AN ACCOUNT OF THE FERN GENUS BELVISIA MIRBEL (POLYPODIACEAE)

P. H. HOVENKAMP & N. A. P. FRANKEN

Rijksherbarium / Hortus Botanicus, Leiden, The Netherlands

SUMMARY

The genus Belvisia is revised. Two species are transferred from Lemnaphyllum to Belvisia, and two species are reduced to varieties. The genus now includes eight species, reaching from tropical Africa to China, Polynesia, and Australia.

Mirbel (1803a: 65; 1803b: 473) established the genus Belvisia for that part of the Linnean genus Acrostichum that is characterized by linear receptacles on both sides of the midrib, reaching to the lamina margin, and opening towards the lower surface. Mirbel included five species in Belvisia, but did not make any of the necessary new combinations (1803c: 114–116). The five species are "remarkably unrelated" (Cope-land, 1947) and a "meaningless jumble" (Morton, 1946), but among them was Acrostichum spicatum L. This mêlée of unnamed species was conveniently forgotten for almost a century.

In the course of that century, Kaulfuss (1824) newly established the genus Hymenolepis, based on Acrostichum spicatum, for which he substituted the name Hymenolepis ophioglossoides. Kaulfuss' generic circumscription was based mainly on the linear sori and the presence of scaly paraphyses. In this sense, the genus was accepted as distinct from Acrostichum L. by most 19th century authors (Blume, 1828; Kunze, 1842; Presl, 1851; Fée, 1852; Moore, 1857; Kuhn, 1868; J. Smith, 1875). Dissenting views were expressed by Mettenius (1869), who linked the ferns under discussion with Taenitis, and Hooker (1863), who adhered to a wider view of Acrostichum. However, Diels (1899) and Christensen (1906) succeeded in firmly establishing the genus as distinct.

By then, several species had been added to Hymenolepis and one of these was again removed by Presl (1851) and used to establish Macrolethus. Kunze (1850) substituted Hyalolepis for Hymenolepis; however, Hyalolepis had been used earlier for a genus of the Compositae. That the same was true for Hymenolepis was later pointed out by Underwood (1899) and Becherer (1936). Becherer therefore revived Mirbel's name Belvisia, and lectotypified it by Acrostichum spicatum, this being simply the species that came first in Mirbel's account. Tagawa (1942) did not accept this lectotypification, and substituted Presl's name Macrolethus, based on Hymenolepis platyrhynchos Kunze. Becherer's arbitrary lectotypification was also disputed by Morton (1946), who chose Acrostichum septentrionale L. as type species, based
on the fact that this species is the only one for which Mirbel cited an illustration. However, Copeland, in his influential Genera Filicum (1947) accepted A. spicatum as type of the genus, which he could accordingly name Belvisia. He was followed by Holttum (1949) and Pichi Sermolli (1954), who settled the argument in an exhaustive study of all the available names and type species for this genus. Since then, consensus exists that Belvisia Mirbel, typified by Acrostichum spicatum L. f., is the proper name for this group of ferns.

VARIABILITY

Fée (1852) accepted 5 species, Moore (1857) 4, and J. Smith (1875) 3. Christensen at first (1906) accepted 4 species, but later, in a monograph of the genus (1929), partly based on unpublished work by Hieronymus, he recognized 11 species and a considerable number of varieties and formae. At the same time he admitted that only two or three characters were “of value as specific ones.” This was perhaps a bit pessimistic. In the present account 8 species are recognized, and 2 subspecies. This is accomplished with the aid of the following characters.

Rhizome

The rhizome is short-creeping in most species, with fronds more or less crowded, but it is long-creeping with well-spaced fronds in Belvisia novoguineensis and

Fig. 1. Scales. – Belvisia spicata (L. f.) Copel., a. outline, b. detail of margin (van Steenis 18445). – B. mucronata (Fée) Copel., c. outline, d. detail of margin (Philipson 10429). — Dotted line in a & b = margin of overlapping basal extensions; scale bars = 1 mm.
**B. abbreviata.** The fronds are inserted dorsally in two (rarely more) rows. The stele is a perforated dictyosteole, and a variable number of sclerenchyma strands is present.

