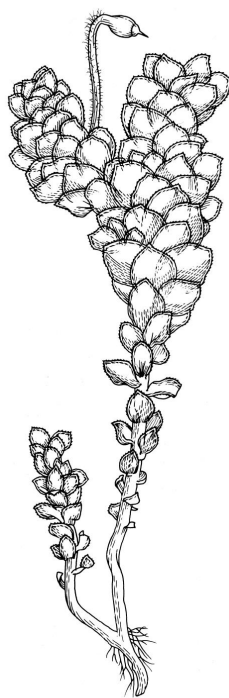




FLORA OF NEW ZEALAND

MOSSES

DALTONIACEAE



A.J. FIFE

Fascicle 34 – JULY 2017

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Cover image: *Calypstrochaeta cristata*, habit with capsule, moist. Drawn by Rebecca Wagstaff from V.D. Zotov s.n., 27 Aug. 1933, CHR 6867.

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Introduction

The Daltoniaceae are a moderately large family of elegant mosses occurring mostly at higher elevations in the tropics and in cooler parts of the southern hemisphere. The family is allied to the Hookeriaceae, and many of the genera have traditionally been placed in that broadly defined family. The genus *Daltonia* is widespread throughout tropical regions worldwide. The largest genus, *Distichophyllum*, is mainly distributed in tropical Asia, the islands of the Pacific, and austral regions, including New Zealand. The extraordinarily tiny *Ephemeropsis* consists largely of a persistent protonema giving rise to campanulate capsules; it occurs on twigs and leaves and is distributed only in N.Z., Tasmania, and Java and its surrounding islands. Several genera of Daltoniaceae are predominantly Australasian in distribution with some species and some small genera endemic to N.Z. Seven genera, 15 species and 1 variety are accepted in the N.Z. flora.

Some of the most striking and characteristic mosses in the N.Z. flora belong here and some of them are often confused with hepatics. The family is recognised in part by having mostly erect or inclined doubly peristomate capsules in which the exostome teeth usually have a distinct median 'furrow' on their outer surface. The exothecial cell walls are usually collenchymatous and the elongate setae are often scabrous or even spiny. The calyptrae are mitrate, fringed at their base, and usually cover only the apex of the developing capsule. The vegetative leaves are mostly singly costate and often bordered by several rows of elongate and thick-walled cells.

Typification

The following typifications are designated in accordance with the International Code of Nomenclature for Plants, Algae and Fungi.

***Distichophyllum microcarpum* var. *homodictyon* Sainsbury, Rev. Bryol. Lichénol. n.s. 18: 113 (1949)**

Lectotype (designated here): N.Z.: "Otupae [Station], Taihape", *E.A. Hodgson* 717, March 1934 ("Sainsbury 9113"), WELT M005802!

***Hookeria adnata* Hook.f. & Wilson, Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II: 123, pl. 93, f. 4 (1854)**

Lectotype (designated here): N.Z., Bay of Islands, on *Trichomanes elongatum*, 1841, *J.D. Hooker*, ("Wilson 378"), BM-Wilson!

***Hookeria flexicollis* Mitt. in Hook.f., Handb. New Zealand Fl. 496 (1867)**

Lectotype (designated here): N.Z., Otago, Dunedin, wet rocks, *Hector*, October 1862, NY-Mitt.!

Isolectotypes (designated here): BM-K!, NY!

***Hookeria luteovirens* Colenso, Trans. & Proc. New Zealand Inst. 17: 260 (1885)**

Lectotype (designated here): N.Z., "Seventy-mile Bush, County of Waipawa"; 1883–84: *W. Colenso* 4030 (350), BM-K!

***Hookeria macroneura* Colenso, Trans. & Proc. New Zealand Inst. 18: 283 (1886)**

Lectotype (designated here): N.Z., on "swamp-mud; fine", *W. Colenso* 3152 [765], BM!

***Hookeria maculata* Colenso, Trans. & Proc. New Zealand Inst. 18: 284 (1886)**

Lectotype (designated here): N.Z., *Colenso* 3042 (632), BM!

***Hookeria sciadophila* Colenso, Trans. & Proc. New Zealand Inst. 17: 259 (1885)**

Lectotype (designated here): N.Z., *Colenso* 3395, BM! Isolectotype (designated here): WELT M000301!

Daltoniaceae

The following family description draws from Buck (1988).

Plants small to medium-sized, mostly glossy, erect or prostrate, rarely layering, pale green to gold- or red-green, forming turves or mats, rarely reduced to a persistent protonema. **Stems** in cross-section lacking a central strand and mostly with cells similar throughout. **Leaves** differentiated (dimorphic) or not, and if so the lateral ones larger, often complanate, lanceolate to broadly spatulate, plane at margins, usually bordered by elongate cells, entire or toothed; **laminal cells** short, smooth, mostly firm-walled; **alar cells** not differentiated. **Costa** mostly single and often percurrent (variable in N.Z. taxa), often bifurcate above or weak and bifurcate near the base. **Gemmae** sometimes borne in axillary clusters, at leaf margins, or on a terminal pseudopodium. **Paraphyllia** lacking.

Pseudoparaphyllia present or lacking.

Mostly autoicous (but often dioicous in N.Z.). **Setae** elongate, smooth, mammillose, or spinose; **capsules** erect to horizontal, smooth or mammillose; **exothelial cells** collenchymatous; **annulus** present or absent; **operculum** conic-rostrate. **Peristome** double; **exostome teeth** narrowly bordered, on outer surface either with a median furrow and cross-striolate or lacking a median furrow and papillose to \pm spiculate; **endostome** with a low or rarely a high (as in *Calypstrochaeta*) basal membrane, the segments keeled and perforate or not; **cilia** poorly developed or absent. **Calyptra** mitrate, naked or pilose, fimbriate at base. **Spores** small, spherical.

Notes: The Daltoniaceae belong in the Hookeriales, an order that has attracted a great deal of systematic attention since c. 1970. W.R. Buck has published extensively on this group and has been responsible for many improvements in our understanding of the relationships in this large, diverse, and predominantly tropical group. According to Buck (1988) the characters that “hold together most of the genera are short leaf cells, complete lack of alar differentiation, exserted capsules, often roughened on setae, collenchymatous exothelial cells, rostrate opercula, baffle-like cross-walls in endostomal segments, and mitrate calyptrae”. Despite the large number of relatively recent publications on the relationships of the Daltoniaceae and their allies (i.e. the Hookeriales), little consensus has emerged concerning boundaries between the component families.

Traditionally (Brotherus 1925) the Daltoniaceae were included in, or close to, the broadly defined Hookeriaceae. This broad and conservative concept of the Hookeriaceae was utilised by Streimann (1997; 1999; 2000) in his useful treatment for Australia.

However, the concept of the Daltoniaceae (and, by implication, the Hookeriaceae) presented here follows Goffinet et al. (2009). Seven N.Z. genera are included in the family here (*Achrophyllum*, *Beeveria*, *Calypstrochaeta*, *Crosbya*, *Daltonia*, *Distichophyllum*, and *Ephemeropsis*) from a total of 14 genera worldwide.

Goffinet et al. (2009) recognised seven families in the Hookeriales worldwide. Of these seven, three (Daltoniaceae, Hypopterygiaceae, and Saulomataceae) occur in N.Z. The much reduced Hookeriaceae *sensu* Goffinet et al. does not occur here.

Buck (1988, p. 33) has argued that *Calypstrochaeta* is anomalous in the Daltoniaceae because of its “weak costa, well-developed stem anatomy and curved seta”, but it is retained here.

- | | | |
|----|---|---------------------------|
| 1 | Plants minute, consisting mostly of persistent, red-brown protonema on twigs or leaves; stems reduced to minute male and female buds; vegetative leaves absent; capsules c. 0.5–0.8 mm; endostome reduced to a basal membrane, with segments absent; spores mostly with 1–3 transverse septa. | <i>Ephemeropsis</i> |
| 1' | Plants larger, lacking persistent protonema, either terrestrial or epiphytic; stems well-developed; vegetative leaves present; capsules >1.0 mm (except <i>Daltonia splachnoides</i>); endostome not reduced to a basal membrane, with well-developed segments; spores unicellular | 2 |
| 2 | Cells of leaf margins at mid leaf short, not markedly differentiated by their shape from adjacent laminal cells and not forming a distinct border (but may form a moderately defined border of compact cells in <i>Achrophyllum</i>) | 3 |
| 2' | Cells of leaf margins at mid leaf elongate and markedly differentiated from adjacent laminal cells, forming a distinct border | 5 |

3	Juxtacostal cells in lower leaf greatly enlarged and lax to form a large but ill-defined group extending c. $\frac{2}{3}$ the length of the costa; exothecial cells collenchymatous and with several (5–11) thickened, cylindrical secondary walls converging over the lumen to form a ribbed vault-like structure <i>Distichophyllum</i> p.p. (<i>D. microcarpum</i>)	
3'	Juxtacostal cells in lower leaf not strongly differentiated; exothecial cells collenchymatous but lacking a ribbed vault-like structure of secondary walls 4	
4	Plants restricted to base-rich rock (including limestone); gemmae borne in a terminal capitulum at the apex of a leafless stem (pseudopodium), unbranched, fusiform and 5–9 times transversely septate; upper laminal cells <45 µm in greater diameter; exostome teeth weakly furrowed (furrow not visible with stereoscope) <i>Beeveria</i>	
4'	Plants not restricted to base-rich rocks; gemmae borne on leaf margins, mostly branched (often L- or T-shaped); upper laminal cells >50 µm in greater diameter; exostome teeth strongly furrowed (furrow visible with stereoscope) <i>Achrophyllum</i>	
5	Plants predominantly terrestrial or aquatic, only rarely epiphytic, robust or sometimes small in stature; leaves not lanceolate (oval, spatulate, obovate, or elliptic) 6	
5'	Plants predominantly epiphytic (<i>Crosbya nervosa</i> occasionally occurs on rock), small in stature; leaves lanceolate to oblong-lanceolate 7	
6	Costa weak, always ending below mid leaf, branched near base (occasionally unbranched or nearly absent in <i>Calypstrochaeta brownii</i>); setae usually spinose, less often merely papillose, mostly stout <i>Calypstrochaeta</i>	
6'	Costa strong, extending beyond mid leaf, mostly bifurcating above (rarely unbranched in <i>D. rotundifolium</i> and <i>D. crispulum</i>); setae smooth or papillose, not spinose, mostly elongate and slender <i>Distichophyllum</i> p.p.	
7	Costa ending well below the leaf apex, not fusing with the leaf border; autoicous ; peristome teeth baculate-spiculate throughout, not furrowed in N.Z. species; endostome lacking a basal membrane <i>Daltonia</i>	
7'	Costa percurrent or excurrent, fusing with the leaf border; dioicous ; peristome teeth cross-striate below, furrowed; endostome with a distinct basal membrane <i>Crosbya</i>	

***Achrophyllum* Vitt & Crosby, *Bryologist* 75: 174 (1972)**

= *Hepaticina* Müll.Hal., *Hedwigia* 41: 124 (1902) nom. inval.

Type taxon: *Achrophyllum quadrifarium* (Sm.) Vitt & Crosby

Plants medium-sized to robust, rather rigid, often darkening upon drying, forming loose turves. **Stems** erect, sparsely branched, complanate, in cross-section with a central strand, beset below with red-brown, smooth rhizoids. **Leaves** inserted in 8 ranks, often pale, those in dorsal and ventral ranks symmetric or nearly so, those in lateral ranks markedly asymmetric, especially at base, with broadly rounded or ± acute apices, plane, entire to coarsely and irregularly toothed; **upper laminal cells** round-hexagonal in outline, thin- or thick-walled, ± thickened at corners, the exposed (abaxial and adaxial) walls very thin and collapsing when dry. **Costa** single, often unevenly bifurcate. **Gemmae** often present on intramarginal cells, usually branched. **Pseudoparaphyllia** present, foliose.

Dioicous. **Perichaetial leaves** lacking costae and border. **Perigonia** globose to ovoid, scattered on main stems, with broadly ovate, obtuse, strongly concave, and ecostate bracts and numerous filiform paraphyses. **Setae** lateral, erect, arcuate at apex, smooth, in cross-section lacking a hyaloderm, twisted weakly to the left throughout, dark red-brown; **capsules** pendent, symmetric, smooth when dry, pale to dark yellow-brown; **exothecial cells** oblong to ± isodiametric, firm-walled, collenchymatous; **annulus** well-developed, falling with the operculum. **Exostome teeth** yellow-brown, linear-lanceolate, deeply furrowed for c. $\frac{2}{3}$ their length, cross-striate to apex of furrow, baculate-papillose near tip, with high lamellae on inner surface that project laterally as strong marginal

trabeculae; **endostome** pale yellow, with a high basal membrane and well-developed and keeled **segments**; **cilia** absent. **Calyptra** mitrate, enclosing only the operculum. **Spores** small, smooth.

Taxonomy: *Achrophyllum* is a small genus restricted to temperate regions in the southern hemisphere. While Brotherus (1925, p. 234, as *Pterygophyllum* Brid.) placed the number of species at 32, this number is certainly inflated. Streimann (1997) suggested that a more accurate number might be about eight species, “most from southern South America”. However, as some of the South American taxa are probably taxonomic synonyms of Australasian species, even Streimann’s estimate of the genus size is probably too large.

Vitt & Crosby (1972) demonstrated that the commonly used *Pterygophyllum* Brid. is illegitimate and described the new genus *Achrophyllum* for *Pterygophyllum* in the 1907 sense of Brotherus (1901–1909, p. 931).

Etymology: The generic name refers to the relatively pale (or colourless) leaves of the type species. The colourless appearance of the type species is due to the collapsed and highly reflective nature of the exposed walls of the laminal cells.

- 1** **Leaves** often strongly crisped when dry and not reviving readily when moistened; **leaf margins** irregularly dentate (some teeth often multi-cellular) in upper half or more, not obviously bordered when dry; **upper laminal cells** (at level of costa terminus) (45–)54–75(–90) µm in greater diam. *A. dentatum*
- 1'** **Leaves** not strongly crisped when dry and reviving readily when moistened; **leaf margins** entire or minutely and evenly toothed (teeth never multi-cellular) in upper portions, usually appearing thickened at margins when dry (due to one or more rows of thick-walled, small cells); **upper laminal cells** (at level of costa terminus) larger, 60–150 µm in greater diam. *A. quadrifarium*

Excluded Taxa: *Achrophyllum* and *Pterygophyllum*

Hepaticina zuerniana Müll.Hal. *nom. inval.* and *H. parvula* Müll.Hal. *nom. inval.* were published in *Hedwigia* (vol. 41, 1902). The genus *Hepaticina* is invalid. Both names were synonymised by Dixon (1927, p. 288) with *Pterygophyllum dentatum*. *Hepaticina zuerniana* has two N.Z. syntypes (collected by G. Zürn at Coromandel and R. Helms at Greymouth). *Hepaticina parvula* is also based on two syntypes, one from Victoria and the other an F.M. Reader collection from an unspecified North I. locality. None of these four syntypes have been studied for this treatment. Dixon “examined the types of [the] various species described by C. Mueller” and referred them to *Pterygophyllum dentatum*. Little purpose would be served by questioning Dixon’s synonymy and these names are not discussed further here.

Hookeria spp. There are five names coined by Colenso in the genus *Hookeria* and treated by Dixon (1927, p. 288–289) as synonyms of either *Pterygophyllum dentatum* or *P. dentatum* var. *robustum*. These Colenso names are *Hookeria curviseta*, *H. obtusata*, *H. ramulosa*, *H. subsimilis*, and *H. telmaphila*. Their types were all gathered near Norsewood (Hawke’s Bay L.D.), and all were published in the *Transactions and Proceedings of the New Zealand Institute*. No appropriate type material under these names can be located in BM and it is likely that Dixon referred to the protologues rather than specimens in proposing their synonymy. However, little purpose would be served by questioning Dixon’s synonymy and these names are not discussed further here.

Hookeria flava Colenso is a synonym of *Distichophyllum pulchellum*, q.v.

***Achrophyllum dentatum* (Hook.f. & Wilson) Vitt & Crosby,
Bryologist 75: 175 (1972)**

≡ *Hookeria dentata* Hook.f. & Wilson, *London J. Bot.* 3: 550 (1844)

≡ *Pterygophyllum dentatum* (Hook.f. & Wilson) Dixon, *J. Linn. Soc., Bot.* 40: 455 (1912)

Lectotype: Lord Auckland’s Islands, *J.D. Hooker 88b*, determined and sent to Wilson by Taylor, BM! (Designated by Streimann 1997.) Probable isotype: NY-Mitten!

= *Hookeria denticulata* Hook.f. & Wilson, *Bot. Antarct. Voy. I. (Fl. Antarct.) Part I*, 143 (1845) nom. illeg.

- = *Hookeria nigella* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II*, 124 (1854)
 ≡ *Pterygophyllum nigellum* (Hook.f. & Wilson) Mitt., *Hooker's J. Bot. Kew Gard. Misc.* 8: 264 (1856)
 Lectotype: "in woods, between Turanga and Te Reinga, 1841", W. Colenso, H[ooker] 3674, BM! (Designated by Streimann 1997.) This collection is a compact, terrestrial form of *A. dentatum*.
- = *Hookeria robusta* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II*, 124 (1854)
 ≡ *Pterygophyllum robustum* (Hook.f. & Wilson) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1875–1876: 343 (1877)
 ≡ *Pterygophyllum dentatum* var. *robustum* (Hook.f. & Wilson) Dixon, *Bull. New Zealand Inst.* 3: 289 (1927)
 Holotype: N.Z., "Northern Island", 1844, W. Colenso 124, BM! Probable isotype: NY-Mitten!
 The Holotype consists of three duplicates of Colenso 124 attached to the same sheet as Wilson's handwritten draft description.
- = *Hookeria macroneura* Colenso, *Trans. & Proc. New Zealand Inst.* 18: 283 (1886)
 Lectotype: N.Z., on "swamp-mud; fine", W. Colenso 3152 [765], BM!
- = *Hookeria pseudopetiolata* Colenso, *Trans. & Proc. New Zealand Inst.* 18: 231 (1886) — as pseudopetiolata
 Probable type: There are two specimens on one sheet in BM-K annotated by Hooker "*Hookeria subpetiolata* Colenso, (his)". The similarity of the epithet, and the absence in BM of material under the name *H. pseudopetiolata* suggest that these are likely Colenso's original material. According to the protologue the type is from "forests near Norsewood, County of Waipawa."
- = *Hepaticina cyclophylla* Müll.Hal., *Hedwigia* 41: 124 (1902) nom. inval.
 ≡ *Pterygophyllum cyclophyllum* Broth., *Nat. Pflanzenfam. [Engler & Prantl]* 1(3), 932 (1907) nom. nov. pro *Hepaticina cyclophylla* Müll.Hal. 1902
 Type: N.Z., "prope Wellington", T. Kirk s.n., BM!
- = *Hepaticina nanocaulis* Müll.Hal., *Hedwigia* 41: 126 (1902) nom. inval.
 ≡ *Pterygophyllum nanocaulis* Broth., *Nat. Pflanzenfam. [Engler & Prantl]* 1(3), 932 (1907) nom. nov. pro *Hepaticina nanocaulis* Müll.Hal. 1902
 Type: N.Z.: "insula australis, litore australasico prope Greymouth", R. Helms, 1885, BM!
- = *Hepaticina pseudo-obscura* Müll.Hal., *Hedwigia* 41: 125 (1902) nom. inval.
 ≡ *Pterygophyllum pseudo-obscurum* Broth., *Nat. Pflanzenfam. [Engler & Prantl]* 1(3), 932 (1907)
 Syntype: N.Z., "insula australis, litore australasico prope Greymouth", R. Helms, 1885, BM!

Plants oily grey-green when fresh, yellow-green to brown, often black in patches or throughout when dry. **Stems** sparsely branched or unbranched, red-brown to black, c. 10–20(–45) mm in terrestrial forms, much longer (to c. 90 mm) in aquatic forms, in cross-section the outermost 4–5 cell layers with thickened walls. **Shoots** to 10 mm wide. **Leaves** inserted in 8 ranks (ranks often obscure in less developed material), imbricate to distant, moderately to strongly crisped when dry, often deciduous, those in dorsal and ventral ranks broadly ovate, those in lateral ranks obovate-spathulate, broadly oblong, or ± elliptic, with broadly rounded or rarely ± acute apices, irregularly and sharply dentate (the teeth often multi-cellular) in upper half or more, rarely nearly entire, 2–6 × 1–3 mm (dorsal leaves smaller); **upper laminal cells** (at level of costa terminus, midway to margin) rather thin walled (2–4 µm at thinnest part), markedly thickened at corners, the exposed (abaxial and adaxial) walls very thin and collapsing when dry, (36–)54–75(–90) µm in greater diam., becoming gradually longer towards base; **marginal cells** somewhat smaller in several rows but not strongly differentiated. **Costa** unequally bifurcate in upper third, c. 80–210 µm wide in lowest third (above basal dilation), the longer branch extending ½ to ¾ (rarely less) the length of the leaf. **Gemmae** frequent on leaf margins of sterile plants, L-shaped or filamentous, to 5 cells and 105 µm long. **Pseudoparaphyllia** to c. 1650 µm long, irregular in outline (lanceolate, ovate, or 2–3-lobed), toothed or ciliate at margins.

