BLUMEA 33 (1988) 395–409

# ADDITIONS TO THE FERN FLORA OF SULAWESI

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SUMMARY

A number of additions to the fern flora of Celebes are given here, including also the description of 15 new taxa in the Polypodiaceae, Cyatheaceae, Dennstaedtiaceae, Thelypteridaceae, Aspleniaceae, and Davalliaceae.

## INTRODUCTION

Identification of the collections made by De Joncheere and Hennipman during the 1979 Rijksherbarium/LIPI expedition to Sulawesi has resulted in a number of additions to the fern flora of Celebes. Some of these represent extensions of known ranges, some represent new species. With the large amount of material collected during this expedition it has occasionally also been possible to complete descriptions, based on earlier, more scanty material. A more extensive report of the expedition and a description of the vegetation of the localities visited has been published by Van Balgooy & Tantra (1986).

All in all, 11 new species, 4 new varieties, and 1 new hybrid are described. Three species are reduced to synonymy. The descriptions and notes for the new taxa of Thelypteridaceae were provided by Prof. R.E. Holttum, Kew. Helpful comments were received from A.C. Jermy, London, and M. Kato, Tokyo.

The species are enumerated in the order proposed by Crabbe, Jermy & Mickel (1975). Abbreviations used are the following: J = De Joncheere (nos. 1003–1765); H = Hennipman (nos. 5001–6159); V = De Vogel & Vermeulen: some additional material collected in 1986 during the Wallace expedition to Gunung Ambang Nature Reserve (nos. 6476–7299).

## SCHIZAEACEAE

**Lygodium versteegii** Christ

First record for Celebes, so far known only from New Guinea.

Soroako, in forest on ultrabasic: *H 5865*, 200 m; *J 1455*, 450 m; Lake Matano: *J 1646*, 400 m.

## ADIANTACEAE

**Adiantum hosei** Baker, J. Bot. 26 (1988) 324.
*Adiantum hollandiae* Alderw., Bull. Jard. Bot. Buitenz. 7 (1912) 1, *syn. nov.* — T y p e: *Gjellerup 946*, Hollandia, New Guinea (iso L!).

Described from Borneo, and so far not recorded from Celebes. Price (1987: 191) added *A. scabripes* Copel., described on material from Mindanao, to its synonymy. With the addition of *A. hollandiae* as a synonym, the distributional range of this species now extends over the whole of eastern Malesia. The serpentinofilic tendency conjectured by Price (l.c.) is confirmed by at least two of the specimens reported here.

Lake Matano: *J 1415*, 380 m; *J 1549*, 500 m; *J 1654*, 400–450 m; Soroako, in forest on ultrabasic: *H 5880*, 200 m; *H 5896*.

**Pteris holttummii** C. Chr.

First record from Celebes, so far known only from North Borneo [C. Chr., Gard. Bull. Str. Settl. 7 (1934) 287].

Palu: *J 1347*, 500 m.

## POLYPODIACEAE

**Selliguea stenosquamis** Hovenkamp, *spec. nov.*

*Crypsinus enervis* (Cav.) Copel. similis, ab eo differt squamis rhizomatis apicibus anguste aciculatis, saepe valde recurvatis. — T y p u s : *Hennipman 5259*, Central Sulawesi, Roroka Timbu, 2000 m, mountain forest (L).

Rhizome 2.5 mm thick (1.5 mm in dry state), glaucous, with more or less deciduous scales; phyllopodia 1–2 cm distant. Anatomy: ground tissue parenchymatous, up to c. 25 scattered sclerenchyma strands present and 9–11 vascular strands. Scales 4–6 by 0.35–0.55 mm; base peltate, margin irregularly incised, with up to 8 gland-tipped short protrusions; acumen above the attachment of the scales more or less gradually narrowed to a long, entire, acicular tip, apex often reflexed, terminating in a gland. Fronds dimorphic. Sterile fronds: stipe 2–10.5 cm, 1/8–2/3 times as long as the lamina; lamina 2–14 by 1.4–4.2 cm, index 1.5–6, widest at 1/5–1/2 from the base; base more or less gradually attenuate, apex occasionally rounded, more frequently acuminate to apiculate with an apiculus to 2 cm long; margin cartilaginous, regularly notched; texture thick-papyraceous. Fertile fronds: stipe 7–14.5 cm, c. 1/5–2/3 times as long as the lamina; lamina 9–14.5 by 1.7–4 cm, index c. 5–7, apex acuminate to apiculate, otherwise similar to sterile ones. Sori in 2 regular rows between the secondary veins, to 5–7 pairs between midrib and margin of frond, when old 1–2 mm diam. Paraphyses to 0.4 mm long, 4–8-celled, uniseriate, unbranched, terminating in a gland. Sporangia stalked, stalk to 0.6 mm long, capsule to 0.3 mm high, with 13–14 indurated annulus cells. Spores monolete, bean-shaped, irregularly verrucose.

Additional specimens:
CELEBES. Mt Roroka Timbu, 2000 m: *H 5288*; Mt Nokilalaki, 100–1300 m: *Meijer 9749* (L), 2250 m: *Alisi 11* (L); Mt Wowonseru, 1100 m: *Darnaedi 2051* (L).
BORNEO. Sarawak, G. Mulu Nat. Park, 1310 m: *Martin S 3706* (L).

Habitat. In mountain (submontane to cloud-)forest, epiphytic; altitude c. 1000–2250 m.

Notes. 1. Scales light green when fresh (note to *H 5259*).