**Scales**

The rhizome scales are basally attached (Fig. 1), pseudopeltate with overlapping basal extensions, clathrate, and have an entire to ciliate margin. The following scale characters have diagnostic value:

Outline — In most species, the scales have a narrow, sometimes almost filiform acumen. However, in *B. spicata* and *B. validinervis* the acumen is relatively short and wide. The apex is usually acute, but may be obtuse to rounded.

Margin — The margin of the scales may be rather irregularly entire, or more or less dentate to distinctly ciliate, with teeth that are formed by protruding thick cell walls (Fig. 1b). Independently from this marginal configuration, a variable number of multicellular hairs, usually tipped with a gland, may also be present, mainly in the basal and extremely apical region. These latter hairs have little, if any, diagnostic value.

Colour — On macroscopic inspection, the colour may vary between reddish-brown and black. A distinct iridescence is present in *B. validinervis*.

Cell structure — In most species, all cells are clathrate. In *B. spicata* and *B. validinervis*, however, there is usually a more or less distinct marginal zone with non-clathrate cells (Fig. 1a). In a less distinct form, such a marginal zone may be present in *B. abbreviata*. The luminae of the central cells vary in width from 10–30 μm wide in *B. henryi* to 30–110 μm wide in *B. platyrhynchos* and *B. dura*.

**Fronds (Fig. 2)**

The fronds are uniformly entire and usually monomorphic, with a distinct stipe and usually a fertile spike at the apex. A light degree of sterile/fertile dimorphism has developed only in *B. abbreviata*. The sterile part shows hardly any diagnostic characters. It is very variable in size, with a length–width index ranging from 4 to 75. The primary veins are immersed or prominent in dried material, the secondary and tertiary veins form irregular areoles with many free veinlets, which are mainly directed towards the primary vein. Mature fronds are usually glabrous, but a few scales may be found on the lamina and the midrib. A major diagnostic character is the shape of the transition between the basal sterile part of the frond (‘lamina’) and the apical fertile part (‘spike’). In most species, the lamina is very gradually narrowed towards the spike, which itself is sharply distinct, often distinctly separated from the lamina by a constriction (Fig. 2c, e–g). In *B. annamensis* (Fig. 2a) and especially *B. henryi* (Fig. 2b) the lamina is more abruptly truncated, but not separated from the spike by a constriction. Especially in *B. annamensis* the spike is not sharply distinct from the lamina, with the sori often extending downwards into the upper, narrowed, part of the lamina. In *B. novoguineensis* (Fig. 2d), lamina and spike are not at all distinct, with a very gradual transition from the wide, sterile part of the lamina to the narrower fertile part.

**Sori**

The sori are located in the apical spike, a strongly narrowed part of the frond. A long narrow spike (length–width index up to 50–120), with sori fully covering the
Fig. 2. Frond outlines (all specimens L).—a. *Belvisia annamensis* (C.Chr.) Tagawa (Hennipman 3987).—b. *B. henryi* (C.Chr.) Raymond (Hennipman 3376).—c. *B. novoguineensis* (Rosenst.) Copel. (Schodde 1535).—d. *B. platyrhynchos* (Kunze) Copel. (Celestino PNH 3044).—e. *B. spicata* (L.f.) Copel. (Beaman 7920).—f. *B. validinervis* (Kunze) Copel. (Croft LAE 61604).—g. *B. validinervis* (Kunze) Copel. var. *longissima* Hovenkamp & Franken (Brass 10647).—Scale bars = 1 cm.
entire width when ripe is present in most species. Wider spikes with a distinct sterile marginal zone occur in *B. annamensis* and *B. platyrhynchos*. In *B. annamensis* the sori are situated centrally between midrib and margin, with a distinct sterile zone usually present between the midrib and the sorus; in the transitional zone the sorus in this species tends to follow the margin (Fig. 2a). The short, wide spike (length−width index 2−12) of *B. platyrhynchos* (Fig. 2d) has a distinct sterile margin 4−5 mm wide.

