, costa 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 median; 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.

Ecot. 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-moving 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.


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 acrosopic 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 acrosopic 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 median; indusia short-hairy.

Distr. Malesia: Philippines (Mindoro), only known from the type.

Note. This may be a hybrid.


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 acrosopic 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 4.5–5.5 mm apart; veins to 12 pairs, basal 1–1½ pairs anastomosing, next acrosopic 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 supramedian; indusia with short stiff hairs.

Distr. Malesia: Lesser Sunda Is. (Timor), only known from type.

Ecot. In grassland along stream at 1300 m.


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Nephrodictum 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).


Cyclosorus benguensis Copel. Philip. J. Sci. 81 (1952) 28; Fern Fl. Philip. (1960) 341.—Thelypteris benguensis (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 16x2 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. Sorii 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 benguensis); 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.


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 9x1.5 cm (fertile), 15x2 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).