2. Differs from *Crypsinus enervis* mainly in the more slender rhizome and the rhizome scales having a narrow, entire, squarrose acumen. *Crypsinus enervis* has scales with a wide, dentate, appressed acumen. The states shown by all other characters investigated fall within the range shown by *C. enervis*. Within the *Crypsinus/Selliguea*-group, however, rhizome scales often appear to be constant for large groups or aggregates of what are traditionally considered species (compare, e.g., *C. triquetrus, S. bellisquamata,* and *C. dekockii*). We have considered it best, pending revision of the genus, to give this aberrant form specific status. In placing it in *Selliguea* rather than in *Crypsinus* we agree with Hennipman et al. (in press) that there is no reason to keep the two genera separate.

**Microsorum monstrosum** (Copel.) Copel. (Det. M. Bosman)

First record for Celebes, regarded as endemic for the Philippines by Copeland, Fern Fl. Philipp. (1960) 485.

Sopu Valley: *H 5099*.

## CYATHEACEAE

**Cyathea saccata** Christ

The material now available to us is more ample than Holttum had at hand when he described the species for Flora Malesiana (Fl. Males. II, $1^2$, 1963, 93). This description can be emended with the following points:

Trunk slender, to 5 cm thick. Stipe 20–35 cm long to the (reduced) first pinnae, sparsely to densely spiny with spines to 8 mm long. Scales as those described for *C. acanthophora*. Basal pinnae at least sometimes reduced, to 13 by 3 cm, fertile.

Sopu Valley, 1000–1200 m: *H 5058, H 5074, H 5114, H 5188, H 5198, J 1097, J 1248*.

For a comparison of *C. saccata* with a number of similar species see below, under *C. roroka*.

**Cyathea roroka** Hovenkamp, *spec. nov.*

*Cyathea crenulata* Blume similis, ab eo differt squamis stipitarum plerumque setiferis, stipite spinosis, segmentis infimis liberis, squamis costularum conspicuis, brunneis, integris. — Typus: *Hennipman 5286*, Roroka Timbu, mountain forest, 2000 m (L).

Tree fern, to 8 m high, with 4–many fronds. Fronds 2–3 m long , with c. 15–20 pinnae. Stipe to 60–100 cm, with or without reduced basal pinnae at c. 10–15 cm above the base; spiny with spines to 3 mm long, densely scaly at base, scales to 25 by 4 mm, rigid, dark-brown, glossy, with an irregular, narrow, light margin,

often also with more or less sinuose setae. Rachis smooth, slightly rough to short-spiny; pinna rachis slightly rough to short-spiny. Pinnae to 40–51 by 14–18 cm; pinnules 70–90 by 12–17 mm, sessile or the basal ones to 1 mm stalked; segments c. 3 mm wide, the lowest basiscopic segment free, somewhat reduced, the others adnate, joined by a c. 0.5 mm wide wing, somewhat falcate, margin conspicuously crenate; costules 4–5 mm apart, veins 8–10 pairs, to 2 times forked. Indumentum: pinna rachis densely squamulose and with narrow flat scales often with dark marginal setae; costae squamulose and with narrow long, as well as wider flat scales; costules with many conspicuous, brown, entire, bullate scales and a few long, narrow, flat scales. Sori 3–6 pairs on each segment; indusium closed when young, often with a short (sub)apical apiculum, when older irregularly cup-shaped. Spores striate.

Additional specimens:
CENTRAL CELEBES. Mt Roroka Timbu: *H 5286, H 5348, H 5420, H 5421, H 5519.*

Habitat. Mountain forest, common; altitude 2000–2250 m.

Notes. 1. This is one of a group of species apparently closely related to *C. crenulata* Blume, all with an entire fragile indusium. *Cyathea saccata* Christ (see above) also belongs to this group, together with a number of species of which some are described on rather fragmentary material [Holttum, Fl. Males. II, $1^2$ (1963) 91–93]. *Cyathea roroka* can be distinguished from these species by the following characters (data partly compiled from Holttum, l.c.):

| | *roroka* | *crenulata* | *macropoda* | *saccata* | *magnifolia* | *acanthophora* |
|---|---|---|---|---|---|---|
| scales on stipe | usually setose | not setose | not described | not setose | not described | not setose |
| lowest segments | free | separately adnate | free | joined by wing | not free | not free |
| pinna rachis | rough to short-spiny | finely warty | smooth to warty | short-spiny | smooth or faintly warty | smooth |
| scales on costules, shape | conspicuous, bullate | small, convex, bullate | flat | small, bullate | few, bullate | bullate |
| scales on costules, colour | brown | pale | pale | pale | pale | pale |
| spores | striate | striate | no data | smooth to slightly striate | smooth to slightly verrucose | no data |

2. Spore size in both *C. saccata* and *C. roroka* is highly irregular, with also some aberrant monolete spores occurring in *H 5058* (*C. saccata*).

## Dicksonia cf. mollis Holttum

Similar in indument to *D. mollis*, but differs from it by having reticulate spores. *Dicksonia mollis* is known from Celebes so far by only one specimen (*Eyma 959*,

cited by Holttum, 1963, as dubiously *D. mollis*) with verrucate spores. A plant resembling the present specimen and also with reticulate spores was collected on Borneo (*Kato et al. B 3513*). Within *Dicksonia* spore characters may be used to distinguish (groups of) species: for example, verrucate spores are also present in *D. hieronymi; D. lanigera* has reticulate spores; *D. sciurus* has spores that seem to be intermediate.