**Paraphyses** (Fig. 3)

The paraphyses are sterile, scale-like structures that occur interspersed between the sporangia. They are best searched for in young sori. In older sori they tend to fall off, and particularly in *B. annamensis* and *B. henryi* paraphyses are often completely absent when the sporangia are ripe. However, in young sori on unfurling fronds the paraphyses are often not fully developed. There is much variation in the shape of the
paraphyses, and different paraphyses often occur in the same sorus. They consist of a stalk with a laterally or peltately affixed blade, which may be entire or variously incised. Like the scales, the blades of the paraphyses are clathrate. Small blades in which the walls of the central cells are so strongly thickened that the lumina are almost entirely filled are characteristic for *B. annamensis* (Fig. 3b) and *B. henryi*. Other species usually have larger blades, in which the central cells have open lumina. Paraphyses with peltately and laterally affixed blades often occur in the same sorus in most species except *B. annamensis* and *B. henryi*, which have only peltate paraphyses. The regular occurrence of irregularly branched scale-like structures (Fig. 3f) is characteristic for *B. spicata* and *B. validinervis*.

**Spores**

The spores of *Belvisia* have been treated separately by Van Uffelen (1992).

**SYSTEMATIC POSITION**

In the present circumscription, *Belvisia* includes two species not included by Christensen (1929), both of which he included in *Lemmaphyllum* (*B. abbreviata, B. novoguineensis*). For Christensen, the position of these species was highly ambiguous, and he expressed his doubts whether any of the two involved genera was really monophyletic. When we now place the two species in *Belvisia* this is based on the observation that the then remaining species of *Lemmaphyllum* (*L. accedens* and *L. carnosum* s.l.) both have strictly peltate scales, whereas in *Belvisia* all species now included have basifixed scales with overlapping auricles. This character, not seen by Christensen, not only separates the genera readily, but also argues against a derivation of *Belvisia* from *Lemmaphyllum*. Following Hovenkamp (1986), we consider pseudopeltate scales to be intermediate in the transformation of simple hairs to peltate scales. Under that assumption, it is not likely that a genus with pseudopeltate scales is derived from a species with peltate scales. There are, in our opinion, no arguments either to favour the opposite, a derivation of *Lemmaphyllum* from *Belvisia*. In fact, *Belvisia* and *Lemmaphyllum* share few, if any, characters with each other that are not shared also with *Lepisorus*. Only the coenosori might be used to unite the two genera, but the plethora of forms intermediate between separate and fused sori in *Lemmaphyllum carnosum* in our opinion clearly shows that the coenosorus in that species is not inherited from a single coenosoroid ancestor. It is an independent development, possibly arrived at independently several times within *Lemmaphyllum*. That coenosori are readily formed independently in unrelated groups has been made sufficiently clear (Christensen, 1929; Ravensberg & Hennipman, 1986).

**References cited above:**

Christensen, C. 1906. Index Filicum.

Hooker, W.J. 1863. Species Filicium V.


Kuhn, M. 1868. Filices Africanae.


Moore, T. 1857. Index Filicum.


Presl, C.B. 1851. Epimeliæ Botanicae.


Smith, J. 1875. Historia Filicum.


BELVISIA


Hyalolepis Kunze, Linnaea 23 (1850) 258, nom. illeg., non DC. (1837). — Type species: Hyalolepis ophioglossoides (Kaulf.) Kunze [= Belvisia spicata (L.f.) Copel.].


Note. — Species of Belvisia have been named in Acrostichum, Gymnopteris, Lomaria, Onoclea, Schizaea, and Taeinius.
Epiphytic, rhizome short- to long-creeping, approximately terete, covered with scales, dorsally with 2 rows of fronds, ventrally and laterally densely set with roots, dictyostelic, with scattered sclerenchyma strands. Rhizome scales basifixed, pseudopeltate, ovate to linear-lanceolate, fully clathrate or with a membranaceous margin, reddish to brown, entire to dentate, with a varying number of glandular cells on the margin. Fronds simple, entire. Stipes articulated to the rhizome, basally terete, adaxially grooved, sometimes winged. Lamina linear-lanceolate to linear, base cuneate, apex gradually narrowed or abruptly truncate to the narrow fertile part, olivaceous to brown when dry, dull, pergamentaceous, thinly covered with scattered, mostly caducous scales. Veins anastomosing, forming areoles with many scattered free veinlets, free veinlets in the costal and marginal areoles all and in the other areoles predominantly directed to the costa; midrib distinct throughout the sterile and the fertile part of the lamina, secondary veins distinct or indistinct, immersed, tertiary veins and veinlets immersed. Fertile part linear-lanceolate to linear, with one elongated, sometimes interrupted, sorus at each side of the midrib usually fully covering the lamina between midrib and margin, sometimes leaving a narrow zone free along the midrib. Sporangia with 12–16 indurated annulus cells, mixed with peltate or basally attached paraphyses. Spores monolete, rugulate.