Diocious. Perichaetial leaves acute from an oblong base. **Perigonia** globose to ovoid, scattered on ♂ stems, 1.5–2 mm long. **Setae** c. 9–30 mm; **capsules** obovate from a moderately defined neck, (1.5–)1.8–2.8 mm, moderately constricted below the mouth when dry, dark yellow-brown; **operculum** high conic, c. 0.8 mm. **Exostome teeth** variable in length, c. 370–750 µm long (apices often broken), transversely striate, with a furrow c. 20 µm wide near base, and extending c. ¾ the length of the tooth, with strong marginal trabeculae; **endostome segments** c. 180–200 µm long, keeled but not perforate, arising from a high (≥255 µm) basal membrane. **Calyptra** c. 2.0–2.7 mm, smooth, lacerate at base. **Spores** spherical, 12–15(–18) µm.

Illustrations: Plate 1. Streimann 1997, fig. 1; Beever et al. 1992, fig. 69 a–f; Buck et al. 2002, p. 83; Meagher & Fuhrer 2003, p. 33; Seppelt 2004, fig. 69.

Distribution: NI: N Auckland, including offshore islands (TK, HC, LB, GB, RT), S Auckland, Gisborne, Hawke's Bay, Taranaki, Wellington; SI: Nelson (including Stephens I., D'U), Marlborough, Canterbury, Westland, Otago, Southland, St; Sol; Sn; A, C, M.

Austral. Tasmania*, mainland Australia*, Rarotonga*, Argentina (Tierra del Fuego)*, Chile*. Reported from New Guinea by Tan & Robinson (1990). Reported as an adventive from glasshouses and from one garden locality in Cornwall, England, by Smith (2004).

Habitat: Occurring in a wide range of habitats. Most commonly on rock, rotten logs, or soil, and associated with flowing or cascading water. This species often grows submerged. When not closely associated with streams, it usually occurs under damp, shaded forest conditions. It less commonly grows on exposed roots, tree trunks (e.g., *Metrosideros*), and even (rarely) epiphyllously on ferns. In limestone areas it can become encrusted with calcium carbonate deposits. On the North I. occurring from sea level to at least 760 m and on the South I. ascending to c. 1500 m.

Notes: The morphological variability of *A. dentatum* is protean and has led to this species being repeatedly described. A broad view of this species is taken here. The observed variability is clearly related to environmental factors, chiefly water availability. Plants growing in drier habitats (i.e., on rotten logs or shaded soil banks) generally have short stems (rarely more than 20 mm) and imbricate, weakly to moderately crisped leaves of firm texture, which occasionally blacken upon drying. Plants growing in moister conditions exhibit larger stature, more distant, more crisped, and darker (when dry) leaves. Aquatic forms have stems to 60 mm or more and distant, strongly crisped, usually strongly blackened (when dry) leaves. Additionally the laminal cells of aquatic material have thinner walls and the leaf margins are less strongly toothed than terrestrial collections. The tendency for aquatic material to be more strongly pigmented parallels that in some species of *Distichophyllum*. Terrestrial specimens that turn black upon drying are often associated with extremely moist microhabitats.

Robust specimens (with shoots >10 mm wide, lateral leaves >5 mm and neither blackening nor crisping upon drying) are occasionally found and it is this expression to which the name *Hookeria robusta* Hook.f. & Wilson (or its homotypic synonyms) has been given.

Material from the Turitea Stream (Tararua Range, Wellington L.D.) gathered by V.D. Zotov (27 Aug. 1933; CHR 6822) compares well in all morphological features to the type of *Hookeria robusta* and is taken here to represent Dixon's concept of *Pterygophyllum dentatum* var. *robustum* (Hook.f. & Wilson) Dixon.

Material that clearly shows the transition between the strongly crisped and black-pigmented expression characteristic of submerged environments and the less crisped, yellow-green to brown "robustum" expression is not rare, and indeed, some duplicates of the type of *Hookeria robusta* show such transition. Material in N.Z. herbaria showing similar transitions includes *B.H. Macmillan* 72/444 from Reefton (Nelson L.D., CHR 164872), *K.W. Allison* 1581 from Mt Cargill (Otago L.D., CHR 576904), and *J.E. Beever* 22–85 from Great Barrier I. (North Auckland L.D., CHR 104656). Such forms are often associated with seepage and other waterlogged, perhaps boggy, terrestrial situations. The "robustum" growth form of *A. dentatum* appears to be an emergent form associated with seepages.

Other N.Z. names of dubious value are mentioned under 'excluded taxa' above.

Type specimens of Tasmanian, Australian, and South American names have been examined as an incidental part of this study. From Tasmania, the holotype (*Archer* s.n., NY-Mitt.!) of *Pterygophyllum obscurum* Mitt. appears to be an aquatic expression of *A. dentatum*. From mainland Australia, type material ("Sealer's Cove et Steep Bank River", Victoria; *F. Müller* s.n., BM!) of *Hookeria hepaticaeifolia* Müll.Hal. & Hampe and of *Pterygophyllum wattsi* Broth. (Wilson's Creek, Richmond River, N.S.W., *W.W. Watts*, BM!) are likewise referable to *A. dentatum*. Both these mainland names were considered synonyms of *A. dentatum* by Streimann (1997).

I have also referred syntype material (Chile, Port Gallant, *Savatier*, NY-Mitt.!) of *Achrophyllum magellanicum* (Besch.) Matteri to *Achrophyllum dentatum*. South American material has more strongly toothed leaf margins and a greater tendency towards acute leaf apices, providing some justification for recognising *A. magellanicum* at the varietal level. However, after examining c. 50 southern South American (mostly Chilean) collections, I have concluded that too much morphological overlap occurs between South American and Australasian material to permit the recognition of *A. magellanicum* at any taxonomic rank. Material from Banks Peninsula (Canterbury L.D., *B.H. Macmillan* 79/282, CHR 357560) is an example of N.Z. plants with the strongly toothed leaf margins and ± acute apices that are often observed in South American material. Similar material has been seen from Tasmania (*J.D. Hooker* 1360, BM). Argentinian isotype material of *Pterygophyllum magellanicum* var.

oligodontum Matteri (CHR 414453), and other collections so-named by Matteri, are less strongly toothed than most South American material, but unremarkable for the species when considered in a wider geographic context. Matteri's varietal isotype is comparable to the short stemmed, moderately crisped, and non-blackened terrestrial forms of *A. dentatum*, which are common in N.Z.

Etymology: The specific epithet *dentatum* refers to the dentation of leaf margins.

***Achrophyllum quadrifarum* (Sm.) Vitt & Crosby, *Bryologist* 75: 174 (1972)**

≡ *Hookeria quadrifaria* Sm., *Trans. Linn. Soc. London* 9: 277 (1808)

≡ *Leskea quadrifaria* (Sm.) Schwägr., *Sp. Musc. Frond. Suppl.* 1(2), 160 (1816)

≡ *Pterygophyllum quadrifarum* (Sm.) Brid., *Bryol. Univ.* 2, 347 (1827)

≡ *Mniadelphus quadrifarius* (Sm.) Müll.Hal., *Linnaea* 21: 196 (1848)

Type: N.Z., Dusky Bay, 1791, A. Menzies 72, H[ooker] 1514, BM-K! (Material from the Smith herbarium not seen.)

= *Hookeria luteovirens* Colenso, *Trans. & Proc. New Zealand Inst.* 17: 260 (1885) — as *luteo-vivens*
Lectotype: N.Z., "Seventy-mile Bush, County of Waipawa"; 1883–84: *W. Colenso* 4030 (350), BM-K!

= *Hookeria atrovirens* Colenso, *Trans. & Proc. New Zealand Inst.* 21: 46 (1889)
Type: N.Z. Not seen. See note below.

= *Hookeria sexfaria* Colenso, *Trans. & Proc. New Zealand Inst.* 21: 45 (1889)
Type: N.Z. Not seen. See note below.

= *Pterygophyllum quadrifarum* f. *marginata* Sainsbury, *Rev. Bryol. Lichénol.*, n.s. 16: 47 (1947)
Type: N.Z., Little Barrier Island, Summit Track, B. Molesworth 297, 2 Oct. 1945, WELT M 006088!

Plants yellow-green when fresh, usually pale brown or rarely black when dry. **Stems** sparsely branched or unbranched, red-brown, (20–)40–60(–200) mm, in cross section with outermost 5–6 cell layers with moderately thickened walls. **Shoots** (6–)8–14 mm wide. **Leaves** inserted in 8 ranks, imbricate, moderately crisped and pale when dry (often undulate at margins), reviving readily when moistened, those in dorsal and ventral ranks broadly ovate to cochleariform, those in lateral ranks obovate to spatulate, with broadly rounded apices, entire or finely and regularly toothed by projecting cell ends in upper portions (teeth never multi-cellular), (3.0–)4.5–6 mm × (2.0–)2.5–3.5 mm (dorsal and ventral leaves smaller), with individual cells concave and highly reflective when dry, with a pale (often appearing thickened) border formed by 1–3 rows of thick-walled cells; **upper laminal cells** rounded-hexagonal in outline, firm walled (5–9 µm at thinnest part, rarely less), weakly to moderately thickened in corners, the exposed (abaxial and adaxial) walls very thin, collapsed and highly reflective when dry, 60–150 µm in greater diam., becoming gradually longer and ± porose towards base; **marginal cells** markedly smaller and firmer-walled and lacking collenchymatous thickenings in 1–3 rows, forming a moderately defined border in upper portion of leaf. **Costa** unequally bifurcate above or unbranched, c. 100–150 µm wide in lowest 1/3 (above basal dilation), 1/2 to 2/3 the length of the leaf, in cross-section weakly convex on both surfaces, composed of firm-walled, ± isodiametric cells throughout, lacking stereids. **Gemmae** infrequent, L- or T-shaped, c. 6 cells and to 250 µm long. **Pseudoparaphyllia** mostly oblong, tapered to an acute apex, c. 1500 µm long.

Dioicous. **Perichaetial leaves** acuminate from an oblong base, c. 2.0–2.5 mm. **Perigonia** globose to ovoid, scattered on ♂ stems, c. 1.3–1.5 mm long. **Setae** 15–35 mm; **capsules** narrowly ovoid from a wrinkled neck, 1.5–3.2 mm, not or weakly constricted below the mouth when dry, pale yellow-brown; **exothecial cells** oblong, collenchymatous; **operculum** long-rostrate from a conic base, 1.5–2 mm. **Exostome teeth** c. 710–750 µm long, transversely striate, with a furrow 30–36 µm wide near base, and extending c. 3/4 the length of the tooth, with strong marginal trabeculae (projecting to c. 20 µm); **endostome** from a basal membrane c. 300 µm high, segments c. 200 µm long, keeled, not or weakly perforate. **Calyptra** to 3.0 mm long, smooth or sparsely covered (mostly densely at base) with long (to c. 1500 µm), hyaline, transversely-walled hairs, the upper portion covered with large, ± hyaline cells. **Spores** spherical, 12–15(–17) µm.

Illustrations: Plate 2. Brotherus 1925, fig. 600 (as *Pterygophyllum quadrifarum*)

Distribution: NI: N Auckland, including offshore islands (LB, GB), S Auckland, Gisborne (Lake Waikaremoana, Makaretu Stream), Hawke's Bay (Patoka), Taranaki, Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland; St; Ch; A.

Endemic.

Habitat: Generally terrestrial in shaded, moist situations in a variety of forest types, from kauri and podocarp-broadleaf lowland forest to subalpine southern beech forest. On duff, soil, rock, or rotten wood and often in moist situations in/near streambeds or depressions. Often associated with *Schistochila* or *Sphagnum* in wet areas on the forest floor. Less frequently at tree bases (*Agathis australis*, *Prumnopitys ferruginea*) or epiphytic (*Ripogonum*, dead tree limbs). On both main islands it is an uncommon species in drier, eastern regions. It is very poorly documented from the Hawke's Bay L.D., although there are 19th century collections from "Redclyffe" at Norsewood and from "Myrsine Wood" near Dannevirke made by W. Colenso in the 1880s and lodged in WELT. Documented localities from Marlborough, Canterbury, and Otago are generally from areas of higher elevation and relatively high rainfall. On the North I. ranging to at least 1130 m (Mt. Pihanga, Wellington L.D.), and on the South I. ranging from near sea level (Dolomite Point, Nelson L.D. and Oneone River near Hari Hari, Westland L.D.) to at least 1120 m (Mt Euclid, Nelson L.D.).

Notes: *Achrophyllum quadrifarium* exhibits considerable variability in stature, but less in its microscopic features. When well-developed it is a very striking species that is unlikely to be confused with anything else, although inexperienced students often mistake it for an hepatic. The very large laminal cells of *A. quadrifarium* are easily distinguished under a hand-lens, and are made obvious by their thick and weakly collenchymatous walls. Also the exposed (abaxial and adaxial) cell walls are exceedingly thin, apparently lacking in secondary thickenings, and, in dried material, collapse to become strongly concave. This collapse gives the dry leaves a distinctive spongy appearance and causes the cell surface to appear highly reflective. This feature is easily observed in surface view using a hand-lens. The entire or minutely toothed leaf margins and the differentiated marginal cells further differentiate this species from *A. dentatum*. The "conspicuous pale border" cited by Sainsbury (1955) for what he termed the *forma marginata* commonly occurs in this species from all parts of its range.

Hookeria atrovirens Colenso and *Hookeria sexfaria* Colenso are included here in synonymy of *A. quadrifarium* on the basis that Brotherus (1901–1909, p. 933) considered them "kaum spezifisch verschieden" from *Pterygophyllum quadrifarium*.

Achrophyllum haesselianum of Argentina and Chile was compared to *A. quadrifarium* by its author (Matteri 1972, p. 249). It differs by having smaller laminal cells, stronger costae, and more distinctly toothed leaf margins. Its affinities lie with *A. dentatum* rather than with the present species.

Etymology: The specific epithet *quadrifarium* refers to the supposedly four-ranked insertion of the leaves; the leaves appear to be four-ranked when view dorsally, but the insertion is here interpreted as eight-ranked.

***Beeveria* Fife, *Contr. Univ. Michigan Herb.* 18: 142 (1992)**

Type taxon: *Beeveria distichophylloides* (Broth. & Dixon) Fife

Taxonomy: *Beeveria* is a monotypic genus with characteristics of the type species.

Etymology: The generic name honours the N.Z. bryologist Jessica Eleanor Beever.

***Beeveria distichophylloides* (Broth. & Dixon) Fife, *Contr. Univ. Michigan Herb.* 18: 142 (1992)**

≡ *Pterygophyllum distichophylloides* Broth. & Dixon in Dixon, *Bull. Torrey Bot. Club* 42: 106 (1915)
Holotype: N.Z., near Auckland, *D. Petrie* 800, 1892, BM 1109228! Isotype: WELT M001607!
The BM material is best considered the holotype, although it was not designated as such in the publication describing the genus. It was clearly designated in Dixon's hand as the type, and it is unclear from Dixon (1915, publication title notwithstanding) whether any material remains in the Mitten herbarium.

= *Pterygophyllum colensoi* Broth. ex Dixon, *Bull. New Zealand Inst.* 3: 290 (1927) nom. nud.
Type: N.Z., s.loc., *W. Colenso* 3115, BM 1109229!

Plants medium-sized, oily yellow-green when fresh, unchanged or dark green when dry. **Stems** prostrate, sparsely to moderately branched, pale brown to yellow, to 45 mm, in cross-section with a distinct central strand, 2–4 cortical cell layers with moderately thickened walls, and lacking a hyaloderm, densely beset below with pale brown, nearly smooth, and much-branched rhizoids.

Shoots c. 3 mm wide, complanate, often ending in naked, 2–3 mm long pseudopodia and terminated by a cluster of fusiform gemmae. **Leaves** inserted in 6 (or 8?) ranks, strongly crisped when dry, erect-spreading, imbricate, and complanate when moist, not or weakly asymmetric, those in dorsal and ventral ranks scarcely differentiated from those in lateral ranks, broadly elliptic to \pm spatulate, tapered to broadly acute, rounded, or sometimes weakly apiculate apices, plane, not concave, unbordered, entire, (1.0–)1.3–2.5(–2.8) \times 0.5–1.3 mm; **upper laminal cells** smooth, thin-walled (c. 2 μ m at thinnest point), weakly to moderately collenchymatous, hexagonal-isodiametric, 24–42 μ m diam., gradually becoming \pm oblong and non-collenchymatous towards base; **marginal cells** and **alar cells** not differentiated. **Costa** single, rather weakly defined, c. 35–60 μ m wide at mid leaf, dilated in lowest $\frac{1}{3}$ or more, unbranched or with a short distal spur, $\frac{1}{2}$ to $\frac{3}{4}$ or more the length of the leaf, in cross-section biconvex and lacking stereids. **Pseudoparaphyllia** foliose, lanceolate, c. 300–400 μ m long. **Gemmae** borne in a terminal cluster at the apex of a pseudopodium, narrowly fusiform, 160–240 μ m long, with 5–9 transverse septa.

Dioicous. **Perichaetial leaves** ovate-lanceolate, ecostate, c. 1.2 mm. **Perigonia** not seen. **Setae** lateral, 7–11 mm, erect, smooth, red, twisted weakly to the left; **capsules** pendent, symmetric, ovoid from a short, tuberculate neck, 1.0–1.5 mm, weakly constricted below the mouth, smooth when dry, red-brown; **exothecial cells** oblong to isodiametric, firm-walled, rather weakly thickened at corners, 12–18 μ m in greater diam. **Annulus** well-developed, falling with the operculum. **Operculum** long-rostrate from a conic base, c. 0.8 mm long. **Exostome teeth** yellow-brown, c. 400 μ m long, lanceolate with a rather distinct shoulder, bordered, scarcely furrowed (the gap between portions of the tooth <6 μ m wide, extending < $\frac{2}{3}$ the length of the tooth, and not visible with stereoscope), finely cross-striate below and baculate above on outer surface, with lamellae on inner surface that project laterally as very weak marginal trabeculae; **endostome** pale yellow, with basal membrane 100–120 μ m high, segments c. 260 μ m, nearly equalling the teeth, keeled and weakly perforate, papillose, cilia absent. **Calyptra** mitrate, smooth, lobed at base. **Spores** (10–)12–15 μ m, green, finely papillose.

Illustrations: Plate 3. Fife 1992, fig. 1.

Distribution: NI: N Auckland (Maungataniwha Range, Titirangi), S Auckland (Kaimai Range), Gisborne (Marumaru Caves), Hawke's Bay (Waitai Valley near Wairoa, Mohi Bush Scenic Reserve, Waipātiki, Herbertville), Wellington (Pohangina Valley); SI: Nelson (widespread), Marlborough (D'Urville I.), Westland (Punakaikī River, Rapahoe Range, Point Elizabeth); Ch. This uncommon species is also recorded (as *Pterygophyllum distichophylloides*) from a c. 60 m deep, hypermoist limestone chasm at the Mangapū Cave System near Waitomo, S Auckland L.D. by de Lange & Stockley (1987), but this material has not been confirmed.

Endemic.

Habitat: On moist and often deeply shaded rock (usually limestone), less commonly on calcareous clay or marl and often associated with stream margins or beds of intermittent watercourses. Tolerant of highly reduced light conditions. Several collections have been seen from dolines. One collection from the Ōpārara River Valley (Nelson L.D.) grew atop a well-rotted log, an unusual substrate.

Achrophyllum dentatum and *Distichophyllum microcarpum* are frequent associates. Ranging from c. 80–300 m on the North I. and from near sea level (several localities including Fox River, Nelson L.D.) to at least 200 m (Ōpārara River, Nelson L.D.) on the South I. Sporophytes are rare.

Notes: *Beeveria distichophylloides* was originally described in *Pterygophyllum* by Dixon (1915). Two New Zealand species of *Pterygophyllum sensu* Broth. were transferred to the newly described *Achrophyllum* by Vitt & Crosby (1972), who excluded, without elaboration, the present species. Although *Pterygophyllum colensoi* is included as a *nom. nud.* in synonymy by Fife (1992), a more considered reading of Dixon (1927) suggests that he merely acknowledged Brotherus' earlier herbarium annotation of *W. Colenso* 3115 (BM 1109229!).

Both sporophytic and gametophytic features preclude placement of the present species in *Achrophyllum*. The exostome teeth have only a very weak furrow (<6 μ m wide near its base and not visible under the stereoscope). The teeth are short (c. 400 μ m), with short (6–9 μ m) marginal trabeculae in their lower portions, and the endostome segments are perforate. In *A. quadrifarium* (the generitype of *Achrophyllum*) the exostome teeth have a strongly developed furrow 30–36 μ m wide near its base and clearly visible under the stereoscope. Its teeth are more than 700 μ m long, with long (18–24 μ m) marginal trabeculae below, and its endostome segments lack perforations.

The morphology of the gemmae provide further distinction. In *B. distichophylloides* the gemmae are unbranched, narrowly fusiform, transversely septate, and borne in terminal clusters atop a leafless pseudopodium that is reminiscent of the pseudopodia in *Aulacomnium*. In *Achrophyllum* the gemmae are L- or T-shaped, septate, and borne on intra-marginal cells of vegetative leaves.