Roroka Timbu, 2000 m: *H 5262.*

## DENNSTAEDTIACEAE

**Dennstaedtia dennstaedtioides** (Copel.) Copel.

Considered by Copeland, Fern Fl. Philipp. (1958) 92, as endemic to Mindanao, this species has been found on Celebes several times already but was not recognized earlier. Other collections are: *Bünnemeijer 11864, 12062, Eyma 791, Posthumus 3496.* They had been identified as *D. scabra* and *D. manilensis. Dennstaedtia dennstaedtioides*, however, is easily recognizable by its lax fronds with sparse hairs on the axes that are otherwise smooth, and by the shallowly cup-shaped indusia.

Roroka Timbu, 2000–2100 m: *H 5524.*

**Histiopteris hennipmanii** Hovenkamp, *spec. nov.*

*Histiopteris incisa* (Thunb.) J. Sm. similis, sed omnibus partibus multo tenuiore: Rhizoma 1,5–2 mm crassus, pilis et squamis ad 0,3–2 mm longis induta. Frondes 130 cm longae vel longiores, 3–4 pinnatifidae, pinnulae 1/2–3/4 ad costam incisae, venulae raro anastomosantes. Sori lineares, ad 3 mm longi. — T y p u s : *Hennipman 5367,* Roroka Timbu, 2000 m, mountain forest, terrestrial along creek (L).

Rhizome 1.5–2 mm thick, solenostelic, set with more or less deciduous unicellular hairs and more persistent scales; stipes 2–15 cm distant. Scales to 0.3–2 mm, basifix, flattened at base, gradually tapering to a short uniseriate apex. Fronds monomorphic, to 130 cm long or more; stipe to 68 cm long, 1/3–1 times as long as the lamina, at the base clothed with hairs and scales as the rhizome, upwards glabrous (glabrescent?), smooth, shining red-brown or dark purplish to straw coloured; lamina 3-pinnate (large fronds 4-pinnatifid), 19–64 by 17–34 cm (large fronds not fully expanded), widest shortly above the base; pinnae opposite, under an angle of 9° with the rachis, lower pinnae remote, upper more closely set, one pair of small pinnules present at the pinna-base; pinnules opposite, under an angle of 9° with pinna-rachis, incised to 1/2–3/4, the larger ones more deeply so, with one pair of reduced segments at their base; venation open, except for the junction of veins with receptacle, rarely anastomosing to form a single large costal areole. Sori marginal, to c. 3 mm long, with a c. 1 mm wide reflexed indusium formed by the margin of the frond. Spores coarsely verrucose (see note 2).

A d d i t i o n a l s p e c i m e n s :
CENTRAL CELEBES. Mt Nokilalaki: *Johansson, Nybom & Riebe 216, Meijer 9873.*

H a b i t a t . Terrestrial and on tree butts, mountain (cloud) forest; altitude 2000–2260 m.

Notes. 1. This species differs strikingly from *H. incisa* in having smaller dimensions of all parts of the plant. Therefore it seems best to recognize it as a species awaiting examination of further collections. From *H. caudata* (Copel.) Holttum, also with an open venation, it differs in the shape of the pinnae, which are in outline equally wide almost to the apex (gradually narrowing in *H. caudata*) and slightly narrowed at the base because of the presence of one pair of small, reduced, stipule-like leaflets.

2. None of the plants collected has fully expanded fronds but nevertheless some are fertile. The spores, however, are apparently sterile, though with a well-developed and ornamented spore wall. It is possible that the development of the spores has been arrested at the collecting of the plants, followed by a process of 'pseudo-ripening' during drying.

**Lindsaea pellaeiformis** Christ

So far known from only 3 collections, all from Celebes, and considered by Kramer [Fl. Males. II, $1^3$ (1971) 232] as 'perhaps only an extreme form of *Lindsaea gueriniana*.' These new specimens support that view, as some of them approach *L. gueriniana* in the presence of obtuse or rounded pinnae.

Lake Matano, 380–500 m: *J 1422, J 1433, J 1542*; Taborano, c. 350 m: *J 1757*.

**Tapeinidium** cf. **prionoides** Kramer

These specimens are more or less intermediate between *T. longipinnulum* (Ces.) C. Chr. with an East Malesian distribution (New Guinea, Moluccas) and *T. prionoides* from West Malesia (several islands off Sumatra). They differ from *T. longipinnulum* mainly in the distinctly hastate apical lamina (*T. longipinnulum* has occasionally a slightly hastate apical pinna) and an abaxially rounded stipe and rachis. From *T. prionoides* they differ in having wider pinnae (to 12 mm in some specimens). Some specimens have deeply serrate pinnae, the sori are then usually situated in the sinuses.

Lake Matano: *J 1389*, 650 m; *J 1592*, 450 m; *J 1663*, 400–450 m; Soroako: *J 1634*, 450 m; *H 5854*, 200 m; Wawandula: *J 1688*, c. 250 m.

## THELYPTERIDACEAE

**Coryphopteris obtusata** (Alderw.) Holttum

First record for Celebes. This species was already recorded from Sumatra, Borneo, and New Guinea.

North Celebes: G. Ambang Nat. Res., G. Muajat, 1780 m, terrestrial in elphin forest: *V 7236*.

**Coryphopteris sulawesica** Holttum, *spec. nov.*

Caudex brevis, erectus; stipes usque 4 cm longus, abaxiali nitidus, basin versus paleis 3–4 mm longis vestitus; lamina usque 9,5 cm longa, apice anguste caudato-acuminata; pinnae ca. 8-jugatae, inferiores 2-jugatae redactae, infimae 5–7 mm longae; pinnae maximae 14 mm longae, basi acrosco-

pici leviter auriculatae, 4 mm latae, margine crenatae, apice rotundatae, venae paucipinnatae vel furcatae; rachis costaeque subtus pilis destitutae, paleis uniseriatis brevibus sparsim praeditae, supra brevipilosae; glandulis nullae; sori ad bases ramorum venarum siti; indusia reniformia, glabra, apices pinnarum versus interdum leviter athyrioida. — T y p u s : *Hennipman 5443A*, Central Sulawesi, Roroka Timbu, 2000 m (L, K).