Distribution – Tropical Africa east to tropical Asia and Polynesia, extending to South China, Tahiti, Rapa and Australia.

Note – In the following key, the term lamina refers to the sterile part of the lamina only, the term spike refers to the fertile apical part.

KEY TO THE SPECIES

1a. Rhizome long-creeping; fronds scattered at intervals of up to 7 cm ............. 2
b. Rhizome short-creeping; fronds tufted or spaced at intervals of at most 2 cm 3

2a. Sori short, up to 1 cm long, on a short spike which is nearly always sharply distinct from the lamina ........................................ 1. B. abbreviata
b. Sori much longer, on a longer spike which gradually merges into the upper part of the lamina .................................................. 6. B. novoguineensis

3a. Paraphyses peltate only (often completely absent in old sori), usually opaque with lumina of central cells almost entirely filled with wall material; lamina usually asymmetrically truncate below the spike ......................................... 4
b. Some paraphyses with laterally affixed blades nearly always present, usually translucent; lamina usually gradually and symmetrically narrowed below the spike ..................................................................... 5

4a. Spike 4–7 mm wide; sori medial between midrib and margin

2. B. annamensis
b. Spike up to 4 mm wide; sori close to the midrib .......... 3. B. henryi

5a. Rhizome scales with dentate to ciliate margin, all cells thick-walled ........ 6
b. Rhizome scales entire or almost so, central cells thick-walled, marginal cells thin-walled ................................................................. 7

6a. Sori leaving a clear marginal and sometimes also a narrow costal zone free; spike relatively wide, to 2 cm wide ....................... 7. B. platyrhynchos
b. Sori completely covering the spike; spike usually narrow, linear, 0.1–0.2 (rarely up to 1) cm wide .............................................. 4. B. mucronata
7a. Rhizome short; leaves tufted; scales dull with a dark-brown centre and a lighter margin; lamina generally 1–2 cm wide ...................... 8. B. spicata
b. Rhizome more widely creeping; fronds scattered at intervals of up to 2 cm; scales uniformly light brown, glossy or iridescent; lamina generally 3–4 (sometimes up to 6) cm wide ...................... 9. B. validinervis

1. Belvisia abbreviata (Fée) Hovenkamp & Franken, comb. nov. – Fig. 3a


Polypodium hymenolepioides Christ, J. de Bot. 19 (1905) 75; C. Chr., Ind. Fil. (1906) 534. — Hymenolepis hymenolepioides Ching ex C. Chr. & Tardieu, Notul. Syst. 8 (1939) 185; Tardieu & C. Chr., Fl. Gén. Indochine 7 (2) (1941) 452. — Belvisia hymenolepioides Ching, Acta Phytotax. Sin. 10 (1965) 301. — Type: Cadière 97, Annam, Quang-Binh (P).

Rhizome very slender, long-creeping, internodes 1–5 cm long. Rhizome scales ovate to ovate-lanceolate, 1.5–2.7 by 0.7–1.3 mm, index 1.2–4, margin entire or minutely dentate, apex rounded; reddish-brown, walls of central cells more strongly thickened than those of marginal cells. Fronds somewhat dimorphic. Stipes to 1 cm long, 0.3–0.7 mm thick, lamina of sterile fronds elliptic to linear-lanceolate, to 5 by 1 cm, of fertile fronds mostly longer and sometimes narrower, to 12 by 0.5–1.5 cm to linear, 4–10 by 0.3–0.8 cm, index 5–33, gradually narrowed to the base, often slightly constricted below the spike; spike ovate to ovate-lanceolate, 0.2–1 by 0.2–0.4 cm. Sori medial between midrib and margin, often interrupted (best visible in young sori), rarely a row of separate round sori present, not covering margin and costa when ripe. Paraphyses peltate, blades flat, 0.4–0.45 mm wide, entire, with thick-walled cells. Spores rugulate, 45–70 by 25–50 μm, index 1.4–1.8.


Habitat – Epiphytic or epilithic; altitude 425 m (Poilane 7939).

Note – Obviously a rare species. Its systematic position remains ambiguous. It is here included in Belvisia on account of the characteristics of the scales of the rhizome and the (rarely present) paraphyses.