At Ōpārara River “luminescent” plants of *B. distichophylloides* have been observed, suggestive of *Schistostega pennata* or *Mittenia plumula* protonema, although the reflective glow may have been in part due to moisture droplets on the plants. Closely associated plants of *A. dentatum* did not appear luminescent at this site.

The habitat and presence of gemmae-bearing pseudopodia are probably sufficient for recognition of this plant, but the latter are often absent or difficult to observe. Confusion seems most likely with the more common *Achrophyllum quadrifarium*, but *B. distichophylloides* is generally a much smaller plant with more elliptic or spatulate leaves and much smaller laminal cells (not visible under the hand-lens). Confusion could also occur with *Distichophyllum microcarpum*, but that is generally a much larger plant, forming distinctive layered mats and having a group of conspicuously enlarged juxtacostal laminal cells. Confusion of *B. distichophylloides* with *Distichophyllum pulchellum* seems less likely, despite their similar coloration when fresh.

Etymology: The species epithet means resembling a *Distichophyllum*.

***Calypstrochaeta* Desv., *Mém. Soc. Linn. Paris* 3: 226 (1825)**

≡ *Chaetephora* Brid., *Muscol. Recent. Suppl.* 4, 148 (1818) nom. illeg.

= *Eriopus* Brid., *Bryol. Univ.* 2, 788 (1827) nom. illeg.

Type taxon: *Calypstrochaeta cristata* (Hedw.) Desv.

Plants small to robust, often rather rigid, forming golden, brown-green, or blue-green and usually glossy turves, mostly terrestrial. **Stems** erect or ± stoloniferous and layering, sparsely branched, often with scattered axillary tufts of brown tomentum. **Leaves** in 6 ranks, complanate, distant below, becoming larger and closer above, mostly asymmetric, those of ventral and dorsal ranks ± erect and imbricate, smaller and more symmetric than those of lateral ranks; lateral leaves erect-spreading, oval, spatulate, or obovate, mostly plane at margins, toothed or nearly entire, bordered by a few to several rows of elongated cells; **upper laminal cells** smooth, hexagonal, thin- or firm-walled and usually ± thickened in corners, lax or compact, becoming larger and laxer towards the base; **border** of a few to several rows of elongate and thick-walled cells; **alar cells** not differentiated. **Costa** usually weak and unequally bifurcate near base, sometimes simple (as in *C. brownii*), not extending beyond mid leaf.

Dioicous in N.Z. species, rarely autoicous. **Perichaetia** lateral and often aggregated, with erect, concave, usually ± acuminate leaves. **Perigonia** scattered on ♂ stems. **Setae** lateral, straight or ± flexuose, usually stout, densely spinose, papillose, or sometimes ± smooth, mostly pale brown; **capsules** horizontal to nearly pendent, small and ovoid from a narrowed neck, narrowed below the mouth when dry; **exothecial cells** ± isodiametric, collenchymatous; **annulus** large-celled, falling with the operculum; **operculum** conic-rostrate. **Peristome** double, yellow-brown; **exostome teeth** linear-lanceolate, strongly furrowed, cross-striate below, ± baculate near apex, with high ventral lamellae that project as lateral trabeculae; **endostome** pale yellow, finely papillose, with a high basal membrane and well-developed, perforate segments ± equal the teeth; **cilia** absent, rudimentary, or rarely well-developed. **Calyptra** mitrate, naked or pilose, fimbriate at base, enclosing only the operculum and distal portion of the urn. **Spores** small.

Taxonomy: *Calypstrochaeta* is a genus of c. 30 species (Streimann 2000) distributed mostly in Malesia, Oceania, Australasia, Madagascar, and South America. The species tend to have restricted geographic distributions; four species occur in N.Z.

Calypstrochaeta is a genus of strikingly beautiful plants, characterised by strongly complanate, oval to obovate leaves that are strongly bordered and have weak and bifurcate costae that end below mid leaf. The strong development of spines (less commonly papillae) on the usually fleshy setae is a striking feature of the genus.

Streimann (2000) presented a useful revision of this genus for Australia that treated two apparent endemic species and four species that occur in N.Z. as well as Australia. Matteri (1975b) revised the Andean/Patagonian species (as *Eriopus*) and included one species that occurs in N.Z.

Etymology: The generic name refers to the hairy calyptra (Greek *calyptra* and *chaete*) in the type species.

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|----|--|-----------------------|
| 1 | Plants robust (stems to 80 mm or greater, rarely <30 mm), with lateral leaves often exceeding 4.0 mm; leaves strongly crisped when dry (especially at margins), coarsely and irregularly toothed; upper median laminal cells averaging >45 µm wide | <i>C. cristata</i> |
| 1' | Plants smaller (stems rarely exceeding 25 mm, generally <20 mm), with lateral leaves not exceeding 3.0 mm; leaves not strongly crisped when dry, variously toothed to nearly entire; upper median laminal cells averaging <45 µm wide | 2 |
| 2 | Leaf border <20 µm (usually 12–18 µm) wide at mid leaf; leaf apices broadly obtuse or rounded and with a short, slender apiculus; margins entire | <i>C. brownii</i> |
| 2' | Leaf border >25 µm wide at mid leaf; leaf apices not rounded, strongly apiculate; margins serrulate to spinose, or ± entire (in <i>C. apiculata</i>) | 3 |
| 3 | Margins sharply spinose-serrate; leaf apices slenderly apiculate; border <45 µm (excluding teeth) wide at mid leaf; setae setose nearly throughout, with spines becoming abruptly longer to form a crest immediately below capsules; predominantly an inland species | <i>C. flexicollis</i> |
| 3' | Margins nearly entire to bluntly serrate; leaf apices stoutly apiculate; border c. 45–60 µm (excluding teeth) wide at mid leaf; setae smooth or papillose, lacking a crest of long spines immediately below capsules; predominantly a coastal species in N.Z. | <i>C. apiculata</i> |

Excluded Taxa: The following Colenso and Müller names were placed in synonymy by Dixon (1927, pp. 285–286), who in some cases cited Brotherus (1901–1909) but failed to note the tentative nature of some of Brotherus' comments concerning their identity. There is no identifiable type material of any of these names in the BM (including herb. Dixon) and it is therefore unlikely that Dixon actually saw type material; it is also unlikely that any identifiable type material of the Colenso names is extant. In at least some cases, the currently known distribution of the species into which Dixon subsumed these names suggests that he was incorrect. While most of Dixon's assignments are no doubt correct, it is better to consider these names *nomina dubia*. The name under which they were placed by Dixon is included in square brackets.

Hookeria petrophila Colenso, *Trans. & Proc. New Zealand Inst.* 18: 234 (1886), [*Eriopus cristatus* following Brotherus].

Eriopus helmsianus Müll.Hal., *Hedwigia* 41: 128 (1902), [*Eriopus cristatus* following Brotherus].

Eriopus zuernianus Müll.Hal., *Hedwigia* 41: 128 (1902), [*Eriopus cristatus* following Brotherus].

Hookeria pygmaea Colenso, *Trans. & Proc. New Zealand Inst.* 18: 235 (1886), [*Eriopus flexicollis*].

Hookeria semiserrulata Colenso, *Trans. & Proc. New Zealand Inst.* 21: 45 (1889), [*Eriopus flexicollis*].

***Calypstrochaeta apiculata* (Hook.f. & Wilson) Vitt, *Canad. J. Bot.* 57: 2251 (1979)**

≡ *Hookeria apiculata* Hook.f. & Wilson, *London J. Bot.* 3: 549 (1844)

≡ *Eriopus apiculatus* (Hook.f. & Wilson) Mitt., *J. Linn. Soc., Bot.* 12: 393 (1869)

Holotype: Chile, Hermite I., Cape Horn, J.D. Hooker, *Antarct. Exp.* 1839–1843. ("Wilson 157"), BM-Wilson! Isotypes: BM-K!, NY!

= *Eriopus tasmanicus* Broth., *Öfvers. Finska Vetensk.-Soc. Förh.* 42: 109 (1900)

≡ *Calypstrochaeta apiculata* var. *tasmanica* (Broth.) Fife, *Bryologist* 98: 315 (1995)

Holotype: Tasmania, Hobart Waterworks, "Gentle Annie", *Weymouth s.n.*, 26 March 1894, H! Isotype: HO 79473!

= *Distichophyllum platyloma* Müll.Hal., *Hedwigia* 41: 121 (1902)

Type: N.Z., Stewart I., *T. Kirk* 524, BM!

Plants small to medium-sized, rigid or soft, yellow-, brown-, or bright green, mostly weakly iridescent, forming loose turves. **Stems** sparsely branched, erect, yellow- to red-brown in older portions, 10–20 mm long, in cross-section with a coloured, subcortical region of firm-walled cells, lacking a central strand, c. 200–350 µm diam., with abundant, golden-brown, smooth rhizoids arising at leaf bases. **Shoots** mostly 4–5 mm wide. **Leaves** firm or less often delicate in texture, inserted in 6 ranks, weakly or moderately crisped when dry, becoming more closely overlapping and larger in upper portions, those in dorsal and ventral ranks symmetric, broadly elliptic, those in lateral ranks

asymmetric, elliptic to \pm obovate, tapered to obtuse, stoutly apiculate apices, plane at margins, strongly bordered throughout, entire to irregularly serrate in upper half, (1.5–)1.8–3.0 \times 1.3–2.0 mm; **upper laminal cells** firm-walled, weakly thickened in corners, 30–45 \times 30–36 μ m, becoming gradually larger towards base; **marginal cells** elongate, thick-walled and porose, forming a concolorous border (5–)6–8(–10) cells and (33–)51–75(–80) μ m wide throughout. **Costa** very short to nearly absent, bifurcating at base or less often single, extending to $\frac{1}{2}$ the length of the leaf but generally shorter.

Dioicous. Perichaetial leaves ovate-acuminate, ecostate, unbordered, c. 1.4–1.7 mm (including acumen). **Perigonia** ovoid, c. 1 mm, scattered along σ stem, with outer bracts shaped as perichaetial bracts and inner bracts broadly obtuse and yellow-brown, apparently without paraphyses. **Setae** 5–10 mm, \pm straight, stout (c. 200 μ m diam.), papillose or less often smooth, pale yellow-brown; **capsules** erect to inclined, symmetric, 1.0–1.5 mm, smooth when dry, red-brown; **operculum** not seen. **Exostome teeth** c. 300 μ m long; **endostome** with rudimentary cilia. **Calyptra** not seen. **Spores** 18–24 μ m, smooth.

Illustrations: Plate 4. Sainsbury 1955, pl. 64, fig. 3 (as *Eriopus*); Streimann 2000, fig. 1; Meagher & Fuhrer 2003, p. 33; Smith 2004, fig. 231, 10–11.

Distribution: NI: N Auckland (Piha, Huia) including offshore islands (LB), Wellington (Somes I., Mokopuna I., Pencarrow, Wharekauhau); SI: Nelson (Kaihoka, D'Urville I., Kōhahai Bluff, Three Mile Creek, Dolomite Point), Marlborough (Motuara I., Ship Cove Scenic Reserve, Port Underwood), Canterbury (Banks Peninsula), Westland (near Hokitika, Ōkārito Estuary, Jackson Bay), Otago, Southland (Dusky Sound, Hump Ridge, Bluff Hill); St (widespread); Ch; Sol; Sn; A; Ant; C. Reported from M by Seppelt (2004).

Austral. Tasmania*, Australia*, Marion I.*, Argentina*, Falkland Is.*, Chile*. Adventive in Britain*.

Habitat: Predominantly a coastal species in N.Z., and tolerant of salt spray. In coastal situations growing on sand, humus, or directly on rock (basalt, granite), in stream beds or seeps, and rarely on stumps/logs, or as an epiphyte (on *Olearia* sp.) in coastal scrub. It favours but is not restricted to sheltered vertical banks. In limestone areas it grows on thin humus or debris mats rather than directly on rock. Linzey (in herb.) recorded it from the “round raised bases of *Leptocarpus simplex* [and] *Scirpus nodosus* in salt marsh” and “covering several acres in this habitat” at Aramoana (Otago L.D.). Material from inland sites has been seen from Stewart I. It is a particularly common species on Stewart I. (from which both inland and coastal material has been seen) and apparently also on other offshore southern islands. Mainly restricted to areas of salt spray at low elevations but ranging to 305 m (Dan Rogers Creek, Banks Peninsula) and to c. 860 m at Hump Ridge.

Vitt (1979) recorded it as “common on the Auckland Islands at lower elevations on peaty margins of hummocks and banks. It is particularly characteristic of overhanging banks in association with *Orthodontium lineare*, *Fissidens leptocladus*, *Rhizogonium novae-hollandiae*, and *R. distichum*. [It] is nearly confined to these habitats subject to salt spray.”

Notes: Both perigonia and sporophytes are rare in New Zealand material and, like Sainsbury, I have seen fruit only in material from Stewart I. In Australia, including Tasmania, this species is apparently markedly less coastal in its distribution than in N.Z. It is reported from a wide range of forest and scrub vegetation types in Australia (Streimann 2000; Meagher & Fuhrer 2003).

In Great Britain, *C. apiculata* is recorded from coastal localities in the Isles of Scilly and East Sussex where it is “almost certainly introduced from the southern hemisphere with horticultural plants” (Smith 2004).

Material from inland sites (mostly from Stewart I.) often has leaves that are more delicate in texture, and more iridescent than material from coastal sites. I have previously (Fife 1995) named such material as *C. apiculata* var. *tasmanica* (Broth.) Fife (*Bryologist* 98: 315, 1995) but no longer consider this taxon worthy of recognition. In this I concur with Streimann (2000).

The var. β , proposed by Wilson & Hooker (Wilson 1854, p. 122) has no nomenclatural standing. Wilson & Hooker cite a “single stem only” collected by Colenso on the North I. I have not seen this material, but consider it unlikely to deserve taxonomic recognition.

Etymology: The epithet refers to the apiculate form of the leaf apices.

***Calyptrochaeta brownii* (Dixon) J.K.Bartlett, *Bull. Auckland Bot. Soc.* 15: 15 (1985)**

\equiv *Eriopus brownii* Dixon, *Bull. New Zealand Inst.* 3: 286 (1927)

Holotype: N.Z., Kennedy's Bush, Port Lyttelton Hills, Christchurch, R. Brown, BM-Dixon!

Plants small, soft, usually dark green, moderately iridescent when dry, forming loose, often open turves. **Stems** sparsely branched, erect, red-brown below, 3–12(–25) mm long, in cross-section with a coloured, subcortical region of firm-walled cells, lacking a central strand, c. 200–225 µm diam., with scattered brown, smooth rhizoids below and a dense tuft at the stem base. **Shoots** complanate, c. 2.5–3.0 mm wide. **Leaves** delicate in texture, inserted in 6 ranks, becoming closer and larger acropetally, strongly asymmetric (especially in lateral ranks), not crisped when dry, obovate or broadly elliptic, tapered to broadly obtuse or broadly rounded and mucronate apices, plane at margins, weakly bordered throughout, entire, 1.3–2.1 × 0.7–1.0 mm (often smaller in ventral and dorsal ranks and on lower stem); **upper laminal cells** thin- or firm-walled, not or scarcely thickened in corners, 30–48 × 21–30 µm (l:w c. 1:5), gradually becoming larger basally; **marginal cells** linear, firm-walled and porose, forming a concolourous border 2–3 cells and 12–18 µm wide at mid leaf (rarely to 24 µm in patches and often fading to 1 cell wide near apex). **Costa** single and very short (<1/6 the leaf) or absent, unbranched or rarely ± bifurcating.

Dioicous. **Perichaetial leaves** acuminate from a broadly obovate base, ecostate, not bordered, c. 1 mm. **Perigonia** ovoid, c. 1 mm, scattered on ♂ stems, with bracts shaped as perichaetial leaves, strongly concave, the inner yellow-brown, with 3–6 antheridia and lacking paraphyses. **Setae** 2–6 mm, straight or flexuose, stout (c. 180 µm diam.), with a few hyaline cells forming low mammillae (portions appearing undulate under microscope), pale brown, in cross-section with an ill-defined hyaloderm; **capsules** inclined, symmetric, ovoid, c. 1 mm, smooth when dry, pale yellow-green at maturity, turning red-brown with age. **Operculum** c. 0.5 mm long. **Exostome teeth** c. 300 µm long. **Calyptra** c. 1 mm, smooth above, strongly fimbriate at base. **Spores** 14–18 µm, green, smooth.

Illustrations: Plate 4. Sainsbury 1955, pl. 64, fig. 2 (as *Eriopus*); Streimann 2000, fig. 5.

Distribution: K (Ravine 8); NI: N Auckland, including offshore islands (HC, LB), S Auckland, Gisborne (Lottin Point Road near Potaka, Lake Waikaremoana), Hawke's Bay, Wellington; SI: Nelson (D'Urville I.), Canterbury (Riccarton Bush, Banks Peninsula including Port Hills), Otago (near mouth of Taieri River).

Australasian. Tasmania*. Recorded from mainland Australia by Scott & Stone (1976) and by Streimann (2000).

Habitat: On bark (*Melicytus ramiflorus*, *Podocarpus laetus*), tree fern caudices and bases, exposed roots, rotten wood, also on rocks or soil. Usually or always in deeply shaded, moist situations in mixed broadleaf or mixed broadleaf-podocarp forest and avoiding salt spray. This inconspicuous species can occasionally form rather "extensive turves", as on a sedimentary rock outcrop at the Taieri River mouth. Ranging from near sea level (Little Barrier I.) to 750 m (near Erua, Wellington L.D.) on the North I. and from near sea level (Taieri River mouth) to at least 580 m (Takamatua Valley, Banks Peninsula) on the South I.

Notes: Until Willis (1957) recorded it from Tasmania, *C. brownii* was considered a N.Z. endemic. Both Scott & Stone (1976) and Streimann (2000) have recorded this species from south-east mainland Australia. I have not examined mainland Australian material, but Streimann's description and illustration permit no doubt as to its occurrence there.

Recognition: *Calyptrochaeta brownii* is a well-characterised species and there is little difficulty in its recognition. In a N.Z. context the gametophytic features of entire, narrowly bordered vegetative leaves with rounded and mucronate apices serve to readily identify it. Stunted, epilithic material of *Distichophyllum pulchellum* could possibly be confused with this species, but the longer and clearly bifurcate costa of the *Distichophyllum* provides a means of ready distinction.

Etymology: The epithet commemorates Robert Brown (1820–1906), a remarkable and eccentric shoemaker of Christchurch, who was an avid collector and enthusiastic describer of N.Z. mosses. Dixon (1913–1929) removed an impediment to the progress of N.Z. bryology by studying and often synonymising many of Brown's alleged species.

***Calyptrochaeta cristata* (Hedw.) Desv., *Mém. Soc. Linn. Paris* 3: 226 (1825)**

≡ *Leskea cristata* Hedw., *Sp. Musc. Frond.*, 211 (1801)

≡ *Hookeria cristata* (Hedw.) Hook. & Grev., *Edinburgh J. Sci.* 2: 228 (1825)

≡ *Eriopus cristatus* (Hedw.) Brid., *Bryol. Univ.* 2, 788 (1827)

Type: "Insulae Australes", *J. Banks s.n.*, NY-Jaeger!, BM-Hampe!

= *Eriopus jelinekii* Müll.Hal. in Reichardt, *Reise Novara* 1, 185 (1870)

Type: N.Z., Auckland, *C. Jelinek* 15 (Expedition Novara), BM-Hampe!

= *Hookeria lophophora* Colenso, *Trans. & Proc. New Zealand Inst.* 17: 260 (1885)

Type: N.Z., Napier, *W. Colenso* 4199, WELT M000329!, BM-Dixon!

Plants robust, rigid, yellow-, brown-, or grass-green, weakly iridescent, forming loose, often layered turves. **Stems** erect or \pm stoloniferous and then forming layered turves, sparsely to much branched, yellow, becoming brown in older portions, c. 20–100 mm or more, in cross-section with a coloured, subcortical region of firm-walled cells, central strand weak or lacking, c. 700 μ m diam., with scattered golden-brown, smooth rhizoids arising at leaf bases. **Shoots** mostly 5–8 mm wide. **Leaves** inserted in 6 or 8 ranks, widely spaced below, becoming larger and closely overlapping above, strongly crisped when dry, those in dorsal and ventral ranks \pm symmetric, broadly elliptic to broadly obovate, those in lateral ranks strongly asymmetric, elliptic to broadly obovate, tapered to a broadly acute and weakly apiculate apex, plane at margins, bordered, spiculose-spinose from about mid leaf, 3–6 mm \times 2–3 mm (ventral and dorsal leaves smaller); **upper laminal cells** thin- to firm-walled, moderately thickened in corners, (45–)65–100 \times 42–60 μ m, becoming gradually longer and laxer towards base; **marginal cells** elongate, thick-walled and porose, forming a \pm yellow border 3–5 cells and c. 36–45 μ m wide at mid leaf, and fading towards apex. **Costa** 150–210 μ m wide near base, bifurcating 150–600 μ m above base, the longer half extending $\frac{1}{4}$ to $\frac{1}{2}$ the leaf.