Caudex short, erect; stipes to 4 cm long, abaxially smooth, near the base with 3–4 mm long scales; lamina to 9.5 cm long, apex narrowly caudate-acuminate; pinnae c. 8 pairs, the lowest two pairs reduced, lowest pair 5–7 mm long, largest pinnae 14 mm long, 4 mm wide, slightly auriculate at the acroscopic base, margin crenate, apex rounded, veins in the largest lobes pinnate with 2–3 pairs of veinlets, in smaller lobes forked or simple; rachis and costae below without hairs but sparsely clothed with short uniseriate scales, above short-hairy; glands absent; sori situated at the bases of the vein-branches; indusia reniform, glabrous, towards the apex of the pinnae occasionally somewhat athyrioid.

## **Pneumatopteris aberrans** Holttum, *spec. nov.*

Caudex in sicco 1,5 mm diametro, elongatus, apice paleis ovatis 1,5 mm longis acutis basi cordatis vestitus; stipes 9–13 cm longus, gracilis, basim versus minute pilosus; lamina usque 15 cm longa; pinnae infimae 2,5 × 1,3 cm, sessiles, basi late truncatae, a pinnis sequentibus 3–4-jugatis basi perangustatis valde dissitae; lamina terminalis acuminata, 6 × 1,6 cm, basin versus profunde lobata; pinnae omnes basin versus profunde lobatae, venis in lobis pinnatis, venulis usque 5-jugatis simplicibus, liberis, inferioribus apices pinnarum versus sub sinus inter lobos conniventibus; sori ad venulas mediales, parvi, indusia minuta paucisetifera; sporangia nuda. — T y p u s : *Hennipman 5523B*, Central Sulawesi, Roroka Timbu, 2000–2100 m, mountain forest, on steep slope along waterfall (L).

Caudex (in dry state) 1.5 mm thick, long-creeping, at the apex with scales, scales ovate, acute, 1.5 mm long, with cordate base; stipe 9–13 cm long, slender, at the base minutely hairy, lamina to 15 cm long, lowest pinnae 2.5 × 1.3 cm, sessile, with widely truncate base, 3–4 cm removed from the next 3–4 pairs of pinnae which have a strongly unequally narrowed base; terminal lamina acuminate, 6 × 1.6 cm, deeply lobate near the base; all pinnae also deeply lobate near the base, veins in the lobes pinnate with up to 5 pairs of branches, free, the lowermost branches near the apex of the pinnae confluent in the sinuses; sori medial on the veins, small, indusia with few hairs; sporangia naked.

N o t e. In view of the irregular arrangement and form of the pinnae, this might be a hybrid, but I cannot suggest possible parent species. In its long-creeping caudex and unreduced basal pinnae it resembles *Pneumatopteris longipes* (Blume) Holttum of Java, but is much smaller, and the pinnae are very different in shape and venation.

## **Pneumatopteris dilatata** Holttum, *spec. nov.*

Stipes usque ad pinnam redactam infimam 4–7 cm longus, usque ad pinnam infimam evolutam 60 cm, glaber, paleis tenuibus mox evanescentibus; pinnae redactae ca. 15-jugatae, reniformes, ca. 4 mm latae, 3 mm longae, basi aerophoris elongatis preditae; rachis abaxiali glabra, pinnae evolutae rigidae, ca. 25-jugatae, infimae basim versus leviter angustatae, maxime usque 22 cm longae, basi 2,5 cm latae, supra basin 2,2 cm latae, dimidio costam versus lobatae, lobis acutis leviter falcatis,

apicem versus anguste attenuatae subintegrae; venae in quoque lobo 10-jugatae, infimae anastomosantes, sequentes $1^1/_2$-jugatae ad membranem sinus procurrentes; pagina inferior glabra vel pilis brevibus paucis praedita, leviter irregulariter pustulosa; sori exindusiati, distales mediales infimi supramediales; sporangia setis 2–6 brevissimis ornata. — T y p u s : *Hennipman 5871*, S. Sulawesi, 2–3° S, 121–122° E, Kampong Walambanoa, along road Soroako–Malili, 35 km from Soroako, 200 m. In primary forest on ultrabasic, near small waterfall; fronds coarse, drooping, young fronds covered with mucilage (L).

Stipes glabrous, the few thin scales soon disappearing, 4–7 cm long to the lowest reduced pinna, base of stipe to the first normal pinnae 60 cm; reduced pinnae c. 15 pairs, reniform, c. 4 mm wide and 3 mm long, each with an elongate aerophore; rachis glabrous on abaxial surface; normal pinnae c. 25 pairs, rigid, the lowest a little narrowed towards its base, largest 22 cm long, 2.5 cm wide at its base, 2.2 cm above the base and lobed halfway to the costa, the lobes acute and slightly falcate, the pinna distantly attenuate and subentire; veins in each lobe 10-jugate, the lowest pair anastomosing, the next $1^1/_2$ pairs terminating at the sinus-membrane; lower surface glabrous or bearing a few very short hairs, slightly irregularly pustular; sori exindusiate, the distal ones medial, the lowest supramedial on the veins; sporangia bearing 2–6 very short setae.