2. Belvisia annamensis (C. Chr.) Tagawa – Figs. 2a, 3b

Rhizome short-creeping, internodes not elongated, 2–4 mm thick. Rhizome scales ovate-lanceolate to linear-lanceolate, 4.8–8.3 by 0.9–2.1 mm, index 3.8–5.6, base dentate, acumen narrowed, dentate near the base, sometimes with a narrow entire filiform apex, reddish brown to black, all cell walls strongly thickened. Stipes 1–4 cm long, 1–2 mm thick, lamina linear-lanceolate, 15–30 by 2–5 cm, index 6–9, base gradually narrowed, apex more or less abruptly truncate; spike 5–25 by 0.4–0.7 cm, index 8–60. Sori often extending downwards to well below the narrowed spike, medial between midrib and margin, leaving a medial and marginal free zone, paraphyses peltate, with circular blade, 0.1–0.4 mm diam., brownish to black, margin toothed, cell walls strongly thickened in mature paraphyses. Spores rugulate, 40–60 by 25–40 μm.

Distribution — Thailand, Laos, Vietnam, Borneo.

Habitat — Epiphytic or on rocks in evergreen forest. Sea level to 1900 m.

Note — The only clear differences between this species and B. henryi are the width of the spike and the relative position of the sori. The two species are reasonably well-separated geographically. However, it may well be that when more material from their contact zone becomes available, the taxonomic status of these two species will have to be reconsidered.

THAILAND. Mt Goping: King 1100 (BO, M). Mt Khao: Hennipman 3745, 3987 (L). Ranong: Geesink & Sanitsuk 4916 (L).

LAOS. Poilane 12210 (P).

VIETNAM. Annam: Cadière 11 (BM, P), 787 (P); Poilane 8010, 11001 (P). -- Tonkin: Pételot 4477 (P).

BORNEO. Haviland & Hose s.n., Aug. 1894 (K).

3. Belvisia henryi (C. Chr.) Raymond — Fig. 2b


Rhizome short-creeping, internodes not elongated, 2–4 mm thick. Rhizome scales ovate-oblong to ovate-lanceolate, 2.7–5.2 by 0.8–1.4 mm, index 2.7–1.5, above the base constricted to a long acumen, base dentate, acumen narrowed, dentate near the base, sometimes with an entire filiform apex, cells with strongly thickened walls. Stipes to 4 cm long, 1–2 mm thick, lamina linear-lanceolate, 7–27 by 1.5–5 cm, index 4–9, base gradually narrowed, apex usually abruptly truncate (sometimes asymmetrically) to the spike, sometimes narrowed more gradually, spike linear, 5–35 by 0.1–0.4 cm, index 15–115. Sori usually completely covering the lamina, paraphyses peltate, with circular blade, 0.1–0.3 mm diam., margin toothed, cell walls strongly thickened in mature paraphyses. Spores rugulate, 40–75 by 25–50 μm.
Distribution — China (Yunnan), Bhutan, Sikkim, India (Assam), Burma, Thailand, Vietnam.

Habitat — Epiphytic; altitude 1200–2000 m.


Bhutan. *Cooper 1109* (BM); *Ludlow 7231* (BM).

Sikkim. *Levinge s.n.* 10-7-1829 (G): *Clarke 25086* (BM, P); *Jerdon s.n.* (B).

India. Jaintea: *Clarke 1003* (M), 18334 (P); *Mann s.n.*. Sep. 1886 (G, M, US), April 1889 (M). — Assam: *Parish (herb. Hope) s.n.* (P); *Mann s.n.*. Apr. 1887 (L), Dec. 1889 (M); June 1890 (BO); *Thakur Rup Chand 4808* (MICH, UC), 6067 (MICH).


4. Belvisia mucronata (Fée) Copel. var. mucronata — Figs. 1c, d, 3c


*Acrostichum spicatum* L.f. var. *schneideri* F. M. Bailey, Comp. Cat. (1913) 649, 849, f. 613. — *Hymenolepis spicata* (L.f.) Presl forma *schneideri* Alderw., Mal. Ferns, Suppl. (1917) 432. — Synotypes: *Tryon & Schneider s.n.*, Australia, Queensland, Macpherson Range (BRI, not seen); *F. M. Bailey s.n.*, Australia, Queensland, Taylor's Range (BRI, not seen).