Dioicous. **Perichaetia** lateral, usually aggregated; **perichaetial leaves** acuminate from an ovate to obovate base, ecostate, unbordered, c. 2.5–3.0 mm (including acumen), often notched at the base of a long filiform acumen. **Perigonia** ovoid, c. 1 mm long, scattered along σ stems, with broadly ovate, obtuse, and ecostate bracts, without paraphyses. **Setae** 1 per perichaetium, 6–14(–22) mm, straight below, arcuate near apex, stout, (c. 300–350 μ m diam.), pale yellow-brown, in cross-section lacking a hyaloderm, densely covered throughout with hyaline, single-celled and non-papillose spines to 165 μ m long, with spines becoming abruptly longer (to c. 650 μ m) to form a crest immediately below the capsule; **capsules** pendent, symmetric, 1.7–2.0 mm, smooth when dry, red-brown; **operculum** conic-rostrate, yellow-brown, c. 0.7 mm long. **Exostome teeth** as per genus, 360–600 μ m; **endostome** with segments shorter than the teeth; **cilia** usually absent or rudimentary, sometimes well-developed (to 135 μ m long). **Calyptra** c. 2 mm, covered with hyaline spines above, strongly fimbriate at base. **Spores** 12–19 μ m, smooth.

Illustrations: Plate 5. Hedwig 1801, tab. 49 (as *Leskea*); Brotherus 1925, fig. 599 (as *Eriopus*); Sainsbury 1955, pl. 64, fig. 1 (as *Eriopus*); Beever et al. 1992, fig. 67; Malcolm & Malcolm 2003, p. 11.

Distribution: NI: N Auckland including offshore islands (TK, LB, GB), S Auckland, Gisborne (Cape Runaway, Raukūmara Range, Ruakituri Valley), Hawke's Bay, Taranaki, Wellington; SI: Nelson, Marlborough, Canterbury (Banks Peninsula), Westland, Southland; St.

Endemic.

Habitat: Occurring in a range of forest types, but avoiding drier regions. Most often on rock in moist situations, often at the margins of streams, in seepages, and sometimes submerged in running water. Also occurring on rotten logs and on soil. Ranging from near sea level to c. 790 m (Tararua Range, Wellington L.D.) on the North I., and from near sea level (Fox River, Nelson L.D. and other localities) to at least 450 m (Croesus Track, Westland L.D.) on the South I. There are relatively few collections from Taranaki, Marlborough and Canterbury L.D. The paucity of Taranaki records is almost certainly a collection artefact, but the paucity of collections from Marlborough and Canterbury reflects an avoidance of drier habitats.

Notes: The only published extra-N.Z. record found is that for a “solitary barren stem” from the magellanic Hermite I. cited by Wilson & Hooker (1847, p. 422). The material forming the basis of this record could not be located in the Wilson herbarium. There is a confusing record for this species in Index Muscorum (Wijk et al. 1962, p. 231) citing this species from several geographic regions. No credence is given here to these records, and *C. cristata* is best considered a N.Z. endemic; Matteri (1975b, p. 692) reached an identical conclusion.

Wilson & Hooker (1854, p. 125) described a var. β based on *W. Colenso* 404 from Waikare (probably Gisborne L.D.). Material *in herb.* Wilson (BM) falls within the range of continuous variation of *C. cristata* and this variety is not worthy of recognition.

Recognition: When well-developed and fruiting *C. cristata* is arguably one of the most attractive and most distinctive mosses in the N.Z. flora. It is generally a more robust plant than the equally elegant *C. flexicollis*. The shoots in the present species are broader (to 8.0 mm vs 4.0 mm) and longer (usually \geq 25 mm) than the more delicate *C. flexicollis*. The leaf apices of *C. cristata* are broadly acute and only

weakly apiculate vs the long-apiculate leaf apices of *C. flexicollis*. The broader upper laminal cells, the coarser and less spinose marginal teeth, and the better developed costae also set *C. cristata* apart from the more widely distributed *C. flexicollis*. In the opinion of R.D. Seppelt (pers. comm. Oct. 2016) the possibility that *C. cristata* could be a polyploid taxon derived from *C. flexicollis* could merit investigation.

Sporophyte characters will immediately set it apart from any leafy hepatic, but in the absence of capsules *C. cristata* could possibly be confused with robust hepatics such as some species of *Schistochila*.

Etymology: The epithet means crested and alludes to the conspicuous tuft of spines at the capsule base.

***Calypstrochaeta flexicollis* (Mitt.) Vitt, *Canad. J. Bot.* 57: 2251 (1979)**

≡ *Hookeria flexicollis* Mitt. in Hooker, *Handb. New Zealand Fl.*, 496 (1867)

≡ *Eriopus flexicollis* (Mitt.) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1875–1876: 338 (1877)

Lectotype: N.Z., Otago, Dunedin, wet rocks, *Hector*, October 1862, NY-Mitt.! Isolectotypes: BM-K!, NY!

= *Eriopus brassii* E.B.Bartram, *Farlowia* 4: 246 (1952)

≡ *Calypstrochaeta brassii* (E.B.Bartram) Streimann, *J. Hattori Bot. Lab.* 88: 108 (2000)

Holotype: Australia, Queensland, Mt. Finnigan, c. 3400 ft., *L.J. Brass 20097*, FH-Bart.!

Isotype: WELT-Sainsbury!

Plants medium-sized, rather rigid, yellow- to bright green, not or scarcely iridescent, forming loose turves. **Stems** erect, unbranched, red-brown, c. 5–25 mm long, in cross-section with a coloured, subcortical region of firm-walled cells, lacking a central strand, typically c. 300 µm diam. near base, beset with abundant, pale brown and smooth rhizoids at base and in leaf axils (often giving rise to chlorophyllose filaments with transverse walls in upper portion of stem). **Shoots** c. 3.0–4.0 mm wide. **Leaves** inserted in 6 or 8 ranks, uniformly spaced throughout the stem, moderately crisped when dry, those in dorsal and ventral ranks ± symmetric, broadly elliptic or obovate, those in lateral ranks asymmetric, broadly elliptic or obovate, tapered to strongly apiculate apices, plane at margins, bordered throughout, spinose-serrate or rarely merely denticulate in upper half, 1.5–2.5(–3.5) × 1.0–1.5 mm (often smaller in ventral and dorsal ranks and on lower stem); **upper laminal cells** firm-walled and moderately thickened in corners, 45–60 × 21–27 µm, becoming gradually longer and laxer towards base; **marginal cells** elongate, thick-walled, and porose, forming a concolourous border 3–6 cells and 30–45(–60) µm wide throughout. **Costa** very weak (sometimes absent), bifurcating at base or occasionally single, extending to c. ½ the leaf but generally shorter.

Dioicous. Perichaetia aggregated on ♀ stems; **perichaetial leaves** slenderly acuminate from an obovate base, ecostate, c. 2 mm. **Perigonia** ovoid, c. 1 mm, scattered on ♂ stems, with bracts ovate-obtuse and often retuse at apices, strongly concave, the inner typically yellow-brown, with 3–6 antheridia and lacking paraphyses. **Setae** 3.5–7 mm, straight below, arcuate below the capsule, stout (c. 180 µm diam.), yellow-brown, densely covered throughout with hyaline, non-papillose spines 45–90 µm long, with spines becoming abruptly longer (to c. 900 µm) and articulated by oblique walls to form a crest immediately below capsule; **capsules** inclined to horizontal, symmetric, 0.8–1.2 mm, smooth when dry, red-brown; **operculum** c. 0.5 mm. **Exostome teeth** c. 350 µm; **endostome** with cilia lacking. **Calyptra** c. 1 mm, densely hairy throughout or less often nearly smooth near apex, strongly fimbriate at base. **Spores** 15–21 µm, smooth or nearly so.

Illustrations: Plate 4. Streimann 2000, fig. 7, fig. 3 (as *C. brassii*, but this material not representative).

Distribution: NI: N Auckland (Lake Rotokawau, Tūtāmoe Range), S Auckland (Moerangi), Gisborne (Manuoha, Te Wera Scenic Reserve, Whinray Scenic Reserve), Hawke's Bay (Tarawera Homestead), Taranaki (Dawson Falls), Wellington (Erua, Akatarawa Range, Mt Munro Road, Wainuiomata–Orongorongo water catchment); SI: Nelson (near Collingwood, Reefton, Punakaikī area), Canterbury (Broad Stream, Banks Peninsula, Waimate), Westland (Camp Creek, Kellys Creek, Lake Paringa), Otago, Southland; St; A.

Austral. Tasmania*, mainland Australia*, Argentina*, Chile*.

Habitat: A predominantly inland species growing on a variety of substrates in moist, shaded forests. It is widely distributed but rather infrequently collected in N.Z. It grows as an epiphyte (on *Schefflera digitata*, the podocarp *Prumnopitys ferruginea*, and the palm *Rhopalostylis sapida*), on rocks, soil, exposed roots, and logs in various stages of decay. Confirmed from c. 300 m (Akatarawa Range) to at

least 900 m (Dawson Falls) on the North I., from sea level (Pororari River near Punakaikī and Taieri River mouth, Otago L.D.) to c. 900 m (Broad Stream) on the South and Stewart Is.

Notes: While *C. flexicollis* varies considerably in its stature, its overall aspect is quite distinctive; the combination of its usually modest stature, stout border, spinose-serrate margins, and strongly spinose setae make this beautiful species easily recognised.

Sainsbury (1956) recorded this species from Tasmania. I have confirmed several specimens from Tasmania (in HO) but reject Sainsbury's suggestion that *Eriopus tasmanicus* Broth. is a taxonomic synonym of *C. flexicollis* (it is here considered synonymous with *C. apiculata*). Streimann (2000) recorded *C. flexicollis* from Tasmania and Victoria. The placement here of *C. brassii* in synonymy extends the Australian range northward to include high elevation sites (Mt Finnigan and Mt Bellenden Ker) in Queensland. The leaves chosen for illustration by Streimann (2000, fig. 3, as *C. brassii*) are exceptionally weakly toothed for the species and the Queensland material (including the type) exhibits greater leaf margin variability than is suggested by his illustrations.

This species was first recorded from South America (Aisén Province in Chile) by Cardot & Brotherus (1923); the Halle collection (in UPS) that was the basis of their report has been confirmed. Other Chilean and Argentinian collections have been confirmed, including isotype material (CHR 637792) of *C. odontoloma* (Dusén ex Matteri) Matteri.

Recognition: *Calyptrochaeta flexicollis* is most often confused with the smaller and more common *Distichophyllum rotundifolium*. The latter forms denser and more compact populations and has smaller leaves (0.7–1.3 vs 1.5–2.5 mm), which are denticulate rather than spinose-serrate. The costae in *D. rotundifolium* are mostly unbranched or spurred, and extend $\frac{2}{3}$ – $\frac{3}{4}$ the leaf length in contrast to the bifurcate and much shorter costae of *C. flexicollis*; upper laminal cell dimensions and the nature of their setae also readily differentiate the two species.

Confusion occasionally occurs between *C. flexicollis* and its congener *C. cristata*, but the present species is a less robust plant, with shoots 3–4 mm wide vs 5–8 mm wide in *C. cristata* (other distinctions are noted under the latter species). *Calyptrochaeta flexicollis* is also confused with *C. apiculata* but the narrower leaf border and spinose-serrate margins of the former are usually sufficient to distinguish them. The setae of the non-coastal *C. flexicollis* are strongly spined while the setae of the salt-tolerant *C. apiculata* are smooth or papillose.

Calyptrochaeta flexicollis is distinguished from the South American *C. setigera* (Mitt.) W.R.Buck primarily by its stronger leaf border and its dioicous sexuality.

Etymology: The epithet *flexicollis* alludes to the flexuose upper seta.

Crosbya Vitt, Canad. J. Bot. 55: 2080 (1977)

≡ *Bellia* Broth., *Nat. Pflanzenfam. [Engler & Prantl]* 1(3), 923 (1907) nom. illeg.

Type taxon: *Crosbya nervosa* (Hook.f. & Wilson) Vitt

The following generic description is modified from Vitt (1977).

Plants medium-sized for the family, usually yellow-green above and darker below, lustrous, forming tufts or mats, usually epiphytic and often on small branches. **Stems** prostrate or ascendant, dark brown, soft or wiry, beset below with smooth rhizoids, in cross-section with or without a central strand.

Leaves not differentiated into ranks, loosely imbricate to flexuose-erect when dry, erect-spreading or secund when moist, not or weakly complanate, lanceolate to oblong-lanceolate, acuminate or cuspidate, bordered by several rows of linear cells; **upper laminal cells** firm-walled, smooth, rounded-hexagonal to rounded-rhomboid or elongate rhombic, gradually becoming ± linear towards insertion; **basal laminal cells** larger, ± oblong-hexagonal or linear-rhomboid, firm- or thin-walled, weakly or not porose; **marginal cells** linear and thick-walled, forming a border 3–8 cells wide at mid leaf; **alar cells** not differentiated. **Costa** strong, single, unbranched, percurrent or excurrent and fusing with the border at apex. **Propagulae** sometimes present in axillary clusters, fusiform, and septate.

Dioicous. **Setae** ± flexuose, rather short, red-brown, smooth throughout or scabrous above; **capsules** inclined, oblong-cylindric from a tapered and tuberculate neck; **exothecial cells** isodiametric or subquadrate, strongly collenchymatous, arranged in well-defined longitudinal ranks; **stomata** restricted to neck, superficial; **annulus** apparently absent (not seen); **operculum** long-rostrate from a conic base. **Peristome** double, inserted at mouth; **exostome teeth** yellow-brown, linear-lanceolate, narrowly furrowed, cross-striate below, ± baculate near apex, with high ventral lamellae that project laterally as stout marginal trabeculae; **endostome** pale yellow, from $\frac{3}{4}$ to nearly equal the exostome in length, with a short or high basal membrane, **segments** biseriate or uniseriate, with or without narrow

perforations; **cilia** absent. **Calyptra** mitrate, lacinate-fringed at base, enclosing the entire capsule. **Spores** round or reniform, mostly 20–40 µm, papillose.

Taxonomy: *Crosbya* is an endemic N.Z. genus consisting of two species. Vitt (1977) proposed the generic name *Crosbya* and discussed the history and taxonomy of the genus and its component taxa. The relationship between *Crosbya* and *Daltonia* remains inadequately understood. Both of the species placed in *Crosbya* by Vitt (1977) have well-developed endostomal basal membranes, while *Daltonia* (typified by *D. splachnoides* (Sm.) Hook. & Taylor) lacks an endostomal membrane. However, numerous gametophytic and sporophytic features differentiate *C. nervosa* and *C. straminea* and suggest a closer relationship between *C. nervosa* and *Daltonia splachnoides*. Gametophytic similarities between these latter two taxa include leaf insertion, orientation, shape, and areolation, stem anatomy (both have a central strand), and habit. Additionally, the setae of *C. nervosa* are often weakly scabrous above, as are those of many species of *Daltonia*. Neither a stem central strand nor scabrous setae occur in *Crosbya straminea*. If more detailed study justifies the transfer of *C. nervosa* to *Daltonia* (the combination *Daltonia nervosa* was published by Müller (1850–1851, p. 17)), the generic name *Crosbya* Vitt will become a synonym of *Daltonia* Hook. & Taylor. It is thus unfortunate that Vitt (1977) selected *C. nervosa* rather than *C. straminea* as the type species of *Crosbya*. A typification using *C. straminea* (*Daltonia straminea* Beckett) would have precluded potential nomenclatural confusion. Further investigation of this problem, perhaps using molecular methods, is warranted but beyond the scope of this Flora.

Crosbya is retained in the Daltoniaceae on the authority of Goffinet et al. (2009). According to Buck (pers. comm., 26 Jan. 2008) the peristome differences between genera of Daltoniaceae “seem to mirror habitat choices rather than phylogeny” and he believes that molecular data “strongly hold [the Daltoniaceae] together”.

Etymology: *Crosbya* honours Marshall R. Crosby, a long-time curator of bryophytes at the Missouri Botanical Garden, who maintained an interest in the Hookeriales. Vitt (1977) proposed the generic name *Crosbya* to replace the illegitimate *Bellia* Broth. (a later homonym of a genus of Apiaceae). The familiar name *Bellia*, honouring the N.Z. collector William Bell (Larsen 1971), can no longer be applied to this genus.

- | | |
|----|---|
| 1 | Stems short, mostly <7 mm, with a central strand; leaves erect-spreading when moist, lanceolate, cuspidate-acuminate and asymmetric at apices, mostly 1.3–1.9 mm long; upper laminal cells ± hexagonal, mostly 9–12 µm long; endostomal segments biseriate and narrowly perforate; propagulae not seen and presumably absent; restricted to Auckland and Campbell Is <i>C. nervosa</i> |
| 1' | Stems longer, commonly 20–30 mm, lacking a central strand; leaves secund when moist; leaves oblong-lanceolate, narrowly acute to acuminate and symmetric at apices, mostly 2.0–2.3 mm long; upper laminal cells rounded-rhomboid, mostly 15–24 µm long; endostomal segments uniseriate and not perforate; propagulae frequent in leaf axils, fusiform, and mostly 5-celled; widespread on North, South, and Stewart Is
..... <i>C. straminea</i> |

***Crosbya nervosa* (Hook.f. & Wilson) Vitt, *Canad. J. Bot.* 55: 2081 (1977)**

≡ *Hookeria nervosa* Hook.f. & Wilson, *London J. Bot.* 3: 549 (1844)

≡ *Daltonia nervosa* (Hook.f. & Wilson) Hampe in Müller, *Syn. Musc. Frond.* 2, 17 (1850) nom. illeg. non *Daltonia nervosa* Hook.f. & Wilson 1842

≡ *Bellia nervosa* (Hook.f. & Wilson) Broth., *Nat. Pflanzenfam. [Engler & Prantl]* 1(3), 924 (1907)
Type: N.Z., Auckland Is, *J.D. Hooker* 87, BM. Not seen.

= *Bellia crumii* Vitt, *Bryologist* 74: 466 (1971)

Isotype: N.Z., Campbell I., slopes of Mt Azimuth, on wet rock, *D.H. Vitt* 2401, 4 Jan. 1976, CHR 458091!

Plants rather small, gold- to dark green, tuft-forming, epiphytic and with the habit of a *Daltonia*. **Stems** simple or branched near base, to c. 7 mm, dark brown and soft, in cross-section lacking a hyaloderm, distinct cortical layers and a central strand, sparsely beset below with smooth red-brown rhizoids.

Shoots c. 2 mm wide, not complanate. **Leaves** erect-spreading when moist, crisped when dry, lanceolate, scarcely narrowed at base, cuspidate-acuminate and often asymmetric at apex, inserted

around the stem, neither complanate nor second, bordered throughout, narrowly recurved at both margins, (1.1–)1.3–1.9 mm; **upper laminal cells** firm-walled, smooth, \pm mostly rounded-hexagonal and $9\text{--}12 \times 4\text{--}6\text{ }\mu\text{m}$, little altered at mid leaf; **basal laminal cells** larger, \pm oblong-hexagonal, thinner-walled, and non-porose; **border** 3–5 cells and $20\text{--}25\text{ }\mu\text{m}$ wide at mid leaf, not tapered towards apex. **Costa** c. $30\text{--}35\text{ }\mu\text{m}$ wide in lower leaf, scarcely tapered, excurrent and fusing with the marginal borders to form a stout cusp. **Propagulae** apparently absent. **Paraphyllia** absent.

Probably dioicous. **Perigonia** not seen. **Setae** 6–7 mm, erect-flexuose, smooth below, smooth or sometimes weakly scabrous above; **capsules** weakly inclined, symmetric, oblong-cylindric from a tapered and strongly tuberculate neck, constricted below the mouth when dehiscent and dry, c. 1.3 mm; **exothecial cells** \pm isodiametric, strongly collenchymatous, arranged in distinct longitudinal ranks, weakly bulging (visible under stereoscope) when dry; **stomata** restricted to neck, superficial; **operculum** long-rostrate from a conic base, c. 0.6 mm. **Peristome** inserted at the mouth; **exostome teeth** pale yellow, linear-lanceolate, narrowly furrowed (furrow c. $5\text{ }\mu\text{m}$ wide), cross-striate on outer surface, the inner surface with lamellae that project laterally as stout marginal trabeculae; **endostome** extending c. $\frac{3}{4}$ the length of the teeth, with a basal membrane c. $\frac{1}{3}$ the total endostomal height and biseriate and narrowly perforate **segments** (the segments c. twice as long as the membrane is high); cilia absent. **Calyptra** mitrate, lacinate-fringed at base, enclosing the entire capsule. **Spores** round, c. $18\text{--}27\text{ }\mu\text{m}$, papillose.

Illustrations: Plate 6. Vitt 1977, figs. 11–20.

Distribution: A; C.

Endemic.

Habitat: Mostly on branches and trunks of *Metrosideros umbellata*. Also on *Coprosma* spp. (Vitt 1977) and *Ozothamnus* (*Cassinia*) *leptophyllus* and occasionally on wet rocks. *Crosbya nervosa* has not been recorded outside of the subantarctic islands but its eventual discovery on more exposed parts of Stewart I. seems plausible.