N o t e. This species resembles *Pneumatopteris callosa* (Blume) Nakai in the mucilaginous covering of young fronds and in pinna-form and substance, but differs in the well-developed reduced pinnae and the lightly pustular lower surface, also in the setiferous sporangia; such sporangia are otherwise known in this genus only in *P. parksii* (Ballard) Holttum in Fiji and in *P. oxyura* (Copel.) Holttum in the Solomon Islands.

**Pronephrium kjellbergii** Holttum var. **eglandulosum** Holttum, *var. nov.*

A var. *kjellbergii* differt: frondibus minoribus; pinnis 3–4-paribus, fertilibus maximis 12 mm longis et 4 mm latis; pagina inferiore inter venas pilosa non glandulosa, pagina superiore inter venas glabra; sporangiis eglandulosis. — T y p u s : *Hennipman 5444*, Central Sulawesi, Roroka Timbu, 2000 m, mountain forest, along rivulet (L).

Differs from the type variety: Fronds smaller, with 3–4 pairs of pinnae, largest fertile pinnae 12 by 4 mm; lamina below between the veins hairy, not glandular, above between the veins glabrous; sporangia not glandular.

**Pronephrium lineatum** (Blume) Presl

The first record for Celebes, so far known only from Java, Borneo, and the Sulu Archipelago [Holttum, Fl. Males. II, $1^5$ (1981) 512].

North Celebes, G. Ambang Nat. Res.: *V 6538*.

**Pronephrium celebicum** (Baker) Holttum var. **sopuense** Holttum, *var. nov.*

A var. *celebico* differt: frondibus vix dimorphis; pinnis fertilibus infimis 4 cm longis et 1,7 cm latis, quarta costam versus lobatis; venis 5–6-paribus; soris exindusiatis. — T y p u s : *Hennipman 5631B*, Central Sulawesi, Sopu Valley, 1000–1250 m, in forest along rivulet (L).

Differs from the type variety: fronds hardly dimorphic, lowest fertile pinnae 4 by 1.7 cm, to 1/4 incised; veins 5–6 pairs, sori not indusiate.

Additional specimens:
CELEBES. Sopu Valley, 1000–1100 m: *J 1088, J 1189, J 1190, H 5071.*

**Pronephrium × interruptum** Holttum, *hybr. nov.*

Stipites frondium sterilium usque 8 cm, frondium fertilium usque 18 cm longi; lamina usque 17 cm lata; forma pinnarum irregularis, pinna singulari mediali saepe valde redacta; pinnae maximae 2,4 cm longae, steriles 1,1 cm latae, fertiles 0,8 cm latae, dimidio costam versus lobatae; pagina inferiore eglandulosa, pagina superiore inter venas pilis brevissimis sparsis suberectis praedita; indusia parva setis brevibus praedita; sporangia nec setis nec glandulis praedita. — Typus: *Hennipman 5452*, Central Sulawesi, Roroka Timbu, 2000 m, in mountain forest along rivulet (L).

Stipes of sterile fronds to 8 cm, of fertile fronds 10–18 cm long, lamina to 17 cm wide, pinnae irregularly shaped, the middle one strongly reduced; largest pinnae 2.4 cm long, the sterile ones 1.1 cm wide, the fertile ones 0.8 cm wide, to 1/2 incised; lamina below without glands, above between the veins sparsely hairy with short erect hairs; indusia small, with short hairs; sporangia bearing neither glands nor setae.

Note. This specimen resembles *P. kjellbergii* Holttum but has pinnae of irregular shape (a middle one often greatly reduced), indicating hybridity. It appears to be a hybrid with *P. kjellbergii* as one parent.

**Sphaerostephanos foliolosus** Holttum var. **minor** Holttum, *var. nov.*

A var. *folioloso* differt: frondibus minoribus; rhachi pilis multis patentibus 1 mm longis vestita; pinnis multo minoribus, usque 2,5 cm longis et 0,9 cm latis, crenatis, apici obtusis; venis 2–3-paribus. — Typus: *Hennipman 5641*, Central Sulawesi, Sopu Valley, 1000–1050 m, forest (L).

Differs from the type variety: fronds smaller, rachis densely hairy with to 1 mm long patent hairs; pinnae much smaller, to 2.5 by 0.9 cm, crenate, apex obtuse; veins 2–3 pairs.

Additional specimens:
CELEBES. Sopu Valley, c. 1000–1100 m: *J 1114, J 1224, H 5078.*

**Sphaerostephanos hirsutus** (G. Kunze. ex Mett.) Holttum var. **elatus** Holttum, *var. nov.*

A var. *hirsuto* differt: caudice 60 cm alto; pagina superiore inter venas interdum glabra; indusiis perparvis; sporangiis nec glandulis nec setis praeditis. — Typus: *Hennipman 5187*, Central Sulawesi, Sopu Valley, 1000–1050 m.

Differs from the type variety: stock 60 cm high, lamina below between the veins occasionally glabrous; indusia very small; sporangia without glands or hairs.

Additional specimens:
CELEBES. Sopu Valley, 1000 m: *H 5050, H 5102, H 5533A.*

**Sphaerostephanos immucosus** Holttum, *spec. nov.*

*Sphaerostephanos appendiculato* (Blume) Holttum aspectu et frondibus immaturis rufescentibus congruens, ab ea differt: pinnis redactis usque 23-jugatis, superioribus usque 1,8 cm longis et 1,5 cm latis, lobatis, non deflexis, basi aequaliter auriculatis; pinnis maximis 14 cm longis et 1,7 cm latis, caudatis (caudis usque 2,5 cm longis), venis usque 11-paribus; pagina superiore inter venas glabra eglandulosa. — T y p u s : *Hennipman 5585*, Central Sulawesi, Sopu Valley, 1000 m, 'young fronds reddish, not covered with mucilage' (L).