*Hymenolepis spicata* (L.f.) Presl var. *novoguineensis* Rosenstock, Hedwigia 56 (1915) 353; Alderw., Mal. Ferns, Suppl. (1917) 433. — Type: *Bamler 60* (B; iso L, P).


*Hymenolepis mucronata* Fée forma *australiensis* C. Chr., Dansk Bot. Ark. 6 (1929) 64. — Type: *Hill s.n.*, Queensland, Moreton Bay (B; iso K, L).
Hymenolepis mucronata Fée forma helocharidioides C. Chr., Dansk Bot. Ark. 6 (1929) 64. — Type: F. von Mueller s.n., New Hebrides (K).

Hymenolepis mucronata Fée var. nigropunctata C. Chr., Dansk Bot. Ark. 6 (1929) 64. — Type: Ledermann 13068, Papua, Kaiserin Augusta Fluss (B).


Hymenolepis mucronata Fée var. nigropunctata C. Chr. forma latior C. Chr., Dansk Bot. Ark. 6 (1929) 65. — Syntypes: Kaudern s.n., Celebes, Bolaang Mongondow, Modajag (not located); Korithals 109, locality not given (B).


Rhizome short-creeping, internodes not elongated, 2–5 mm thick. Rhizome scales ovate-oblong, ovate-lanceolate to linear-lanceolate, 2.5–8.5 by 0.5–2 mm, index 3–8, margin minutely to distinctly dentate, acumen contracted, apex acute, reddish-brown to black, all cells with thickened walls. Stipes up to 6 cm long, 1–2 mm thick, lamina linear to linear-lanceolate, 10–50 by 1–5 cm, index 5–22, narrowed towards base and apex, spikes linear, 3–25 by 0.3–0.7 cm, index 3–8. Sori close to the midrib, completely covering the lower surface when ripe, paraphyses with laterally affixed or peltate blades, peltate blades round, 0.1–0.65 mm diam., brownish to black, margin entire to toothed, cells with thick walls. Spores rugulate, 40–90 by 60 μm.


Habitat — Epiphytic on all kinds of trees or on rocks. In primary and secondary forest; altitude 0–1500 (rarely 4000) m.

Notes — 1. Christensen erroneously indicated Bamler 60 as type of Hymenolepis mucronata Fée forma graminifolia. This taxon is based on H. spicata (L.f.) Presl var. graminifolia Rosenstock, typified by Keysser 290.

2. The paraphyses are excellently illustrated by Fée in his original publication. He illustrated the paraphyses that are characteristic for Belvisia mucronata (fig. 6B: 1') as well as those characteristic for B. spicata and B. validinervis (fig. 6B: 1")

3. A very variable species, particularly in the width of the fronds. A few specimens from New Guinea with extremely narrow fronds, 0.3–0.9 cm wide, have been described as var. graminifolia Rosenstock. They do not differ from normal specimens in any other character.
5. *Belvisia mucronata* (Fée) Copel. var. *dura* (Copel.) Hovenkamp & Franken, *stat. nov.* – Figs. 1c, d, 3c


Diffs from the type variety: Rhizome scales 6.6–10.5 by 1.5–3 mm, index 3–5. Stipes 2–3 cm long, lamina lanceolate to linear lanceolate, 7–12 by 2–3 cm, index 3–5; spike lanceolate, 1.5–4 by 0.8–1 cm, index 2–4. Paraphyses with laterally affixed or peltate blades, blades 0.4–0.7 × 0.08–0.6 mm, entire. Spores 100–120 by 75–90 μm.


Habitat – Ledge of high basalt precipice, at 330 m altitude.

Notes – 1. *Belvisia dura* was described on the basis of one specimen, and no other collections are known so far. The extremely large spores and paraphyses suggest that this aberrant specimen is a polyploid.

2. Judging by the description, *B. melanesica* Brownlie, described from Fiji, is rather similar. No authentic specimen of *B. melanesica* could be located.