Notes: Sainsbury's concept of *Bellia nervosa* is based primarily on material of *C. straminea* and differs from the concept presented both here and by Vitt (1977).

Based on peristome features, especially the ornamentation of the exostome teeth and the presence of the endostomal basal membrane, this species is treated here as congeneric with *C. straminea*. This accords with the published opinions of Vitt (1977). However, the relationship between *Crosbya nervosa* and the genus *Daltonia* deserves further investigation for reasons outlined above.

Recognition: Sterile material of *Crosbya nervosa* species could very easily be confused with members of the genus *Daltonia*, of which only one species occurs in the N.Z. botanical region. When sterile, *C. nervosa* can be distinguished from *Daltonia splachnoides* by its smaller upper laminal cells (mostly $9\text{--}12 \times 4\text{--}6\text{ }\mu\text{m}$ vs $21\text{--}36 \times 6\text{--}8\text{ }\mu\text{m}$), by leaf borders that are uniform in width throughout the leaf length, and by excurrent costae that fuse at the leaf apices with the margin borders to form stout cusps (vs borders tapered to a single row of cells near the leaf apices and costae ending below the leaf apices in *D. splachnoides*).

Etymology: The species epithet refers to the strong and excurrent (cusp-forming) costa.

***Crosbya straminea* (Beckett) Vitt, *Canad. J. Bot.* 55: 2082 (1977)**

\equiv *Daltonia straminea* Beckett, *Trans. & Proc. New Zealand Inst.* 26: 276 (1894)

\equiv *Bellia straminea* (Beckett) Broth., *Nat. Pflanzenfam. [Engler & Prantl]* 1(3), 924 (1907)

Lectotype: N.Z., Stewart Island, *W. Bell*, January 1889, CHR 602628! Isolectotypes: CHR 602629!, NY! (Lectotype designated by Vitt 1977.)

Plants bright yellow-green when fresh, yellow-green and moderately lustrous when dry, epiphytic. **Stems** much-branched, variable in length, commonly c. $20\text{--}35\text{ mm}$, dark brown and wiry, in cross-section with a core of firm-walled cells, no central strand, and 3–4 outer layers of incrassate and pigmented cells, densely beset below with smooth and pale brown rhizoids. **Shoots** $2.5\text{--}3.5\text{ mm}$ wide, curved away from the substrate, weakly complanate. **Leaves** weakly complanate and second when moist, scarcely contorted, plicate, and sometimes weakly undulate when dry, oblong-lanceolate, moderately keeled, tapered to a narrowly acute or weakly acuminate and symmetric apex, not or only weakly cuspidate, bordered, narrowly recurved at margins, $2.0\text{--}2.3 \times 0.40\text{--}0.60\text{ mm}$; **upper laminal cells** firm-walled, smooth, mostly rounded-rhomboid, mostly $15\text{--}24\text{--}(30) \times 4\text{--}6\text{ }\mu\text{m}$; **basal laminal cells** linear-rhomboid, firm-walled, occasionally weakly porose; **border** at mid leaf of c. 6–8 rows of linear and thick-walled cells, narrowing towards apex and not or scarcely fusing with the costa (poorly

illustrated here), often obscured by the recurved leaf margin. **Costa** mostly 30–40 µm wide in lower leaf, subpercurrent, percurrent, or fusing with border and then appearing short-excurrent. **Propagulae** borne in axillary clusters, fusiform, c. 90–105 µm, transversely septate and mostly 5-celled, on multicellular stalks. **Paraphyllia** lacking.

Dioicous. **Perichaetia** scattered and usually numerous on ventral surface of the ♀ stems, with **inner perichaetial leaves** variable in size and shape, to c. 1 mm, ecostate and faintly bordered, some oblong and obtuse or rounded at apices. **Perigonia** gemmiform, axillary, c. 0.7 mm, strongly pigmented, conspicuous on the dorsal surface of the ♂ stems (which are <10 mm long). **Setae** c. 2.5–4 mm, flexuose, smooth; **capsules** inclined, oblong-cylindric, 1.2–1.8 mm, with an ill-defined and tuberculate neck; **exothecial cells** subquadrate, strongly collenchymatous, arranged in well-defined longitudinal ranks; **stomata** restricted to neck, superficial; **operculum** long-rostrate from a conic base, c. 0.6 mm. **Peristome** inserted at mouth; **exostome teeth** pale yellow, linear-lanceolate, inrolled when dry, narrowly furrowed (furrow c. 5–8 µm wide), cross-striate on outer surface, with lamellae on inner surface that project laterally as stout marginal trabeculae; **endostome** extending nearly the length of the teeth, with a basal membrane equal to the uniseriate **segments**; cilia absent. **Calyptra** mitrate, lacinate-fringed at base, apparently enclosing the entire capsule. **Spores** variable in size in a single capsule, often malformed, when well-formed reniform, 21–40 µm, strongly papillose.

Illustrations: Plate 6. Vitt 1977, figs. 1–10; Brotherus 1925, fig. 593 (as *Bellia straminea*).

Distribution: NI: N Auckland (Waipoua Forest, Tūtāmoe Range), S Auckland, Gisborne (Huiarau Ra, Rākauora Scenic Reserve, several localities near Lake Waikaremoana), Taranaki (several localities at/near Mt Taranaki), Wellington; SI: Nelson (Ōpārara River, Denniston Plateau, Paparoa Range; Pororari River), Westland, Southland (widespread in Fiordland); St (many localities); Ch. Vitt (1977, fig. 22) provided a distribution map; the general pattern he depicted has altered little with more recent collections, except for a northward range extension to include N Auckland L.D.

Endemic.

Habitat: On bark of small trees, shrubs, and lianes; usually on smaller branches and twigs. In wet broadleaf-podocarp and southern beech forests, and wet subalpine and coastal scrub. Occurring on a variety of host genera including *Aristotelia*, *Beilschmiedia*, *Carpodetus*, *Coprosma*, *Fuchsia*, *Griselinia*, *Hoheria*, *Laurelia*, *Melicytus*, *Pseudopanax*, *Pseudowintera*, *Ripogonum*, and *Weinmannia*. Its occurrence as an epiphyte on southern beech is probable, but not documented. From 20 m (Hamilton, S Auckland L.D.) to at least 940 m (Tūroa Road on Mt Ruapehu, Wellington L.D.) on the North I.; from near sea level to at least 600 m (South Branch of Cleddau River, Southland L.D.) on the South I. Frequent close associates include *Cladomnion ericoides*, *Daltonia splachnoides*, *Dichelodontium nitidum*, *Ephemeropsis trentepohlioides*, *Rhaphidorrhynchium amoenum*, *Weymouthia cochlearifolia*, *W. mollis*, and *Metzgeria* spp.

Notes: Perigonia are rarely observed and I have seen them only in a single Westland L.D. collection (A.J. Fife 10588, CHR 592173); the male stems seen are <10 mm long (considerably smaller than most female stems). The apparent rarity of males and the frequent presence of numerous sporophytes in this species is perplexing.

Sainsbury (1955) applied the name *Bellia nervosa* (Hook.f. & Wilson) Broth. to material of *Crosbya straminea*.

Recognition: *Crosbya straminea* is sometimes confused, particularly in the field, with *Glyphothecium sciuroides*. The shoots in the present species are ± complanate and its leaves decidedly secund and c. 0.5 mm wide while the shoots of *G. sciuroides* are not complanate, its leaves weakly or not secund and c. 1 mm wide. *Crosbya straminea* leaves have a strong single costa and a strong border, while those of *G. sciuroides* have weak and double costae and lack a border. The absence of paraphyllia in the present species contrasts with the numerous paraphyllia in *Glyphothecium*. Both species frequently produce capsules and the smooth capsules of the present species contrast with the striate capsules of *G. sciuroides*. *Crosbya straminea* should be readily distinguished from its congener by the features in the key above; it differs from *Daltonia splachnoides* in many ways, including its overall habit (e.g., complanate shoots and secund leaf orientation), leaf areolation, smooth setae, and the presence of a well-developed endostomal basal membrane.

Etymology: The specific epithet *straminea* means straw-coloured and is apt given the yellow-green coloration of both fresh and dry material.

***Daltonia* Hook. & Taylor, *Muscol. Brit.*, 80 (1818)**

Type taxon: *Daltonia splachnoides* (Sm.) Hook. & Taylor

Plants small to medium-sized, lustrous, yellow-green to golden, caespitose, epiphytic. **Stems** erect, simple or branched, several usually arising from a common point. **Leaves** spirally inserted, not in distinct ranks, closely-spaced, symmetric, \pm erect and straight when moist, linear-lanceolate to ovate-lanceolate, acuminate to finely hair-pointed, recurved or plane, bordered; **upper laminal cells** smooth, firm-walled, linear-rhombic, oval to \pm hexagonal, becoming longer, thinner-walled, and oblong or linear-rhombic towards base; **border** of few to several rows of thick-walled and linear cells; **alar cells** not differentiated. **Costa** single, narrow, unforked, ending well below the leaf apex. **Propagulae** sometimes clustered in leaf axils, uniseriate, fusiform. **Axillary hairs** 2–3-celled, the basal cell short and brown, the distal cell/s longer and hyaline.

Autoicous or **synoicous**. **Perichaetia** scattered on stems, inconspicuous, the inner leaves ovate to ovate-lanceolate, acute to acuminate, scarcely bordered, weakly costate. **Perigonia** mostly scattered on bisexual stems. **Setae** lateral, \pm straight, scabrous above or less often hirsute or smooth throughout; **capsules** erect, symmetric, oblong-cylindric to ovoid; **exothecial cells** isodiametric and collenchymatous; **annulus** absent; **operculum** conic-rostrate. **Peristome** double, pale, inserted at the mouth; **exostome teeth** linear-lanceolate, neither bordered nor shouldered, not furrowed, with a \pm straight median line, finely baculate-spiculose throughout, lacking marginal trabeculae, on the inner surface with low lamellae and baculae; **endostome** lacking a basal membrane, segments \pm equal the teeth in length, lacking perforations, baculate throughout; **cilia** absent. **Calyptra** mitrate, lacking hairs, strongly fimbriate at base. **Spores** small.

Taxonomy: *Daltonia* is a genus of 30 or more species which is widespread in tropical and subtropical areas, particularly in moist, high elevation forests. Representatives often grow on twigs. Only one species is recognised in the N.Z. flora, but there are difficulties in interpreting the relationship of *Crosbya nervosa* to this genus (discussed under *Crosbya*).

Buck (1998) characterised the genus by “its erect stems in tufts with singly costate, bordered leaves. The laminal cells are mostly oval and thick-walled. The capsules are erect with pale, spiculose peristomes. The calyptrae are mitrate and ciliate at base.”

Streimann (2000) treated two species of *Daltonia* from Australia and differentiated them largely on the degree of leaf contortion in dry plants.

Etymology: The genus was named in honour of the Rev. James Dalton (1765?–1843), a cleric of Croft in Yorkshire who studied mosses and the genus *Carex*. W.J. Hooker and T. Taylor dedicated their *Muscologia Britannica* (1818) to James Dalton.

***Daltonia splachnoides* (Sm.) Hook. & Taylor, *Muscol. Brit.*, 80 (1818)**

\equiv *Neckera splachnoides* Sm., *Engl. Bot.* 36, 2564 (1813)

Type: Ireland. Not seen.

$=$ *Daltonia novae-zelandiae* Mitt., *J. Proc. Linn. Soc., Bot.* 4: 95 (1859)

Holotype: N.Z., “ravines near Wellington, *Stephenson*”, NY (*vide* Streimann 2000, p. 125).

Probable isotype: N.Z., no data, NY-Mitten!

Misapplications: *Daltonia angustifolia sensu* Sainsbury (1955)

Plants small, yellow-green to golden, forming tufts on small branches or twigs. **Stems** mostly simple, soft, c. 3–6(–10) mm, in cross-section with large and thin-walled internal cells, hyaloderm, distinct cortical layers, and a central strand all absent, beset with finely papillose, red-brown rhizoids. **Shoots** c. 2.5–3 mm wide, neither flattened nor secund. **Leaves** erect and straight when moist, weakly spirally twisted around stem or weakly contorted when dry, weakly or not keeled, neither complanate nor secund, linear-lanceolate, acuminate, recurved at both margins, mostly 1.5–2.5 mm; **upper laminal cells** smooth, firm-walled, linear-rhombic to \pm hexagonal, 21–27(–36) \times 6–8 μ m, becoming gradually longer below (mostly c. 30–38 μ m at mid leaf); **basal laminal cells** \pm linear-rhombic to oblong, thin-walled, non-porose, a single row at extreme leaf base pigmented; **alar cells** not differentiated; **border** of c. 5 rows of thick-walled and linear cells at mid leaf, tapered to a single row near apex. **Costa** single, narrow, unforked, ending well below the leaf apex. **Propagulae** sometimes present in leaf axils, fusiform, c. 100–125 μ m, transversely septate and mostly 5-celled. **Axillary hairs** not seen.

Autoicous. **Perichaetial leaves** ovate, acute, scarcely bordered, weakly costate, c. 0.6–0.7 mm. **Perigonia** scattered on stems, lacking paraphyses, with strongly concave, ovate, \pm yellow bracts, c. 0.7 mm. **Setae** borne laterally, scabrous above, smooth below, c. 3–7 mm, red-brown, weakly

twisted (apparently in either direction); **capsules** erect, symmetric, oblong-cylindric from a distinct and tapered neck, c. 0.6–0.8 mm; **exothelial cells** with bulging cell walls and weakly collenchymatous; **operculum** short-rostrate from a conic base. **Peristome** white or pale yellow under the stereoscope, inserted at the mouth; **exostome teeth** and **endostome** as per genus. **Calyptra** as per genus, enclosing the operculum and c. $\frac{1}{3}$ of the urn. **Spores** variably sized in a single capsule, (12–)14–18(–24) μm , very finely papillose.

Illustrations: Plate 7. Sainsbury 1955, pl. 63, fig. 4. Streimann 2000, fig. 15; Smith 2004, fig. 231, 1–3.

Distribution: NI: N Auckland (Waipoua, Hunua Range), S Auckland, Gisborne (Moanui Conservation Area, Rākauroa Scenic Reserve, Hopuruahine River), Hawke's Bay (Mōrere), Wellington; SI: Nelson, Westland, Otago (Pūrākaunui Falls), Southland (Lake Manapōuri, Milford Sound); St.

Anomalous. Tasmania*. Recorded from mainland Australia (Vic. and Qld) by Streimann 2000.

Recorded from the British Isles (where it is "very rare") and "China, Madeira, Azores, Fernando Pó, western N. America, Mexico, [and] Antilles" by Smith (2004, p. 703). *Daltonia angustifolia* Dozy & Molk. is probably conspecific and is widespread in south-east Asia.

Habitat: Most often collected from twigs and small branches in hyper-moist but insolated scrublands or forest margins. Less frequently on tree trunks or epiphyllous on fern fronds (e.g., *Dicksonia fibrosa*). Host species are varied and include *Aristotelia serrata*, *Carpodetus serratus*, several *Coprosma* spp., *Fuchsia excorticata*, *Hoheria* sp., *Leptospermum scoparium*, *Melicytus ramiflorus*, *Muehlenbeckia complexa*, *Neomyrtus pedunculata*, *Pseudopanax arboreus*, and *Weinmannia racemosa*. Also on nikau palm (*Rhopalostylis sapida*) and cabbage tree (*Cordyline australis*) and recorded from twigs of introduced species of *Crataegus* and *Salix*. On the North I. from c. 140 m to at least 680 m (Rākauroa Scenic Reserve); on the South I. from near sea level (Fox River, Nelson L.D.) to c. 500 m (Duffy Creek, Nelson L.D.). The most frequently associated species are *Tetraphidopsis pusilla* and *Metzgeria* spp.; the wide range of other associated species include *Calypotropogon mnioides*, *Calypstrochaeta flexicollis*, *Cladomnion ericoides*, *Ephemeropsis trentepohlioides*, *Macromitrium* spp., *Alleniella hymenodonta*, *Orthotrichum calvum*, *Rhaphidorrhynchium amoenum*, *Ulota lutea*, *Weymouthia mollis*, and *Leptogium* spp.

Notes: Streimann's (2000) decision to apply the Irish name *D. splachnoides* to Australasian material is accepted here. Streimann (p. 128) expressed the opinion the predominantly Asian *D. angustifolia* would prove to be synonymous with *D. splachnoides*. Although there is considerable variation in vegetative leaf length, I agree with Streimann that there is no clear morphological discontinuity between these two species that would justify taxonomic segregation. Sainsbury and other 20th century N.Z. workers referred the bulk of N.Z. *Daltonia* to *D. angustifolia* Dozy & Molk.

Recognition: *Daltonia splachnoides* is sometimes confused with species of *Crosbya*. *Daltonia splachnoides* is a much smaller, softer, and more delicate plant (stems mostly c. 3–6 mm and fragile) compared to *Crosbya straminea* (stems mostly c. 20–35 mm and rigid). The costae in *D. splachnoides* end well below the leaf apices, while those in *C. straminea* are subpercurrent to short-excurrent. The scabrous setae and erect symmetric capsules here contrast with the smooth setae and inclined capsules in *C. straminea*. In *D. splachnoides* the exostome teeth lack a median furrow, are finely baculate throughout, and lack marginal trabeculae while in *C. straminea* the teeth are narrowly furrowed, cross-striate, and trabeculate at margins. The two taxa also differ in their sexuality and clearly deserve placement in different genera.

Confusion is more likely between *D. splachnoides* and *Crosbya nervosa*. *Daltonia splachnoides* leaves have a narrow costa ending well below the apex, differentiated borders c. 5 rows of cells wide at mid leaf and tapered to a single row near the leaf apex, and erect capsules (c. 0.6–0.8 mm), with a distinct, tapered, and non-tuberculate neck. These features contrast with, in *C. nervosa*, a stout excurrent costa that fuses with the margins to form a cusp, leaf borders 3–5 cells wide at mid leaf and not tapered toward the leaf apex, and weakly inclined capsules (c. 1.3 mm) with a tapered and strongly tuberculate neck. *Daltonia splachnoides* lacks an endostomal basal membrane while *C. nervosa* has a well-developed endostomal membrane. The relationship between these two species deserves further study.

Scott & Stone (1976, pp. 388, 396) suggested *D. splachnoides* could be confused with *Sauloma tenella*. All of the following features of *D. splachnoides* contrast sharply with *S. tenella*: erect stems, linear-lanceolate leaves with non-reflexed apices; much stronger and non-bifurcate costae; upper laminal cell dimensions; capsule orientation; peristome colour and ornamentation; and the nature of the calyptrae.

Etymology: The epithet *splachnoides* is a confusing reference to the northern hemisphere coprophilous genus *Splachnum*. This may be partially explained by the fact that, at the time *Neckera splachnoides* was described, several Hedwigian species that were subsequently transferred to other genera were included in *Splachnum*.

***Distichophyllum* Dozy & Molk., *Musci Frond. Ined. Archip. Ind.*, 99 (1846)**

= *Mniadelphus* Müll.Hal., *Linnaea* 21: 196 (1848) nom. illeg.

Plants small to robust, soft, iridescent or not, usually complanate, mostly terrestrial and often forming layered mats. **Stems** erect or prostrate, sparsely branched, in cross-section lacking a hyalodermis, lacking distinct cortical layers, and lacking a central strand, sparsely beset below with brown to red-brown, ± smooth rhizoids. **Shoots** mostly complanate, but sometimes nearly terete. **Leaves** in 6–8 ranks, widely or closely spaced, mostly symmetric, oval, elliptic, or obovate, apiculate or rounded at apices, mostly plane, entire, bordered or occasionally unbordered (as in *D. microcarpum*), those of ventral and dorsal ranks smaller than those of lateral ranks; **upper laminal cells** smooth, firm-walled, ± hexagonal, compact, becoming larger and laxer towards the base, occasionally inflated and pale adjacent to the lower costa; **alar cells** not differentiated. **Costa** single, narrow, often forked in upper portions, usually ending well below the leaf apex.

Autoicous, dioicous, or rarely synoicous. **Perichaetial leaves** with weak border and costa ± absent. **Perigonia** lateral on stems, gemmiform, bracts with weak border and costa ± absent. **Setae** lateral or ventral (as in *D. microcarpum*), erect, smooth or papillose, mostly red-brown; **capsules** horizontal, pendent, or occasionally nearly erect, symmetric, oblong-cylindric from a tapered neck, smooth or tuberculate; **exothecial cells** collenchymatous, rarely (in *D. microcarpum*) with arching secondary thickenings converging over the lumen; **annulus** narrow and falling with the operculum or absent; **operculum** long-rostrate from a conic base. **Peristome** double; **exostome teeth** yellow to brown-yellow, linear-lanceolate, furrowed, densely and finely cross-striate, with high lamellae on inner surface that project laterally to form marginal trabeculae; **endostome** pale yellow, finely papillose, with a moderate to high basal membrane; **endostome segments** usually well-developed and usually ± perforate; **cilia** rudimentary or absent. **Calyptra** mitrate-rostrate, often hairy, fimbriate at base. **Spores** small.