Resembles *S. appendiculatus* (Blume) Holttum in aspect as well as in the fronds being reddish when young, but differs as follows: reduced pinnae to 23 pairs, the upper to 1.8 by 1.5 cm, lobate, not deflexed, base equally auriculate on both sides; largest pinna 14 by 1.7 cm, with a cauda to 2.5 cm long; veins to 11 pairs; lamina above between the veins glabrous, without glands.

A d d i t i o n a l s p e c i m e n s :
CELEBES. Sopu Valley, 1100 m: *J 1225, H 5065, H 5092*; Soroako, 750 m: *H 5946*.

**Sphaerostephanos subcanescens** Holttum, *spec. nov.*

*Sphaerostephanos canescenti* (Blume) Holttum aspectu congruens, ab ea differt: frondibus minoribus; pinnis inferioribus 2–3-jugatis sensim redactis, pinnis maximis 1,8 cm longis et 0,4 cm latis, subintegris, basi subcordatis; costis subtus pilis brevibus antrorsis vestitis; pagina superiore inter venas pilis brevibus suberectis praedita. — T y p u s : *Hennipman 5453B*, Central Sulawesi, Roroka Timbu, 2000 m, in mountain forest along rivulet (L).

Resembles *S. canescens* (Blume) Holttum in aspect, but differs as follows: fronds smaller; lower 2–3 pairs of pinnae gradually reduced, largest pinna 1.8 by 0.4 cm, almost entire, base subcordate; costa below with short antrorse hairs; lamina above between the veins with short suberect hairs.

N o t e. At the same locality another specimen was collected which appears to be a young plant of *S. adenostegius* (Copel.) Holttum, known previously from eastern New Guinea at 2300–2900 m; this specimen differs from that of *S. subcanescens* in its lobed pinnae, nature of pubescence, and indusiate sori.

**Stegnogramma** (sect. *Leptogramma*) **crenata** Holttum, *spec. nov.*

Caudex brevis, suberectus, apice paleis vix 2 mm longis, fuscis, brevi-setiferis vestitus; stipes usque 3 cm longus, sparsim minute pilosus; lamina usque 5 cm longa; pinnae usque 5-jugatae, infimae 6 mm longae et 3 mm latae, ceterae ca. 16 mm longae et 5 mm latae, omnes margine crenatae, apice rotundatae, inferiores acroscopici leviter auriculatae, venae pleraeque unifurcatae, in auriculas paucipinnatae; costae venaeque subtus pilis sparsis 0,5–1.0 mm longis, supra pilis brevioribus (plerisque marginem versus) praeditae, pagina superiore inter venas pilis adpressis gracilibus 0,1–0,2 mm longis sparsim vestita; sori ad ramos acroscopicos venarum mediales, exindusiati, leviter elongati; sporangia copiose setifera. — T y p u s : *Hennipman 5443B*, Central Sulawesi, Roroka Timbu (L).

Caudex short, suberect, at the apex with to 2 mm long, short-hairy scales; stipe to 3 cm long, sparsely minutely hairy; lamina to 5 cm long; pinnae to 5 pairs, lowest pinnae 6 by 3 mm, the others c. 16 by 5 mm, all with crenate margins and rounded

apex, the lower ones slightly auriculate at the acroscopic base, veins mostly once-forked, sparsely pinnate in the auricles; costae and veins below sparsely hairy, hairs 0.5–1.0 mm long, above (mostly towards the margin) with shorter hairs; lamina above between the veins with slender appressed hairs 0.1–0.2 mm long; sori medial on the acroscopic branches of the veins, not indusiate, slightly elongate; sporangia copiously setiferous.

N o t e. The only species of this genus previously known to occur in Celebes is *S. celebica* (Ching) Holttum, which has been found only on G. Bonthain in the Southwest at 2000 m.

## ASPLENIACEAE

**Asplenium cromwellianum** Ros.

This is the first record for Celebes of this species, known so far only from New Guinea. It differs from the superficially similar *A. caudatum* in having the pinna-rachis on the upper surface raised instead of grooved, and the frond apex proliferous.

Roroka Timbu, 1750–1800 m: *H 5484.*

**Asplenium persicifolium** J. Sm. ex Mett.

*A. dicranurum* C. Chr., Svensk Bot. Tidskr. 16 (1922) 91; syn. nov.

All specimens here identified as *A. persicifolium* were initially identified as *A. dicranurum* C. Chr., which is distinguished from the former mainly by the presence of furcate and budded apices of the pinnae. However, many specimens of *A. persicifolium* from the Philippines have also some of the pinnae more or less distinctly furcated and proliferous (e.g., *Elmer 10889, Elmer 13640, Cuming 125,* type of *A. persicifolium*). Moreover, the degree of furcation is not at all constant in the specimens from Celebes. Considering this, there seems to be no reason to keep the two species apart. It remains curious that furcation of pinnae is a much more common phenomenon in plants from Celebes than in Philippine plants.