6. *Belvisia novoguineensis* (Rosenstock) Copel. – Figs. 2c, 3d


Rhizome long-creeping, internodes 2–7 cm long, slender, 0.8–1.5 mm thick. Rhizome scales 2.5–5 by 0.9–1.3 mm, thin, translucent, red-brown to fuscous, margin minutely toothed, apex rounded to acute, all cells thin-walled. Stipes 2–7 cm long, 0.7–1.2 mm thick, lamina ovate-lanceolate to linear, 5–30 by 1–3 cm, index 4–20, gradually narrowed to the base and apex, glabrous or with a few scales on abaxial side of stipe and costa; spike from a wide base gradually narrowed, 4–17 by 0.5–1.5 cm (basal width). Sori sometimes interrupted, marginal, leaving a sterile zone near mid-rib and margin, especially in the lower, widened part of the spike, paraphyses with laterally affixed or peltate blades, laterally affixed blades 20–30 by 5–30 μm, sometimes irregularly lobed; peltate blades 0.3–0.5 mm diam.; brownish, margin entire. Spores rugulate, 60–80 by 50–60 μm.

Distribution – Malesia: New Guinea, from West to East, many collections. New Ireland: *Croft 277* (L); *LAE 68366* (L).

Habitat – Epiphytic in mid-montane, wet or mossy forest, 1100–3000 m.

Note – This species resembles *Lemmaphyllum* in the long-creeping rhizome and the broad base of the spike.

7. *Belvisia platyrhynchos* (Kunze) Copel. – Figs. 2d, 3e


Rhizome short-creeping, internodes not elongated, 2–6 mm thick. Rhizome scales ovate-oblong to ovate-lanceolate, 6.8–10.5 by 1.5–3 mm, index 3–5, sometimes narrowed towards the acumen, apex acute; margin long-dentate; reddish-brown, cells with thickened walls. Fronds sessile to clearly stalked, stipe up to 1(–4) cm long, 2–4 mm thick; lamina linear-lanceolate to linear, 5–75 by 1–5 cm, index 5–20; narrowed towards base and apex, somewhat constricted below the spike; spike lanceolate to linear-lanceolate, 2–10 by 0.5–2 cm, index 3–11.5. Sori close to the midrib, when ripe covering the midrib and leaving a marginal zone 1–5 mm wide free, paraphyses with laterally affixed or peltate blades, laterally affixed blades flat or cylindric, 0.15–0.4 by 0.04–0.3 mm, peltate blades 0.25–0.65 mm wide, margin entire, cells with thick walls. Spores rugulate, 40–90 by 25–60 mm.

Distribution — Philippines, New Guinea.

Habitat — Epiphytic, in primary and secondary forest; sea level to 2300 m.


NEW GUINEA. Japen I.: Cheesman 1345, 1395 (BM).

8. Belvisia spicata (L. f.) Mirbel ex Copel. — Figs. 1a, b, 2e, 3f


Hymenolepis spicata (L.) Presl var. tenella Alderw., Mal. Ferns (1908) 729. — Type: Zollinger s.n. (BO, L).


Hymenolepis spicata (L.) Presl forma minima Alderw., Mal. Ferns, Suppl. (1917) 432. — Type: not indicated.

Hymenolepis spicata (L.) Presl var. occultivenia C. Chr., Dansk Bot. Ark. 6 (1929) 57; ibid. 7 (1932) 160. — Syntypes: Pahl & Afnelius s.n., Madagascar, Moramanga (S, C, not seen); Pool s.n., Meller s.n., Madagascar (K, not seen); d’Alleizette 117, Madagascar, Betisira (P); HOrne 206, Thomasset s.n., de l’Isle s.n., Seychelles, Mah (K, not seen); Quinoston s.n., St. Thom, Africa (K).

Hymenolepis spicata (L.) Presl var. usambarenensis C. Chr., Dansk Bot. Ark. 6 (1929) 57. — Syntypes: Holst 143, 7485, Usambara Mts (B); Holst 9093, Usambara Mts (B, BM, P).
Rhizome short-creeping, internodes not elongated, 2–4 mm thick. Rhizome scales ovate, ovate-lanceolate or narrowly triangular, 1.7–4.1 by 1–1.5 mm, index 1.7–3, apex acute to rounded, often recurved; margin usually entire, rarely dentate; central cells with thickened walls, marginal cells in a 0.2–0.3 mm wide membranaceous zone with thin walls. Stipes 0.5–4 cm long, 1–2 mm thick; lamina linear-lanceolate to linear, 8–30 by 0.3–2 cm, index 5–70; narrowed towards base and apex; spikes linear, 2–25 by 0.2–0.4 cm, index 5–100. Sori covering the lamina when ripe, situated close to the midrib; paraphyses with irregularly branched and lobed blades, cells with thick walls. Spores rugulate, 40–90 by 25–60 μm, index 1.5–1.7.