Taxonomy: A large genus with up to 100 species, distributed mostly in Malesia and Oceania, but with a secondary centre in the cool-temperate regions of the southern hemisphere. Many of the described species are recorded from a single island or land mass. The palaeotropical species are often difficult to distinguish with confidence and the genus needs a large-scale taxonomic revision; it is likely that this would result in drastic reduction of the number of recognised species. Four species occur in N.Z., one with two varieties. The N.Z. species are somewhat anomalous in the genus in that all are dioicous with the exception of the autoicous *D. crispulum* var. *adnatum*. In the intra-generic classification of Brotherus (1925, p. 227) all but one of the N.Z. species (*D. microcarpum*) are placed in the section *Discophyllum*. While a firm case could be mounted on morphological grounds (discussed under that species) for the segregation of *D. microcarpum*, this is not advocated here.

Streimann (1999) presented a revision of seven species occurring in Australia that is useful in N.Z. Matteri's (1975b) earlier monograph of Andean/Patagonian Hookeriaceae also included useful information on this genus, but her species concepts are narrower than those applied here and there is only modest species overlap with N.Z.

The genus *Distichophyllum* was based by Dozy & Molkenboer (1845–1854) on three species, of which two (*D. cuspidatum* and *D. spathulatum*, both from Java) were retained in the genus by Brotherus (1925). One of these two species should be selected as the generic type.

Etymology: The generic name alludes to the seemingly 2-rowed (actually mostly 6-rowed and strongly complanate) arrangement of the leaves in many of the species (Greek *distichos* & *phyllon*).

In the following key and descriptions, the phrase “upper laminal cells” refers to cells midway between the termination of the costa and the leaf margin.

- | | | |
|----|--|---|
| 1 | Vegetative leaves rounded at apex and with or without a small apical apiculus, mostly spathulate but sometimes elliptic | 2 |
| 1' | Vegetative leaves acute and clearly apiculate at apex, never spathulate, mostly elliptic (often broadly so) | 3 |

- 2 **Plants** not iridescent, often with brown secondary pigments; **juxtacostal laminal cells** enlarged and lax to form an ill-defined group extending c. $\frac{2}{3}$ the length of the costa (usually visible under the hand-lens); **marginal cells** neither elongate, nor forming a distinct border; **perichaetial leaves** acute; **capsules** c. 1.0 mm long; **exothecial cells** collenchymatous and with several cylindrical secondary wall thickenings converging over the lumen to form a ribbed vault-like structure *D. microcarpum*
- 2' **Plants** mostly iridescent, usually yellow-green but often with red secondary pigmentation in some or all of the leaf or sometimes nearly black; **juxtacostal laminal cells** in lower leaf not strongly differentiated; **marginal cells** elongate in several rows and forming a distinct border; **perichaetial leaves** obtuse or rounded; **capsules** mostly 1.2–1.8 mm long; **exothecial cells** collenchymatous but lacking a ribbed vault-like structure of secondary wall thickenings *D. pulchellum*
- 3 **Leaves** mostly denticulate in upper half or more, occasionally entire, stoutly bordered, 0.7–1.0(–1.3) × 0.3–0.5(–0.6) mm; **shoots** 1–2 mm wide *D. rotundifolium*
- 3' **Leaves** entire, stoutly or narrowly bordered, 1.0–2.3 × 0.5–0.8 mm; **shoots** c. 3 mm wide 4
- 4 **Dioicous**; **leaves** strongly crisped when dry, obscuring the complanate nature of the shoots, 1.0–1.5(–1.8) mm long; **border** stout, usually 18–30 µm wide at mid leaf; **upper laminal cells** 9–15(–20) × 9–12 µm *D. crispulum* var. *crispulum*
- 4' **Autoicous**; **leaves** weakly to moderately crisped when dry, not obscuring the complanate nature of the shoots, 1.4–2.3 mm long; **border** narrow, 6–12(–15) µm wide at mid leaf; **upper laminal cells** 18–24(–30) × 12–18 µm, often smaller in several rows near margin *D. crispulum* var. *adnatum*

Excluded Taxa: *Distichophyllum aloma* Müll.Hal. (1902) was tentatively placed in synonymy in 1907 with *D. microcarpum* by Brotherus (1901–1909, p. 930). The type specimen (*T. Kirk* 502 from “Ligars Gulley”, Auckland) has not been seen, but is likely in the Stephani herbarium at Geneva.

Hookeria amoena Colenso (1886) and *H. smaragdina* Colenso (1886) are discussed briefly under *D. rotundifolium*.

Hookeria cataractae Colenso (1887) and *H. concinna* Colenso *nom. illeg.* (1886) were both placed by Dixon (1927, p. 282) as synonyms of what is termed here *D. crispulum* var. *adnatum*. Colenso’s type locality (near Norsewood, Wellington L.D.) for both these names is far south of the known distribution of the var. *adnatum*. Therefore Dixon’s synonymies are questionable. However, in the absence of type material, these names are not further discussed here.

Hookeria flexuosa Mitt. in Hooker (1867) and *H. subsinuata* Colenso (1886) were both tentatively placed by Dixon (1927, p. 282) in synonymy with the taxon treated here as *D. crispulum* var. *crispulum*. It is unlikely that Dixon saw type material for these names and their type localities are far south of the confirmed distribution of the var. *crispulum*. Therefore Dixon’s synonymies are questionable, and these names are not further discussed here.

Hookeria microclada Colenso (1886) and *Distichophyllum zuernii* Schlieph. in Müll.Hal. (1902) are both discussed briefly under *Distichophyllum pulchellum*.

***Distichophyllum crispulum* (Hook.f. & Wilson) Mitt., Trans. & Proc. Roy. Soc. Victoria 19: 77 (1882)**

≡ *Hookeria crispula* Hook.f. & Wilson, *London J. Bot.* 3: 550 (1844)

≡ *Mniadelphus crispulus* (Hook.f. & Wilson) Müll.Hal., *Syn. Musc. Frond.* 2, 25 (1850)

Holotype: N.Z., Bay of Islands, “on clay earth at roots of trees”, Aug. 1841, *J.D. Hooker s.n.*, (“Wilson 377”), BM-Wilson! The Wilson herbarium (at BM) contains several duplicates of the type of *D. crispulum*. All are attached to a single sheet, bearing drawings and a handwritten draft of the description that was published in Wilson (1854, p. 122); collectively this material is deemed to constitute the holotype.

Plants small, soft, yellow-green, variably iridescent when dry, forming loose to compact layered mats. **Stems** prostrate to weakly ascendant, weakly to moderately and irregularly branched, pale red-brown

in older portions, to 15 mm or more, in cross-section as per genus. **Shoots** c. 3 mm wide. **Leaves** inserted in 6–8 rows, complanate, slightly asymmetric (especially at insertion), strongly or weakly crisped when dry, broadly elliptic from a narrowed insertion, apiculate, plane, weakly or stoutly bordered, entire, (0.8–)1.0–2.3 × 0.7–1.1 mm; **upper laminal cells** beyond costa firm-walled, slightly thickened at corners, ± hexagonal, compact, becoming larger and laxer towards the base; **juxtacostal cells** not markedly differentiated; **border** of elongate cells well-differentiated, stout or delicate, concolorous. **Costa** concolorous, 20–30 µm wide at mid leaf, widening further at extreme base, unbranched or weakly spurred, extending $\frac{1}{2}$ – $\frac{3}{4}$ the leaf length.

Autoicous or **dioicous**. **Perichaetial leaves** ovate-acuminate, not or weakly bordered, ecostate. **Perigonia** gemmiform, scattered on stems, with cuspidate, ecostate, scarcely bordered bracts, with 1–3 antheridia and lacking paraphyses. **Setae** 3–11 mm, smooth, weakly sinistorse, yellow- to red-brown; **capsules** horizontal to ± pendent, oblong-cylindric from a tapered neck, c. 0.7–1.0 mm, constricted below the mouth when dry, pale red-brown; **exothelial cells** oblong and strongly collenchymatous; **annulus** not seen; **operculum** long rostrate, c. 0.5–0.6 mm. **Exostome teeth** c. 240–270 µm; **endostome segments** uniseriate, c. 150 µm, neither keeled nor perforate. **Calyptra** c. 1.0 mm, hairy above. **Spores** 10–16 µm, green, smooth.

Notes: *Distichophyllum crispulum* is treated here as including one typical (autonymic) and one atypical variety.

Etymology: The epithet *crispulum* is apt, describing the strongly crisped dry leaves in the typical variety.

***Distichophyllum crispulum* var. *adnatum* (Hook.f. & Wilson) Dixon, Bull. New Zealand Inst. 3: 282 (1927)**

≡ *Hookeria adnata* Hook.f. & Wilson in Wilson, Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II, 123 (1854)

≡ *Mniadelphus adnatus* (Hook.f. & Wilson) Reichenhardt, Reise Novara 1, 186 (1870)

≡ *Distichophyllum adnatum* (Hook.f. & Wilson) Broth., Nat. Pflanzenfam. [Engler & Prantl] 1(3), 928 (1907)

Lectotype (designated here): N.Z., Bay of Islands, on *Trichomanes elongatum*, 1841, J.D. Hooker, (“Wilson 378”), BM-Wilson!

= *Distichophyllum integerrimum* Müll.Hal., Hedwigia 41: 122 (1902)

Probable type: N.Z., Waitakere Ranges, Sept. 1882, T.F. Cheeseman, CHR 535616! There is no material of this collection in the Cheeseman collection at AK.

Plants iridescent when dry, forming loose to ± compact mats. **Stems** ± prostrate, moderately and irregularly branched, to at least 15 mm. **Shoots** c. 3 mm wide. **Leaves** weakly to moderately crisped when dry, not obscuring the complanate appearance of the shoot, 1.4–2.3 × 0.7–1.1 mm; **upper laminal cells** firm-walled, hexagonal, (12–)18–24(–30) × 12–18 µm, becoming larger (to 60 µm), laxer, and somewhat more oblong towards insertion; **border** narrow, c. 6–15 µm at mid leaf. **Costa** unbranched or weakly spurred, extending $\frac{1}{2}$ – $\frac{3}{4}$ the leaf length.

Autoicous. **Perichaetial leaves** ovate-acuminate, not or weakly bordered, c. 900 µm long. **Perigonia** gemmiform, scattered on fertile stems, with ± cuspidate, ecostate, scarcely bordered bracts c. 400 µm long. **Setae** 7–11 mm, **capsules** c. 0.8–1.0 mm; **annulus** and **operculum** not seen. **Exostome teeth** c. 240 µm long; **endostome segments** uniseriate, c. 150 µm, neither keeled nor perforate. **Peristome** and **calyptra** as per species. **Spores** 12–16 µm.

Illustrations: Plate 8. Wilson 1854, pl. 43, fig. 4 (as *Hookeria adnata*).

Distribution: NI: N Auckland (Puketi State Forest, Ōmahuta State Forest, Bay of Islands, Waipoua Forest, near Kawerua, Waitakere Ranges) including offshore islands (LB, GB).

Polynesian? Mainland Australia (Qld*), Norfolk I.*, Tahiti*.

Habitat: In shaded, moist sites in warm temperate forest; frequently epiphyllous on *Trichomanes elongatum* (and then mostly without close associates), but also occurring on tree trunks (including *Rhopalostylis*), rotten logs, and shaded soil. When growing terrestrially this variety is sometimes associated with *Mittenia plumula*. The three Queensland and one Norfolk I. collection examined all grew terrestrially.

Notes: Sainsbury (1955) recorded this taxon only from Little Barrier I. but it is here recorded as more widespread in N Auckland L.D.; several collections have been seen from the Far North and from various localities in the Waitakere Ranges.

The conclusions of Dixon (1927, p. 282) and Sainsbury (1955) that *D. adnatum* is best treated as a variety of *D. crispulum* are accepted here; this contrasts to my earlier acceptance of it at species rank (Fife 1995).

Type material (BM!) of *D. nadeaudii* Besch. (1894), as well as non-type Tahitian material collected by Nadeaud (CHR 637818!), can be referred to *D. crispulum* var. *adnatum*.

The lectotype of *Hookeria adnata* bears no collection data beyond "J.D.H." and Wilson's herbarium number, but the protologue allows little doubt that this collection was made in 1841 at the Bay of Islands. The specimen is mounted on several cards with Wilson's handwritten draft description.

Both *Hookeria concinna* Colenso (1886) *nom. illeg.* and *Hookeria cataractae* Colenso (1887) are excluded from the synonymy of *Distichophyllum crispulum* var. *adnatum* for reasons briefly discussed under "excluded taxa" of *Distichophyllum*.

Etymology: The varietal epithet *adnatus* presumably refers to a perceived attachment to the substrate by the prostrate shoots.

Distichophyllum crispulum* (Hook.f. & Wilson) Mitt., Trans. & Proc. Roy. Soc. Victoria 19: 77 (1882) var. *crispulum

Plants not or weakly iridescent when dry, forming rather compact mats. **Stems** weakly ascendant, weakly branched, to at least 10 mm. **Shoots** c. 3 mm wide. **Leaves** strongly crisped when dry, obscuring the complanate nature of the shoot, (0.8–)1.0–1.5(–1.8) × 0.6–0.8 mm, stoutly bordered, entire; **upper laminal cells** beyond costa firm-walled, ± hexagonal, 9–15(–20) × 9–12 µm, becoming larger (to 54 µm) and laxer toward insertion and adjacent to the costa; **border** stout, c. 15–30 µm wide at mid leaf. **Costa** unbranched or weakly spurred, extending $\frac{2}{3}$ – $\frac{3}{4}$ the leaf length.

Dioicous. **Perichaetial leaves** ovate-acuminate, not or weakly bordered, ecostate, to c. 750 µm.

Perigonia gemmiform, scattered on ♂ stems, with cuspidate, ecostate, and scarcely bordered bracts c. 600 µm long. **Setae** 3–6 mm; **capsules** c. 0.7–0.8 mm; **annulus** not seen; **operculum** long rostrate, c. 0.5–0.6 mm. **Peristome** and **calyptra** as per species. **Spores** 10–12 µm.

Illustrations: Plate 8. Wilson 1854, pl. 43, fig. 2 (as *Hookeria crispula*). Streimann's (1999, fig. 1) illustration of *D. crispulum* is drawn in part from *H. Streimann* 52479 (HO 80106), a duplicate of which (CHR 504066) is referable to *D. crispulum* var. *adnatum*.

Distribution: K; NI: N Auckland (Te Huka, Whangaruru North Head, Trounson Kauri Park, Kaukapakapa, Waipoua Forest, Waitakere Ranges) including offshore islands (LB, GB), S Auckland (Coromandel Peninsula), Gisborne (Waihou Bay, Opotiki).

Probably endemic. Sainsbury's (1955, p. 398) statement concerning the distribution of *D. crispulum* is difficult to interpret, but he seemed to consider this taxon to be restricted to northern portions of the North I., an interpretation in agreement with that given here.

Habitat: Restricted to warm temperate forests; growing on moist shaded soil or weathered rock, often beneath canopies of *Agathis australis* or *Beilschmiedia tarairi*. Ranging from c. 20 m (Whangaruru North Head Scenic Reserve) to at least 300 m (Walker Bush Track in Waitakere Ranges) on the North I. The single Kermadec collection grew in pōhutukawa/nīkau forest at an elevation of 451 m.

Notes: *Distichophyllum crispulum* has been reported from mainland Australia by Scott & Stone (1976, p. 390) and by Streimann (1999), who recorded it to be widespread in extreme eastern Australia from the easternmost Victoria northward to the vicinity of Cooktown, Queensland. The few mainland Australia (and one Norfolk I.) specimens that I have seen named as *D. crispulum*, including three named by Streimann, are either better referred to the var. *adnatum* (q.v.) or are clearly *D. rotundifolium*. Scott & Stone (1976, p. 390) also recorded *D. crispulum* from Tasmania. However, Dalton et al. (1991) were unable to confirm its presence on that island and Streimann (1999) did not record it there. All the purported *D. crispulum* in HO has been referred to *D. rotundifolium*. The Archer collections (in BM) cited in Flora Tasmaniae by Wilson (1859) are likewise referable to *D. rotundifolium*. The occurrence of the variety *crispulum* outside of N.Z. is therefore considered doubtful.

Using the characters given in the key to species, all but a small fraction of N.Z. specimens can be confidently named to either this variety or to var. *adnatum*. I concur with Sainsbury that recognition at the varietal, rather than specific, rank is appropriate. The difficulty in distinguishing some material of *D. crispulum* var. *crispulum* from *D. rotundifolium* is discussed under the latter taxon.

Hookeria crispula was aptly compared, at the time of its original description, to the South American *D. dicksonii* (Hook. & Grev.) Mitt. (Mitten 1869). *Distichophyllum dicksonii* is a smaller plant with entire

leaves generally <1 mm long with a much more delicate border and larger upper laminal cells than *D. crispulum*. A marked iridescence in *D. dicksonii* also serves to differentiate it from *D. crispulum* var. *crispulum*.

***Distichophyllum microcarpum* (Hedw.) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 77 (1882)**

≡ *Hypnum microcarpon* Hedw., *Sp. Musc. Frond.*, 244 (1801)

≡ *Pterygophyllum microcarpum* (Hedw.) Brid., *Muscol. Recent. Suppl.* 4, 149 (1818) — as *microcarpon*

≡ *Mniadelphus microcarpus* (Hedw.) Müll.Hal., *Linnaea* 21: 196 (1848)

Type: "Insulae Australes", possibly *J. Banks*. Type neither seen nor designated; see comments below.

= *Hookeria sciadophila* Colenso, *Trans. & Proc. New Zealand Inst.* 17: 259 (1885)

Lectotype: N.Z., Colenso 3395, BM! Isolectotype: WELT M000301!

= *Hookeria maculata* Colenso, *Trans. & Proc. New Zealand Inst.* 18: 284 (1886)

Lectotype: N.Z., Colenso 3042 (632), BM!

= *Distichophyllum microcarpum* var. *homodictyon* Sainsbury, *Rev. Bryol. Lichénol.*, n.s. 18: 113 (1949)

Lectotype: N.Z.: "Otupae [Station], Taihape", E.A. Hodgson 717, March 1934 ("Sainsbury 9113"), WELT M005802!

Plants robust or medium-sized, yellow-green, often tinged with brown (never red) pigments, scarcely altered and not or weakly iridescent when dry, forming rather loose, distinctly layered mats. **Stems** moderately and irregularly branched, brown, to c. 80 mm (rarely as short as 3 mm) long, in cross-section lacking a hyalodermis and central strand, with 3–4 layers of thick-walled, pigmented and ± well-defined cortical cells, beset below with brown, smooth rhizoids. **Shoots** mostly 3–4 mm wide. **Leaves** inserted in c. 6 ranks, complanate, somewhat asymmetric (especially at insertion of lateral leaves), not or little crisped when dry, obovate to oblong-elliptic from a narrowed insertion, broadly rounded at apex, not apiculate, plane, unbordered, finely crenulate throughout, (1.0–)2.5–4.0 × (0.8–)1.1–2.5 mm; **upper laminal cells** firm-walled, irregular to ± hexagonal, 12–18(–21) × (6–)8–10(–15) µm; **juxtacostal cells** greatly enlarged (to c. 120 × 36 µm), lax, ± hexagonal, forming a large but ill-defined group extending c. 2/3 the length of the costa and 1/3 to 1/2 to the margin (clearly visible with a hand-lens); **marginal cells** not elongate, somewhat smaller and more quadrate than adjacent laminal cells but not forming a distinct border. **Costa** yellow-brown, c. 30–75 µm wide in lowest 1/3, unbranched, spurred, or branched near terminus, extending 3/4 or more the leaf length and usually ending 200–350 µm below leaf apex.

Dioicous. **Perichaetia** scattered on ventral surface of stems, with **perichaetial leaves** ovate, acute, ecostate, and c. 800 µm long. **Perigonia** gemmiform, scattered on ♂ stems, with ovate, acute, ecostate bracts c. 650 µm long, enclosing c. 4–5 antheridia, and lacking paraphyses. **Setae** arising from ventral surface of stem and inconspicuous, 5–9(–13) mm, smooth, weakly sinistorse, red-brown; **capsules** inconspicuous (mostly hidden by shoots in fresh material), erect to horizontal, ovoid or obovoid, c. 1 mm long, with a weakly developed neck, not constricted below the mouth when dry, appearing scabrous under hand-lens, dark red-brown; **exothecial cells** ± hexagonal, 30–56 µm in greater diam., with collenchymatous secondary thickenings and (5–)6(–11) columnar arching secondary thickenings that arise from the cell angles and converge on a central point over the lumen to form a ribbed vault-like structure; **annulus** ill-defined; **operculum** rostrate from a conic base, c. 0.7 mm long. **Exostome teeth** c. 360 µm long; **endostome segments** arising from a moderately high basal membrane, equal to the teeth in height (c. 165 µm long excluding the membrane), nearly smooth, narrowly perforate. **Calyptra** mitrate-rostrate, c. 1.0 mm long, smooth at apex. **Spores** 9–12 µm, green, smooth.

Illustrations: Plate 9. Beever et al. 1992, fig. 68 h–i; Malcolm & Malcolm 2006, pp. 184, 238, 266.