Sopu Valley, 800–1200 m: *J 1111, J 1136, J 1196, J 1209, J 1241A, J 1322, H 5193.*

**Diplazium spinulosum** Blume.

This species was described by Blume in 1828 (Enum. Pl. Jav. Filices: 193) with the only locality given as Celebes. The type specimen in L, however, is from Ternate (Moluccas). *Diplazium spinulosum* is not cited in any recent flora. It differs from other species in the *D. dilatatum*-group mainly in the spinulose axes. It may be conspecific with *D. acanthopus* C. Chr. [Svensk Bot. Tidskr. 16 (1922) 94], described from Celebes. The main character by which Christensen distinguishes this latter species, is: 'scales peltate, attached to the end of distinct spines'. In the specimens we examined no scales were left on the basis of those stipes that could be used to check this character. Slightly spinulose axes are also found in *D. vestitum* var. *borneense* [C. Chr. & Holttum, Gard. Bull. Str. Settl. 7 (1934) 273]. Somewhat similar, but smaller plants from Borneo have been identified as *D. spiniferum* Alderw.

(= *Athyrium muricatum* Copel.), and similar plants have also been found on Celebes (*Meijer 9491*). This group of *Diplazium* is evidently in need of revision.

Sopu Valley, c. 1000 m: *J 1061, H 5055, H 5084, H 5532.*

**Diplazium mutabile** Hovenkamp, *spec. nov.*

Rhizoma breve, erectum vel adscendens, primus squamis fatiscentibus praeditum, demum glabrum; frondes pinnatae vel bipinnatae, usque 250 cm longae et 50 cm latae, segmentis ultimis 3–5 cm longis et 1,5–1,7 cm latis, inferioris 3–4 jugatis liberis, apicem pinnarum versus confluentibus; stipes rhachisque squamis flaccidis sparsus praeditus; costae pinnarum subtus papillatae et squamis flaccidis laminam adpressis praeditae. Sori diplazioides, costulae fere ad marginem currentes. — Typus: *Hennipman 5003*, Sopu Valley (L).

Rhizome ascending or erect; rhizome scales fleshy, quickly disintegrating into a fibrous mass, rhizome accordingly glabrous in the older parts. Fronds simply pinnate to bipinnate. Simply pinnate specimens: stipe 9–24 cm, at the base with a few scales like the rhizome, upwards glabrous, finely fibrillose, with a few papillose multicellular protrusions; lamina to 27–35 by 7.5–14 cm, widest at 1/4–1/3, sometimes hardly narrowed at base; pinnae alternate, sessile, to 5.5 by 1.5–2.5 cm, the lowest pair reflexed, lower 7–9 pairs free, above gradually confluent to an almost entire apex; rachis on the upper side often shortly papillose, at the lower side with scales appressed to the lamina and papillose multicellular protrusions; scales whitish, flaccid, the larger ones with a fleshy dark base, entire, strongly shrivelling when dry; secondary veins like the rachis, veins free. Bipinnate specimens: stipe to 55–65 (–150) cm, at base with a few scales like the rhizome or slightly scabrid with the bases of fallen scales, dark, upwards stramineous, finely fibrillose, with sparse scales; lamina to 90(–100) by 40–50 cm, narrowed at the base, from about halfway up gradually narrowing; rachis as the upper part of the stipe; pinnae alternate to opposite, perpendicular to ascending, largest pinna to 1.5 cm stalked, to 22–26 by 6–10 cm; pinnules opposite, 3–5 by 1.5–1.7 cm, serrate or up to 1/4 incised, apex rounded or often emarginate to truncate, the lower 3–4 pairs free, the upper adnate and gradually confluent to the apex; indument and venation like the pinnate specimens, costae corresponding to rachises of the pinnate specimens, pinnule-rachises to the pinna-rachis of pinnate specimens. Sori diplazioid, on all veins of a vein-group, running from costule to c. 1 mm within margin; spores monolete, bean-shaped, almost smooth.

Additional specimens:

CELEBES. Sopu Valley: *H 5151, H 5571, H 5587, H 5625, H 5640*; Gumbassa River: *H 5711*; Soroako: *H 6040.*

Habitat. Terrestrial, in primary forest, often in somewhat disturbed situations (near clearings, rivulets); occasionally on limestone; altitude 550–1500 m.

Notes. 1. Petiole green, with yellow linear areoles (note to *H 5625*).

2. Although highly variable with regard to the size of the frond and degree of dissection, this is a species that can fairly easily be recognized if the ultimate and penultimate segments are compared instead of the most basal and highly dissected parts of the fronds. Unfortunately, conventional descriptive schemes and terms hardly allow

such an approach. However, I suspect that the development of such a scheme and the descriptive terms appropriate to it may be a prerequisite for a satisfactory account of this difficult genus. In the present species, irrespective of the degree of dissection, the penultimate segments (representing whole fronds, or the lower pinnae of a dissected frond) always have a few pairs of free segments at the base and a long apical part that is gradually less deeply dissected towards the apex, and usually only crenate for a considerable length. In addition, the indumentum of particularly the axes of the penultimate segments is distinctive. Hairs are apparently absent, but multicellular elongated papillae are always present. The scales are inserted laterally on the axes and closely appressed to the lamina. The larger scales have a dark fleshy central part and a strongly shrivelling marginal area that usually does not regain its shape after boiling in water. Usually some of these scales are also present on the main axes of bipinnate specimens. Other species of *Diplazium* with bipinnate fronds and a free venation (*D. dilatatum, D. simplicivenium*) have thin, rigid scales with often a dark dentate margin. The protrusion on the axes in the present species bears some resemblance to the scale-bearing protrusions of some species, but they are more numerous, softer, and not associated with any scales.

**Athyrium costulisorum** Copel., Leafl. Philipp. Bot. 3 (1910) 815. — T y p e: *Elmer 11515*, Todaya, Mt Apo, Mindanao (iso L!).