Habitat — Epiphytic or epilithic in primary or secondary forest. Common in mountainous areas. Up to 3000 m altitude.

Notes — 1. In Malesia this widespread species is often very close to B. validinervis, and may be hybridizing with the latter.

2. Superficially, this species is very similar to B. mucronata. The main difference is found in the rhizome scales, and Christensen (1929), noting that B. spicata and B. mucronata often are mixed in a single collection, even expressed his doubts whether the two species really could be kept separate. We believe that the differences in structure of the scales are in fact sufficient to do so, and we find a supporting character in the irregular paraphyses in B. spicata.

9. Belvisia validinervis (Kunze) Copel. var. validinervis — Fig. 2f


Hymenolepis squamata C. Chr. var. borneensis C. Chr., Dansk Bot. Ark. 6 (1929) 60. — Type: Clemens 10064, Borneo, Mt. Kinabalu (B; iso MICH, US).

Hymenolepis validinervis Kunze var. celebica C. Chr., Dansk Bot. Ark. 6 (1929) 61. — Type: Bünne meijer 12032, Celebes, G. Bonthain (B; iso BM, BO, L, M, P).

Rhizome creeping, internodes 0.5–2 cm long, 2–6 mm thick. Rhizome scales large, ovate-oblong to ovate-lanceolate, 2–6 by 1–3 mm, attenuate to an acute or
rounded apex, margin entire or minutely dentate; light red- or grey-brown, glossy and often iridescent, cell walls thin, central cells with slightly more thickened walls than the marginal cells. Fronds subsessile to clearly stalked, stipes up to 15 cm long, 1–2.5 mm thick, lamina linear, 5–60 by 0.3–4 cm, narrowed to base and apex, glabrous or with a few to many, often irregularly shaped scales, especially along the costa. Spike continuous with lamina, not constricted at the base, relatively broad to linear, 2–25 by 0.2–0.8 cm, index 5–85. Sori close to the midrib but covering the entire lamina when ripe. Paraphyses with laterally affixed or peltate blades or irregularly lobed, laterally affixed blades flat or cylindrical, 0.10–0.30 by 0.04–0.20 mm, peltate blades 0.25–0.65 mm wide, margin entire or incised. Spores rugulate, 40–90 by 25–60 μm.

Distribution — Throughout Malesia, New Ireland, New Hebrides, New Caledonia. Habitat — Epiphytic or epilithic in primary and secondary montane forest.; altitude 1200 (rarely lower) to 4000 m.

Notes — 1. *Belvisia validinervis* is not always sharply distinct from *B. spicata*, and may be hybridizing with the latter.

2. As here construed, typical *B. validinervis* is best recognized by the scales, and the moderately spaced leaves, and, less typical, by wide spikes and a subsessile lamina. As may be clear from the above description, especially the shape of the lamina, length of the stipe and the presence of scales on the leaves is variable. This has given rise to the recognition of several taxa:
   a) *Hymenolepis squamata* and its var. *borneensis*. Based on the presence of rather permanent scales. These are most often found on Philippine specimens.
   b) *Hymenolepis brachystachys*, based on forms with a subsessile, broad and fleshy lamina with a short spike.

   However, there are numerous transitions between these forms and the typical form all over the range of the species. Alderwerelt’s *Hymenolepis brachystachys* var. *mirabilis* is a monstrosity.

In New Guinea a well-delimited form can be segregated as a variety:

10. *Belvisia validinervis* (Kunze) Copel. var. *longissima* (Holttum) Hovenkamp & Franken, *stat. nov.* — Fig. 2g


Differs from the type variety: Fronds larger, stipes to 40 cm long, lamina 65–220 by 2–6 cm, suddenly narrowed to the spike, which is up to 60 by 0.4–0.6 cm wide.

   Distribution — New Guinea, many collections; Celebes: Sopu Valley, *Hennipman 5652* (L).

Habitat — Epiphytic, especially on *Pandanus* in montane forest; 2200–3500 m.