Distribution: K; NI: North Auckland, including offshore islands (LB, GB, RT), S Auckland, Gisborne, Hawke's Bay, Taranaki, Wellington including KA; SI: Nelson, Marlborough, Canterbury, Westland (Lake Kaniere, near Fox Glacier, near Franz Josef, Te Naihi River), Otago, Southland; St; Ch; A. Reported from C by Vitt (1974).

Australasian. Tasmania* and mainland Australia (N.S.W.*). Recorded from many localities in Vic. by Streimann (1999) and from eastern parts of S.A. by both Catcheside (1980) and Streimann (1999).

Habitat: Throughout the main islands, from lowland to upper subalpine zones. On the North I. ranging to at least 670 m (Oroua Valley, Wellington L.D.) and on the South I. ranging from 20 m or less (Ship Cove and Napenape Scenic Reserves, both Marlborough L.D.) to c. 1200 m (Mt Owen, Nelson L.D.).

Common substrates include soil banks and rock outcrops, usually those associated with seepages. Also found on rotten logs, and occasionally on rocks in stream beds, and on damp forest litter. It can occur at the mouths of limestone caves or at the bases of dripping limestone outcrops and there often becomes heavily encrusted with lime. It is more common in eastern regions of both main islands than other species of *Distichophyllum* and appears to be an uncommon species in Westland L.D.. Its widespread occurrence in drier and more easterly parts of the South I. (and probably the North I.) is paralleled by its widespread occurrence in southern Australia, where its range extends westward to South Australia.

Notes: Although *D. microcarpum* is highly variable in stature, its inflated group of juxtacostal cells, normally readily seen with a hand-lens, and lack of a leaf border are constant features. The leaf areolation is highly characteristic in *Distichophyllum*. The juxtacostal group often becomes more conspicuous in dried material. When fresh the plants have a distinctive dull and oily appearance and yellow-brown coloration quite unlike any other N.Z. species of *Distichophyllum*. The usually large size of the plants, the pale appearance of the juxtacostal cell region, lack of elongate marginal cells, the placement of the perichaetia on the ventral surface of the stems, and the usual occurrence of this species in seepages make it easily recognisable in the field. In fresh material the sporophytes are inconspicuous and normally not visible until the plants are inverted. The 'ribbed vault' columnar secondary thickenings of the exothecial cells are another striking feature of the species. These ribbed vault thickenings cause the exothecial cells to be strongly mamilliose and hence the dry capsule appears roughened under low magnification. I am unaware of similar exothecial cells elsewhere in the Daltoniaceae or related families. Collectively these features could justify the creation of a monotypic genus to accommodate *D. microcarpum*, but this departure from traditional placement is not advocated here. The distinctiveness of *D. microcarpum* within *Distichophyllum* was recognised by Brotherus (1925) and may be appreciated by perusal of his generic treatment, where it is placed in a small group of dioicous species within the section *Mniadelphus*; all other N.Z. taxa are placed by him in section *Discophyllum*.

The selection of a lectotype for *Hypnum microcarpon* Hedw., *Sp. Musc. Frond.* 244 (1801) is problematic. There is strong reason to believe that the "Insulae Australes" referred to in Hedwig's protologue is N.Z. (Fife 1996). However, there appears to be neither J. Banks nor A. Menzies (the only significant collectors of N.Z. mosses prior to 1801) collections in either BM or the Hedwig-Schwägrichen herbarium at G (Fife 1996). Both the protologue and illustrations in Hedwig (1801, Tab. LIX, 6–8) are uninformative and my earlier suggestion (Fife 1996, p. 46) that typification using Hedwig's illustration would be appropriate is therefore not acted upon here. Hopefully an appropriate lectotype for this Australasian species can be found.

As comments by Brotherus (1925, p. 231) suggest, it is unlikely that any of the species placed by him near to *D. microcarpum* deserve recognition. Three names based on New Zealand types (two described by Colenso and one by Mueller) are considered by Brotherus "kaum spezifisch verschieden"; type material of two have not been located. *Distichophyllum levieri* (Geh.) Broth. is based on material from Mt Wellington, Tasmania. Four specimens so-named by Brotherus, including one from Mt Wellington, have been studied and all are clearly referable to *D. microcarpum*; the type specimen has not been located. *Hookeria subrotunda* Hampe collected from Mt Disappointment (Victoria?) by F. Mueller (Type: NY-Jaeger!), is synonymous. I have seen no material of *D. complanatum* (Hampe) Mitt., which is based on a Victorian type. *Distichophyllum aloma* Müll.Hal. is mentioned under "excluded taxa", above.

Sainsbury's (1949) description of *Distichophyllum microcarpum* var. *homodictyon* emphasises supposedly larger upper laminal cells and less differentiated juxtacostal cells. The upper laminal cells in the type specimen range from 15–21 × 9–15 µm, and fall at the upper end of the range of continuous variation of the species. The degree of differentiation of the juxtacostal cells likewise is not remarkable in the species context. The var. *homodictyon* does not deserve taxonomic recognition.

Etymology: The species epithet meaning small-capsuled is not particularly appropriate relative to the species' N.Z. congeners. The capsules, however, are very inconspicuous given their position on the ventral surface of stems.

***Distichophyllum pulchellum* (Hampe) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 77 (1882)**

- ≡ *Hookeria pulchella* Hook.f. & Wilson, *London J. Bot.* 3: 548 (1844) nom. illeg.
≡ *Mniadelphus pulchellus* Hampe in Müller, *Syn. Musc. Frond.* 2, 23 (1850)
Lectotype: N.Z., Lord Auckland's Islands, *J.D. Hooker*, *Antarct. Exp.* 1839–1843, “Wilson 89”, BM-Wilson! (Designated by Streimann 1999.)
= *Hookeria amblyophylla* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II*, 123 (1854) nom. illeg.
≡ *Distichophyllum amblyophyllum* (Hook.f. & Wilson) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 77 (1882)
Lectotype: N.Z., Port Nicholson, *Sinclair s.n.*, BM-Wilson! (Designated by Streimann 1999.)
= *Hookeria sinuosa* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. III. (Fl. Tasman.) Part II*, 219 (1859)
Lectotype: Tasmania, Arthur's Lakes, 17 Jan. 1845, *Gunn 1652*, BM-Wilson! Isolectotypes: BM-Hooker!, NY-Mitten! (Designated by Streimann 1999.)
= *Mniadelphus kraussei* Lorentz, *Moosstudien*, 163 (1864)
≡ *Distichophyllum kraussei* (Lorentz) Mitt. in Hemsley, *Rep. Challenger, Bot.* 1(3), 200 (1885) — as *Distichophyllum krausii*
Type material: Chile, “prope Corral, puerto de Valdivia”, *H. Krausse s.n.*, NY-Mitten!
= *Hookeria flava* Colenso, *Trans. & Proc. New Zealand Inst.* 21: 46 (1889)
≡ *Pterygophyllum flavum* (Colenso) Paris, *Index Bryol.*, 1052 (1898)
Type material: N.Z., Dannevirke, County of Waipawa, 1888, *W. Colenso E/87*, WELT M003989! & M010374!
= *Distichophyllum pulchellum* var. *parvirete* Sainsbury, *Rev. Bryol. Lichénol., n.s.* 16: 47 (1947)
Holotype: N.Z., Ātiāmuri–Rotorua Road, 17 June 1929, *K.W. Allison 200*, WELT M010368!
Isotype: CHR 464340!
= *Distichophyllum pulchellum* var. *ellipticifolium* Sainsbury, *Rev. Bryol. Lichénol., n.s.* 21: 222 (1952)
Holotype: N.Z., “on more or less swampy floor of beech forest, Longwood Range, Southland”, *W. Martin 875*, WELT M006752! Isotypes: CHR 536479!, CHR 465792!
= *Distichophyllum fuegianum* Matteri, *Fl. Criptog. Tierra del Fuego* 14(9), 20 (1975)
Isotype: Argentina, Tierra del Fuego, Depto. Ushuaia, Paso Garibaldi, *C.M. Matteri 767*, CHR 414362!

Plants medium-sized to robust, soft, yellow-green to red-brown to occasionally nearly black, variably iridescent when dry, forming dense and usually layered terrestrial or aquatic mats. **Stems** ± prostrate, sparsely to densely and irregularly branched, red-brown in older portions, in cross-section as per genus, c. 5–60 mm. **Shoots** mostly complanate, sometimes (in aquatic forms) terete, c. 2 mm wide. **Leaves** either inserted in c. 6 rows and complanate or neither conspicuously ranked nor complanate, symmetric or weakly asymmetric at insertion, mostly strongly crisped when dry (sometimes weakly crisped), usually obscuring the complanate nature of the shoots, variable in outline (broadly obovate, spathulate, lingulate, oblong-elliptic, or occasionally ovate), broadly rounded at apex, often with a small apiculus, weakly narrowed towards insertion, clearly or scarcely concave, plane or reflexed at margins, bordered by elongate concolorous or pigmented cells, entire, (1.0–)1.2–2.0(–2.8) × 0.7–1.0(–1.2) mm; **upper laminal cells** hexagonal (sometimes oblong or ± irregular), firm-walled, (6–)9–18(–24) × (5–)7–16 µm, becoming larger and more regularly hexagonal in mid leaf and larger still (to c. 60 µm) and lax towards insertion; **juxtacostal cells** not differentiated; **border** strongly defined, either 2–5 cells and 15–24 µm wide at mid leaf in terrestrial forms or 27–36 µm at mid leaf in aquatic forms, extending entire leaf length, either concolorous (in terrestrial forms) or red-brown to dark cerise (in aquatic forms). **Costa** concolorous and (9–)12–21(–24) µm wide in lowest ⅓ (in most terrestrial forms) or red-brown to dark cerise and 21–39 µm wide in lowest ⅓ (in aquatic forms), simple or with a lateral spur, reaching ⅔–¾ the leaf length, usually ending 225–400 µm from the apex (or <225 µm in aquatic forms). **Axillary gemmae** rare, filamentous, 150–225 µm and c. 6 cells long, in dendroid clusters arising from rhizoids on the abaxial surface of the leaf base.

Dioicous. Perichaetial leaves ovate-oblong to elliptic, broadly obtuse or rounded apically, often irregularly toothed, variably (usually weakly) costate and bordered, c. 0.5–1 mm. **Perigonia** rarely seen, scattered on ♂ stems, c. 0.8 mm long, with ovate, obtuse, ± apiculate bracts, with several (c. 8) antheridia and lacking paraphyses. **Setae** (7–)10–25 mm, slender and smooth, weakly sinistorse, red-brown; **capsules** horizontal or pendent, oblong-cylindric from a tapered neck c. ¼ the total capsule length, (1.0–)1.2–1.8 mm, constricted below the mouth when dry, red-brown; **exothecial cells** isodiametric or short-hexagonal, strongly collenchymatous; **annulus** apparently lacking; **operculum**

rostrate from a conic base, c. 0.8 mm. **Exostome teeth** c. 350 μm , yellow- or pale brown; **endostome segments** arising from a high basal membrane, \pm equal the teeth in height. **Calyptra** mitrate-rostrate, c. 1.8 mm, smooth above, fimbriate at base. **Spores** 9–18 μm , green, appearing smooth.

Illustrations: Plate 10. Wilson 1854, pl. 43, fig. 3 (as *Hookeria amblyophylla*); Sainsbury 1955, pl. 65, fig. 1; Matteri 1975a, pl. 1 (as *D. kraussei*); Matteri 1975a, pl. 4 (as *D. fuegianum*); Fife & Matteri 1984, fig. 1–4 (mostly spores, as *D. kraussei*), figs 5–6 (spores); Streimann 1999, fig. 11; Malcolm & Malcolm 2003, p. 24.

Distribution: NI: N Auckland, including offshore islands (TK, LB, GB), S Auckland, Gisborne, Hawke's Bay, Taranaki, Wellington; SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland; St; Ch; A; C.

Austral. Tasmania*, mainland Australia*, Argentina (Tierra del Fuego)*, Chile (Magallanes Province)*.

Habitat: This is the most widespread, common, and variable species of *Distichophyllum* in N.Z.; it occurs widely in virtually all forest types in N.Z., ranging from coastal forest to subalpine southern beech-dominated forests and extends into the alpine zone in protected microhabitats. It also occurs in lowland wetlands such as wet dune slacks, and *Typha*-dominated swamps. In forests, *D. pulchellum* is predominantly but not exclusively a terrestrial species occurring on a range of substrates including moist duff, on shaded rocks and outcrops, decaying logs, on tree bases and trunks. It is best developed in moist but not waterlogged sites, but also occurs in ponding areas within forests. In mesic to moist forest habitats its yellow-green and layered mats of very soft, weakly complanate shoots with bordered, spatulate, apically rounded, and loosely ranked leaves are readily recognisable. Such plants characteristically lack secondary pigmentation and have narrow costae (mostly $<24 \mu\text{m}$ in lowest $\frac{1}{3}$) and narrow leaf borders (15–24 μm wide at mid leaf). Stem length is extremely variable, ranging from c. 5 to c. 50 mm, with irregular branching. The species also occurs in waterlogged sites (e.g., lake or tarn margins), as well as in swiftly flowing rivulets and waterfall margins in subalpine and lower alpine zones. One aquatic collection from a depth of 25 m in either Lake Rotoroa or Lake Rotoiti (Nelson L.D.) has been seen. It occurs in plantations of exotic trees as well as in native forests. *Distichophyllum pulchellum* assumes characteristic growth forms in some of these habitats (as discussed in greater detail below), some of which have been taxonomically described.

On the North I. *D. pulchellum* s.l. ranges from near sea level (near Wairoa, Hawke's Bay L.D.) to greater than 1200 m elevation (Mt Taranaki and Mt Ruapehu) and on the South I. from near sea level (Measly Beach, Otago L.D.) to at least 1580 m (Mt Arthur, Nelson L.D.).

Notes: *Distichophyllum pulchellum* is extremely catholic in its habitat preferences and correspondingly variable in its morphology. Several infra-specific taxa have been proposed, but none are accepted here as having taxonomic value. The South American name, *D. kraussei*, which has been widely applied in N.Z., is likewise regarded as unworthy of taxonomic segregation. The great range of morphological variation of *D. pulchellum* correlates with environmental factors, particularly water availability, flow rates, and light intensity.

When *D. pulchellum* occurs in insolated and waterlogged habitats, it often assumes a characteristic growth form, with the shoots terete (rather than loosely complanate) and leaves oblong-elliptic (rather than \pm spatulate) and not in clear ranks on the stem. The borders (at mid leaf) in such material are 18–30 μm wide, the costae are 21–30(–36) μm wide below and all these structures lack (or have minimal) secondary pigmentation. This growth form has been described from Southland L.D. as var. *ellipticifolium* Sainsbury (1952) and occurs widely throughout the main islands from sites near sea level to in excess of 1300 m elevation. Plants growing in non-flowing water usually do not develop strong secondary pigmentation although exceptions do occur (e.g. *G.B. Huang* 179 from the margin of Lake Cobb, Nelson L.D., CHR 462705). The features that distinguish it from more representative *D. pulchellum* are taxonomically trivial and a range of intermediates occur. The variety *ellipticifolium* is not recognised but is considered as an environmentally induced growth form.

Sainsbury (1947) applied the varietal name *parvirete* to plants of *D. pulchellum* with smaller-than-normal upper laminal cells. The type specimen of the variety (from South Auckland L.D.) has upper laminal cells of $6\text{--}11 \times 5\text{--}9 \mu\text{m}$, with considerable variation between leaves. These dimensions lie near the lower end of a continuous range of variation for *D. pulchellum*. These smaller leaf cell dimensions occur in specimens from throughout N.Z. and are correlated with thicker cell walls and strongly crisped leaves. The continuous nature of the variability precludes recognition of the var. *parvirete* Sainsbury. H.N. Dixon was apparently of the same opinion when he wrote to Sainsbury (4 Jan. 1935) stating that the type specimen of the var. *parvirete* was merely an “extremely small” celled form of *D. pulchellum*.

Distichophyllum pulchellum also occurs on submerged rocks or gravels in or at the margins of swift subalpine streams and in adjacent flushes. Plants from such habitats develop broader leaf margins and costae, usually with strong secondary pigmentation. The secondary pigments often suffuse the

walls of the laminal cells rendering the entire plants cerise to nearly black. The individual shoots are terete, with the plants usually forming \pm pendent, layered mats. The leaf borders are usually 27–36 μ m wide at mid leaf and the costae are mostly >30 μ m wide in their lowest third, but with extreme values overlapping with terrestrial plants. The costae in such plants tend to end closer to the leaf apex than those in representative terrestrial plants. Stoutly bordered and highly pigmented plants from high energy aquatic habitats often have eroded leaves on the lower shoots, sometimes with only the costae persisting. When viewed in isolation such aquatic material is distinctive and has been treated in both N.Z. and South America (Fife & Matteri 1984; Matteri 1975a) as *D. kraussei* (Lorentz) Mitt. Streimann (1999), studying Tasmanian material, rejected the value of the distinguishing features used by Fife & Matteri (1984) to segregate *D. kraussei*. New Zealand plants exhibiting these features occur largely near to or west of the Main Divide on the South I., to elevations of c. 1400 m. Examination of large numbers of specimens (particularly those made since the 1980s) from a wide elevational range on all three main islands shows that intermediates occur for all these features, and the distinction between terrestrial forms of *D. pulchellum* and the alleged N.Z. *D. kraussei* has become increasingly blurred. Accordingly, and following examination of South American material including the type, *D. kraussei* is considered to be a growth form and a taxonomic synonym of *D. pulchellum*. The absence of records of *D. pulchellum* s.s. from South America then invites explanation. Isotype material (CHR 414362) of *D. fuegianum* Matteri (1975b) is in my opinion referable to *D. pulchellum*, notwithstanding her statement in the protologue that the former is monoicous. However, further investigation of this question is beyond the scope of this Flora.

Dendroid clusters of axillary filamentous gemmae can very rarely be found in *D. pulchellum*, and these are similar to those Sainsbury (1952) described for the so-called var. *ellipticifolium*.

Mniadelphus pulchellus Hampe in Müll.Hal. is the earliest legitimate name for the present species, but Müller (1850–1851, p. 23) cited *Hookeria pulchella* Hook.f. & Wilson (1844) as an earlier published name. The 1844 name, however, is an illegitimate homonym preceded by the Indian *Hookeria pulchella* Griff.

Distichophyllum zuernii Schlieph. in Müll.Hal. (1902) and *Hookeria microclada* Colenso (1886) were both placed in the synonymy of *D. amblyophyllum* by Dixon (1927, p. 283), who saw type material of the former, but not the latter. Types of these names have not been seen for this treatment, but little purpose would be served by questioning Dixon's synonymies.

Dixon (1927) took a narrower view of *D. pulchellum* than the one proposed here. He differentiated *D. amblyophyllum* from *D. pulchellum* on the basis that the former had leaves broader above, and leaf margins generally reflexed, quite obtuse or rarely with a minute apiculus. Dixon allowed for insufficient variability within the protean *D. pulchellum*.

Etymology: The epithet *pulchellum* means pretty. The disused epithet *kraussei* commemorates Dr Hermann Krausse, who collected plants in Chile in 1860. The disused epithet *amblyophyllum* means blunt-leaved.

***Distichophyllum rotundifolium* (Hook.f. & Wilson) Müll.Hal. & Broth., Abh. Naturwiss. Vereins Bremen 16: 506 (1900)**

≡ *Hookeria rotundifolia* Hook.f. & Wilson, *London J. Bot.* 3: 551 (1844)

≡ *Mniadelphus rotundifolius* (Hook.f. & Wilson) Müll.Hal., *Syn. Musc. Frond.* 2, 21 (1850)

Holotype: N.Z., "Bay of Islands, on stumps of trees", no date (presumably Aug. 1841),
J.D. Hooker, ("Wilson 376"), BM 001109144!

= *Hookeria trichophora* Colenso, *Trans. & Proc. New Zealand Inst.* 17: 259 (1885)

Holotype: N.Z. "in patches on rotten trunks, deep and wet forests, Norsewood, County of Waipawa; 1884", *W. Colenso*, WELT M000310! Probable isotypes: NY-Mitten!, BM 001109152! The BM material bears a collection data of Dec. 1885, which is later than the May 1885 publication date. However, it is labelled as *Hookeria trichophora* Col. in Colenso's script.

= *Distichophyllum crenulatum* Müll.Hal., *Hedwigia* 41: 121 (1902)

Type: N.Z., prope Greymouth, 1885, *R. Helms*, BM 001109154!

Plants small, yellow-green to bright green, weakly or not iridescent when dry, forming dense, compact and layered mats. **Stems** moderately and irregularly branched, red-brown, to c. 10 mm (rarely 20 mm). **Shoots** 1–2 mm wide. **Leaves** inserted in c. 6 ranks, \pm symmetric, weakly complanate, strongly crisped when dry (and then obscuring the complanate nature of the shoot), orbicular-elliptic from a narrowed insertion, strongly apiculate at apex, plane, stoutly bordered, denticulate in upper half or

more, occasionally nearly entire; $(0.5\text{--}0.7\text{--}1.0\text{--}1.3) \times 0.3\text{--}0.5\text{--}0.6$ mm; **upper laminal cells** firm-walled, rhombic to \pm hexagonal, $(8\text{--}10\text{--}15\text{--}18) \times 9\text{--}12\text{--}(15)$ μm , becoming larger (to 54 μm in greater dimension), laxer and more oblong towards the base; **juxtacostal cells** not to moderately differentiated; **border** of elongate cells stout, extending from insertion to apiculus, c. 15–21 μm wide at mid leaf, concolorous. **Costa** concolorous, c. 13–18 μm wide below, unbranched, weakly spurred or rarely branched above, extending $\frac{2}{3}\text{--}\frac{3}{4}$ the leaf length and usually ending 200–330 μm below the base of the apiculus.