*Diplazium apatelium* Alderw., Bull. Jard. Bot. Buitenz. sér. 3, 5 (1922) 195, *syn. nov.* — T y p e: *Beguin 1500*, Ternate (iso L!).

This species is here for the first time recorded from Celebes. It is aberrant within *Athyrium* by the more or less dense cover of multicellular catenate hairs on the lower surfaces of the axes. In general aspect and dissection it is at first sight similar to *Deparia boryana* (Willd.) M. Kato, and the specimens enumerated below had been identified with the latter. However, it differs from *D. boryana* in a number of characters:

| *Athyrium costulisorum* | *Deparia boryana* |
|---|---|
| upper surface glabrous | upper surface with sparse, thick, often pluriseriate hairs |
| ridges along axes on upper surface interrupted | upper surface with ridges along axes continuous near junctions |
| pinnules to 11 by 2.2 cm, often long-caudate | pinnules to 9 by 2.5 cm, not long-caudate |
| pinnules joined to pinna-rachis by at most a narrow cartilaginous wing | pinnules joined to pinna-rachis by a distinctly laminar wing |
| sori elongate | sori not or hardly elongate |
| spores light brown, with few longitudinal ridges or wings | spores dark, with many short papillae |

Sopu Valley, 1000 m: *H 5649.*

A d d i t i o n a l s p e c i m e n s (all in L):
CELEBES. *Bünnemeijer 11859, Koorders 17093, Ramlanto 257.* — N. BORNEO. *Clemens 32563.*

## DAVALLIACEAE

**Davallia brevipes** Copel.

Described from Mindanao and so far not reported from Celebes. A beautiful and very characteristic species with a strikingly glaucous thin rhizome with broad, shining, deciduously ciliate scales. There can be little doubt that *D. pullei* Rosenst., Nova Guinea 8 (1912) 719, is conspecific. In that case *D. brevipes* has a wide East Malesian distribution, ranging over the Philippines, Celebes, and New Guinea.

Sopu Valley, c. 1100 m: *J 1194, J 1207, H 5580*; G. Wawonseru, 1000–1100 m: *H 6111*.

**Davallia dejoncheerei** Hovenkamp, *spec. nov.*

Rhizoma repens, 8–10 mm crassus, squamis peltatis, dentatis ca. 5 mm longis dense vestitum; frondes nonnihil dimorphae, steriles usque 54 cm longae et 28 cm latae, 3–4 pinnatae, fertiles magniores 4–5 pinnatae; sori lobis ultimis siti, indusiis laceratis obtecti. — Type: *de Joncheere 1157*, Sopu Valley, path to Danau Tambing, 1100 m (L).

Rhizome 8–10 mm thick (7 mm in dry state), with a more or less ventrally situated furrow; densely set with scales; phyllopodia alternating in 2 dorsal rows, 2–3 cm distant. Anatomy: ground tissue parenchymatous, dark-coloured, vascular strands 13–17 in a cilinder, with two opposite (approximately dorsal and ventral) invaginations, each one with a large dorsoventrally flattened vascular strand at the inner end. Scales peltate, 4–7 × 1–1.5 cm, above the point of attachment mostly abruptly contracted to a narrow acumen, often with a dark central 'pseudocosta' and a narrow light margin; margin set with short to long, often recurved, bicellular teeth. Fronds slightly dimorphic. Sterile fronds 25–54 cm long, stipe 6–24 cm, 1/3–4/5 as long as the lamina; lamina 19–39 by 14–28 cm or wider, index 2/3–1, widest near the base; 3–4-pinnatifid, pinnae acuminate, pinnules rounded to acute, ultimate segments 1.5–3 mm wide, crenate to dentate. Fertile fronds to over 1 metre long and wide; stipe 7–45 cm or longer, 1/2–1 times as long as the lamina; lamina not complete of large fronds, index c. 1; 3–5-pinatifid, pinnae acuminate, distinctly curved upwards, lowest pinnae largest, to 57 by over 24 cm; ultimate segments c. 1 mm wide. Sori mostly each on a teeth or lobe, indusium c. 1 by 1 mm or somewhat longer than wide, irregularly, often deeply, lacerate, attached at base only or to halfway up the sides.

Additional specimens:

CELEBES. Central: Sopu Valley: *H 5046, H 5595*; Lake Matano, 400 m: *H 5779*. Living specimens cultivated in the Leiden Botanical Garden: *LEI 20367, LEI 23751*.

Habitat. Epiphyte or high epiphyte in more or less disturbed primary forest along rivers; also creeping on limestone rock; altitude 400–1000 m.

Note. The deeply lacerate indusium is unique in *Davallia* and clearly distinguishes this species from all others.

**Davallodes dolichosorum** Copel.

This species, restricted to New Guinea, is distinguished by Holttum [Kew Bull. 27 (1972) 245] from *D. burbidgei* C. Chr. from Borneo, merely by the difference in density of the hairs on the lamina. The present specimens from Celebes are obviously close to these two species, but cannot be assigned to either of them unambiguously. They are less hairy than either species, and I doubt whether the distinction can be upheld. A similar variability with regard to hairiness is encountered in *D. novo-guineensis*, which includes specimens that are distinctly hairy between the veins (*Brass 30863*) as well as specimens that are practically glabrous.

Sopu Valley, above Palu, 1000–1250 m: *J 1016, J 1148, J 1210, J 1226, H. 5105*; S. of Ladu Ladu Mts, near Wasupondo, 600–750 m: *J 1563*; Roroka Timbu, 1750–1800 m: *H 5476*.

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