Dioicous. Perichaetial leaves acute-cuspidate, ecostate, weakly bordered, c. 900 μm long.

Perigonia gemmiform, scattered on σ stems, lacking paraphyses, with ovate, acute to stoutly acuminate, ecostate, and scarcely bordered bracts c. 500 μm long. **Setae** 4–10 mm, smooth, weakly sinistorse, red-brown; **capsules** inclined to horizontal, oblong-cylindric from a tapered neck, c. 1 mm, constricted below the mouth when dry, pale red-brown; **exothecial cells** oblong to isodiametric, collenchymatous; **annulus** not seen; **operculum** rostrate from a conic base, c. 0.5 mm. **Exostome teeth** c. 210 μm , otherwise as per genus; **endostome segments** conspicuous when dry, arising from a high basal membrane, equal to or slightly longer than exostome teeth, perforate. **Calyptra** mitrate-rostrate, c. 1.0 mm, hairy above. **Spores** 9–15 μm , green, smooth.

Illustrations: Plate 11. Brotherus 1925, fig. 596; Matteri 1975b, pl. 4; Streimann 1999, fig. 13.

Distribution: K (Ravine 8); NI: N Auckland, including offshore islands (TK, LB, GB), S Auckland, Gisborne, Hawke's Bay, Taranaki, Wellington; SI: Nelson, Marlborough (Haldon Hills, Endeavour Inlet), Canterbury (near Mt Peel Station), Westland, Otago, Southland; St; Ch; A; Sol; C.

Austral. Tasmania*, mainland Australia (Vic.)*. Additionally reported from N.S.W. by Streimann (1999) and from Argentina and Chile by Matteri (1975b).

Habitat: Occurring from lowland forest to the subalpine zone, this species is catholic in its substrate preferences. It commonly grows on logs in a wide range of decay, and on damp soil banks, usually in shaded situations. It also occurs on tree trunks and branches and rarely grows as an epiphyll (sometimes on fern fronds). It can occupy thin soil over a wide variety of rock types (including limestone) and may be found on rocks submerged in swift or cascading (usually small) streams. It is far more common in the wetter parts of the country and occurrences in the drier parts of the South I. are rare. From near sea level to c. 900 m (Mt Taranaki, Taranaki L.D.) on the North I. and from near sea level to c. 1025 m (Hope Range, Nelson L.D.) on the South I.

Notes: *Distichophyllum rotundifolium* is an extremely attractive species occurring on a wide range of substrates. Once its distinctive combination of small size, usually terrestrial habitat, and strongly crisped, orbicular-elliptic, strongly apiculate, and stoutly bordered leaves is known, this species is easily recognised. The marginal toothing is usually barely visible under the hand-lens, and is sometimes absent. The species can develop longer-than-normal stems when growing on rocks in stream beds.

Dixon (1927, pp. 281–282), placed *Hookeria amoena* Colenso and *H. smaragdina* Colenso (both published in *Trans. & Proc. New Zealand Inst.* 18, 1886) in the synonymy of *D. rotundifolium*. Dixon based his decision concerning *H. amoena* on his interpretation of Colenso's description and he did not see type material. He gave no reason for his decision regarding *H. smaragdina*. No identifiable type material has been available for study (including in BM) but little would be gained by questioning Dixon's proposed synonymy.

Recognition: Several non-fruiting collections from Taranaki and Nelson L.D. are difficult to confidently assign to either *D. rotundifolium* or *D. crispulum* var. *crispulum* using available features, and suggest that further study is required to clarify the relationship between the two taxa, both of which are dioicous. The endostome segments of the two taxa appear to differ, with those of *D. rotundifolium* perforate and those of *D. crispulum* non-perforate. *Distichophyllum rotundifolium* as conceived here is a smaller plant with shoots ≤ 2 mm (vs c. 3 mm) wide. The leaves of *D. rotundifolium* are narrower ($0.3\text{--}0.5\text{--}0.6$) vs $0.7\text{--}1.1$ mm) and usually shorter (not or scarcely exceeding 1.3 mm vs $1.0\text{--}2.3$ mm long), but these size ranges are not discrete. *Distichophyllum rotundifolium* usually has denticulate leaf margins, while *D. crispulum* leaf margins are invariably entire. The distinction between the two taxa is obscured by some collections (mostly in WELT), but the two taxa are retained here as distinct pending further study. If these taxa were to eventually prove synonymous it is unclear which would have priority (the basionyms of both were published in 1844).

Distichophyllum rotundifolium is sometimes confused with *Calypstrochaeta flexicollis*; the features that readily separate them are discussed under the latter species.

Etymology: The epithet *rotundifolium* is an apt description of the leaf shape in this species.

***Ephemeropsis* K.I.Goebel, *Flora* 76: 98 (1892)**

= *Archepheeropsis* Renner, *Ann. Jard. Bot. Buitenzorg* 44: 88 (1935)

Type taxon: *Ephemeropsis tjibodensis* K.I.Goebel

Plants minute, yellow- or red-brown, forming epiphytic mats on twigs or leaves. **Protonema** persistent, forming dense wefts; primary protonema with oblique walls, with or without fan-shaped holdfasts; secondary protonema erect, branching dichotomously, with transverse walls, with or without elongate terminal assimilative filaments. **Shoots** reduced to minute ♂ and ♀ buds arising from the primary protonema. **Vegetative leaves** absent.

Dioicous or **autoicous** (with ♂ and ♀ buds arising from same primary protonema). **Perigonia** and **perichaetia** reduced to minute, globose or ellipsoid buds arising from the primary protonema. **Setae** straight or nearly so, smooth; **capsules** small, erect or nearly so, campanulate or oblong-turbinate, with a distinct sterile neck; **exothelial cells** with or without thickened transverse walls, collenchymatous (in N.Z. species) or not; **stomata** present or absent, cryptopore or phaneropore; **annulus** poorly differentiated; **operculum** rostrate from a conic base. **Peristome** double; **exostome teeth** 16, linear-lanceolate, yellow-brown, outer surface transversely striate, inner surface with numerous low trabeculae; **endostome** with a basal membrane; **endostome segments** present or lacking; **cilia** lacking. **Calyptra** mitrate, smooth above, finely lacinate at base. **Spores** oblong or fusiform, unicellular or multicellular with transverse septa, green, smooth.

Taxonomy: A genus of two species, one in Malesia and tropical south-east Asia and the other in Australasia. It is renowned for its highly simplified gametophytes, which are associated with morphologically complex sporophytes, and for its remarkably small size. The genus has attracted a high degree of morphological interest, particularly by German morphologists of the late 19th and early 20th centuries (Goebel 1892; Fleischer 1899; 1908; 1929; Renner 1935), since its type species was collected in Java in the 1890s.

A second wave of interest in the genus was provoked by K.W. Allison's discovery in 1928 of the plant that was eventually named as *E. trentepohlioides* on the volcanic plateau near Ātiāmuri, South Auckland L.D. (Dixon 1928; Renner 1935; Sainsbury 1951).

The generic placement of the N.Z. species treated here as an *Ephemeropsis* is problematic; this species has been plausibly placed in a segregate genus *Archepheeropsis* by Renner (1935), who argued (p. 88) that the superficial similarity of the two taxa is a result of convergent reduction in a hookeriaceous ("Hookeriaceen") group. Goffinet et al. (2009) recognised only the genus *Ephemeropsis*, which they place in the Daltoniaceae. The appropriate generic treatment cannot be resolved using morphological characters alone and needs to be considered in the context of the Daltoniaceae as a whole, probably using morphological and molecular or other non-traditional methods. For now it seems preferable to follow the generic assignment used by Sainsbury (1955) and hence most familiar to Australasian workers. The following morphological observations highlight the differences between the Australasian *E. trentepohlioides* and the Malesian *E. tjibodensis*.

The sporophytes of the Australasian species are more common than, and differ by many features from, those of the Malesian *E. tjibodensis*. The capsules of *E. trentepohlioides*, while longer (0.5–0.7 mm) than those of the Malesian species (c. 0.3–0.5 mm), have peristomes and stomata that are more difficult to observe microscopically. Exothelial cells in *E. trentepohlioides* have thin walls with collenchymatous thickenings while in *E. tjibodensis* exothelial cells have thickened and curved transverse walls and lack thickened corners. The peristome teeth of *E. trentepohlioides* are c. 150 µm long, not furrowed, strongly reflexed when dry, and have a median zigzag line extending either c. 1/3 the tooth length or absent altogether. By contrast the teeth of *E. tjibodensis* are c. 210 µm long, erect when dry, furrowed for c. 2/3 of their length and have a median zig-zag line extending nearly to the apex. In transverse section a peristome tooth of *E. trentepohlioides* has the inner layer thicker than the outer layer (c. 18 µm thick vs. c. 3–4 µm thick), in contrast to that of *E. tjibodensis* where the teeth have inner and outer layers of approximately equal thickness. In *E. trentepohlioides*, the inner layer in surface view is roughly equal in width to the outer layer at mid tooth, while in *E. tjibodensis* the inner layer is considerably narrower than the outer layer at mid tooth. In *E. trentepohlioides*, the endostomal basal membrane is highly reduced or absent with nil segments, while in *E. tjibodensis* the basal membrane is present (commonly c. 87 µm high) and the segments are well-developed (from c. 3/4 to nearly equal the height of the teeth and narrowly perforate). Cilia are absent in both species. Stomata in *E. trentepohlioides* are exceedingly difficult to observe, cryptopore, and either few and scattered or none at the capsule base, while those of *E. tjibodensis* are relatively easily observed, phaneropore, numerous, and arranged in a single transverse row. In *E. trentepohlioides* the spores are mostly transversely septate, whereas those of *E. tjibodensis* are unicellular. *Ephemeropsis trentepohlioides* has a more compact protonemal weft than *E. tjibodensis*. The protonema of *E. trentepohlioides* lacks

both the holdfasts (“Hapteren”) described by Renner (1935) and Fleischer (1908) and the elongate terminal protonemal filaments (“Assimilatoren”) described by Renner (1935) that are characteristic of *E. tjibodensis*. *Ephemeropsis trentepohlioides* is autoicous (with ♂ and ♀ gametangial buds connected by protonemal filaments), while my observations tend to confirm Fleischer’s (1908) statement that *E. tjibodensis* is either dioicous or occasionally apparently monoicous.

Etymology: The generic name means appearing like *Ephemerum*, an unrelated moss genus that also has a persistent protonema

***Ephemeropsis trentepohlioides* (Renner) Sainsbury, *Trans. & Proc. Roy. Soc. New Zealand* 79: 205 (1951)**

≡ *Archephemeropsis trentepohlioides* Renner, *Ann. Jard. Bot. Buitenzorg* 44: 88 (1935)

Lectotype: N.Z.: Rotorua, K.W. Allison, 1930, JENA! Isolectotype: near Ātiamuri, south of Rotorua, K.W. Allison 633, CHR 604781!

Plants red-brown, appressed to twigs or rarely epiphyllous. **Protonema** red-brown in mass, and forming dense wefts; primary protonema with oblique walls, lacking holdfasts, directly giving rise to ♂ and ♀ buds; secondary protonema with transverse walls, lacking both conspicuous terminal filaments and brood bodies. **Shoots** as per genus. **Vegetative leaves** absent.

Autoicous (with ♂ and ♀ buds arising from the same primary protonema). **Perichaetial leaves** c. 4 per perichaetium, in form as per ♂ bracts. **Perigonia** ellipsoid, c. 300 µm long, bracts c. 4, brownish, broadly ovate, acute, c. 250–300 × 120–195 µm, with median laminal cells oblong-hexagonal, firm-walled, and mostly 36–48 × 9–15 µm; antheridia on 2-celled stalks, ellipsoid, c. 125 µm long. **Setae** 1–3 mm, red-brown, scarcely twisted; **capsules** oblong-turbinate, green-or red-brown at maturity, appearing strongly papillose when dry, with columella persistent and occasionally exerted, 0.5–0.7 (–0.8) mm long; **exothecial cells** isodiametric or ± quadrate, thin-walled or with transverse walls moderately thickened, distinctly collenchymatous; **stomata** cryptopore, few and scattered in neck or sometimes apparently absent; **annulus** not observed; **operculum** pale, rostrate, c. 0.3 mm.

Exostome teeth 16, paired, strongly reflexed when dry, incurved with moist, not furrowed, c. 150 × 40 µm, with median zig-zag line extending c. ½ the tooth length or absent; outer surface transversely striate; inner surface with numerous low lamellae and roughly equal in tangential width to the outer layer at mid tooth; in cross-section with the inner layer of tooth radially thicker than the outer layer (c. 18 µm vs. c. 3–4 µm); **endostome** with a very low (or sometimes apparently absent) basal membrane, with both segments and cilia absent. **Calyptra** mitrate, laciniate-ciliate at base. **Spores** fusiform, clavate, or oblong, with (0–)1–3 transverse septa, 60–96 × 27–30 µm, occasionally germinating in capsule.

Illustrations: Plate 12. Renner 1935, figs 24–27, 29 a–d, 37–40; Sainsbury 1955, pl. 62, fig. 1; Beever et al. 1992, fig. 66; Dalton 1998, pl. 1, figs b–d; Malcolm & Malcolm 2003, p. 27; Malcolm & Malcolm 2006, p. 130.

Distribution: NI: S Auckland, Wellington (Mt Ruapehu, Mt Hauhungatahi); SI: Nelson (Porika Stream, Donald Creek, Little Totara River, Lewis Pass), Marlborough (Pelorus Bridge Scenic Reserve), Canterbury (Peel Forest), Westland, Otago (Haast Pass, Hollyford Valley), Southland (Doubtful Sound, Spey River). *Ephemeropsis trentepohlioides* is a common species in Westland and apparently also in parts of the North I., including the Rotorua/Ātiamuri region.

Australasian. Tasmania*. Reported from Tasmania by Dalton (1998) and earlier by Willis (1953). Recorded from the Otway Ranges of Victoria (D. Meagher, pers. comm., 28 Aug. 2016).

Habitat: Occurring on living and dead twigs and small branches of a number of native shrubs and trees including *Aristotelia serrata*, *Coprosma* cf. *parviflora*, *C. propinqua*, *C. rotundifolia*, *Leptecophylla juniperina*, *Fuchsia excorticata*, *Gaultheria* sp., *Leptospermum scoparium*, *Lophozonia menziesii*, *Melicope simplex*, *Neomyrtus pedunculata*, *Pennantia corymbosa*, and especially *Pseudowintera colorata*. Rarely epiphyllous on *P. colorata* and also known from dead fronds of *Lycopodium deuterodensum* and the trunks of introduced conifers (*Larix decidua* and *Pinus nigra* subsp. *laricio*). Occurrences on introduced tree species are known only from the volcanic plateau on the central North I. It is a rare plant east of the Main Divide on the South I. Ranging from c. 300–800 m in the central North I. and from c. 60–560 m on the South I. It is frequently associated with *Crosbya nervosa*, *Daltonia splachnoides*, *Tetraphidopsis pusilla*, and various species of *Frullania*, Lejeuneaceae, and *Metzgeria*.

Although sometimes found in damp forest, *Ephemeropsis* is most abundant in open scrub and forest margins in areas of heavy and evenly distributed rainfall; it thrives in scrub with nearly constant high

humidity and high levels of insolation. On alluvial terraces and open road margins where such conditions prevail (as at Kellys Creek and Lake Kaniere, both Westland L.D.) this species is sometimes very common.

Notes: The description of the sexuality of this species is problematic. To my knowledge there is no accepted term to describe the autoicous condition in which the ♂ and ♀ gametangia arise from a common protonema, as here. Fleischer (1908) applied the term rhizautoicous to *E. tjiibodensis*, but this term describes plants in which gametangia are connected by rhizoids, rather than by protonemal filaments. Germinating spores can frequently be found amongst the protonemal wefts of *E. trentepohlioides*, and these could easily be incorrectly interpreted as brood bodies.

Recognition: There is no moss in the N.Z. flora that could be mistaken for *T. trentepohlioides*. It is often confused or overlooked because of its minute size and because of its similarity to the green alga genus *Trentepohlia* (which is typically bright orange in colour) but the sporophyte here immediately identifies *T. trentepohlioides* as a moss belonging to the Daltoniaceae. Microscopically, the presence of oblique cross-walls in the primary protonema precludes confusion with any green algal filament, which has transverse cross-walls.

Etymology: The species epithet alludes to the similarity of the gametophyte to the green alga genus *Trentepohlia*.

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Conventions

Abbreviations and Latin terms

Abbreviations	Meaning
A	Auckland Islands
A.C.T.	Australian Capital Territory
<i>aff.</i>	allied to (<i>affinis</i>)
agg.	aggregate
Ant	Antipodes Islands
a.s.l.	above sea level
<i>auct.</i>	of authors (<i>auctorum</i>)
B	Bounty Islands
C	Campbell Island
c.	about (<i>circa</i>)
cf.	compare with, possibly the species named (<i>confer</i>)
<i>c.fr.</i>	with fruit (<i>cum fructibus</i>)
Ch	Chatham Islands
<i>comb. nov.</i>	new combination (<i>combinatio nova</i>)
D'U	D'Urville Island
et al.	and others (<i>et alia</i>)
et seq.	and following pages (<i>et sequentia</i>)
ex	from
fasc.	fascicle
<i>fide</i>	according to
GB	Great Barrier Island
HC	Hen and Chicken Islands
Herb.	Herbarium
hom. illeg.	illegitimate homonym
I.	Island
ibid.	in the same place (<i>ibidem</i>)
incl.	including
<i>in herb.</i>	in herbarium (<i>in herbario</i>)
<i>in litt.</i>	in a letter (<i>in litteris</i>)
<i>inter alia</i>	among other things (<i>inter alia</i>)
Is	Islands
K	Kermadec Islands
KA	Kapiti Island
LB	Little Barrier Island
L.D.	Land District or Districts
<i>leg.</i>	collected by (<i>legit</i>)
loc. cit.	in the same place (<i>loco citato</i>)
l:w	length:width ratio
M	Macquarie Island
Mt	Mount
<i>nec</i>	nor
NI	North Island
no.	number
nom. cons.	conserved name (<i>nomen conservandum</i>)
nom. dub.	name of doubtful application (<i>nomen dubium</i>)
nom. illeg.	name contrary to the rules of nomenclature (<i>nomen illegitimum</i>)
nom. inval.	invalid name (<i>nomen invalidum</i>)
nom. nud.	name published without a description (<i>nomen nudum</i>)
<i>non</i>	not
N.P.	National Park
N.S.W.	New South Wales
N.T.	Northern Territory (Australia)
N.Z.	New Zealand
op. cit.	in the work cited (<i>opere citato</i>)
pers. comm.	personal communication

PK	Poor Knights Islands
P.N.G.	Papua New Guinea
<i>pro parte</i>	in part
Qld	Queensland
q.v.	which see (<i>quod vide</i>)
RT	Rangitoto Island
S.A.	South Australia
<i>s.coll.</i>	without collector (<i>sine collectore</i>)
<i>s.d.</i>	without date (<i>sine die</i>)
sect.	section
SEM	scanning electron microscope/microscopy
<i>sensu</i>	in the taxonomic sense of
SI	South Island
<i>sic</i>	as written
<i>s.l.</i>	in a broad taxonomic sense (<i>sensu lato</i>)
<i>s.loc.</i>	without location (<i>sine locus</i>)
Sn	Snares Islands
<i>s.n.</i>	without a collection number (<i>sine numero</i>)
Sol	Solander Island
sp.	species (singular)
spp.	species (plural)
<i>s.s.</i>	in a narrow taxonomic sense (<i>sensu stricto</i>)
St	Stewart Island
<i>stat. nov.</i>	new status (<i>status novus</i>)
subg.	subgenus
subsect.	subsection
subsp.	subspecies (singular)
subspp.	subspecies (plural)
Tas.	Tasmania
TK	Three Kings Islands
U.S.A.	United States of America
var.	variety
vars	varieties
Vic.	Victoria
viz.	that is to say (<i>videlicet</i>)
vs	versus
W.A.	Western Australia

Symbols

Symbol	Meaning
µm	micrometre
♂	male
♀	female
±	more or less, somewhat
×	times; dimensions connected by × refer to length times width
>	greater than
<	less than
≥	greater than or equal to
≤	less than or equal to
=	heterotypic synonym of the preceding name
≡	homotypic synonym of the preceding name
!	confirmed by the author
*	in distribution statements, indicates non-N.Z. localities from which material has been confirmed by the author

Technical terms conform to Malcolm, B.; Malcolm, N. 2006: *Mosses and other Bryophytes: an Illustrated Glossary*. Edition 2. Micro-Optics Press, Nelson.

Abbreviations for Herbaria follow the standard abbreviations listed in *Index Herbariorum*.

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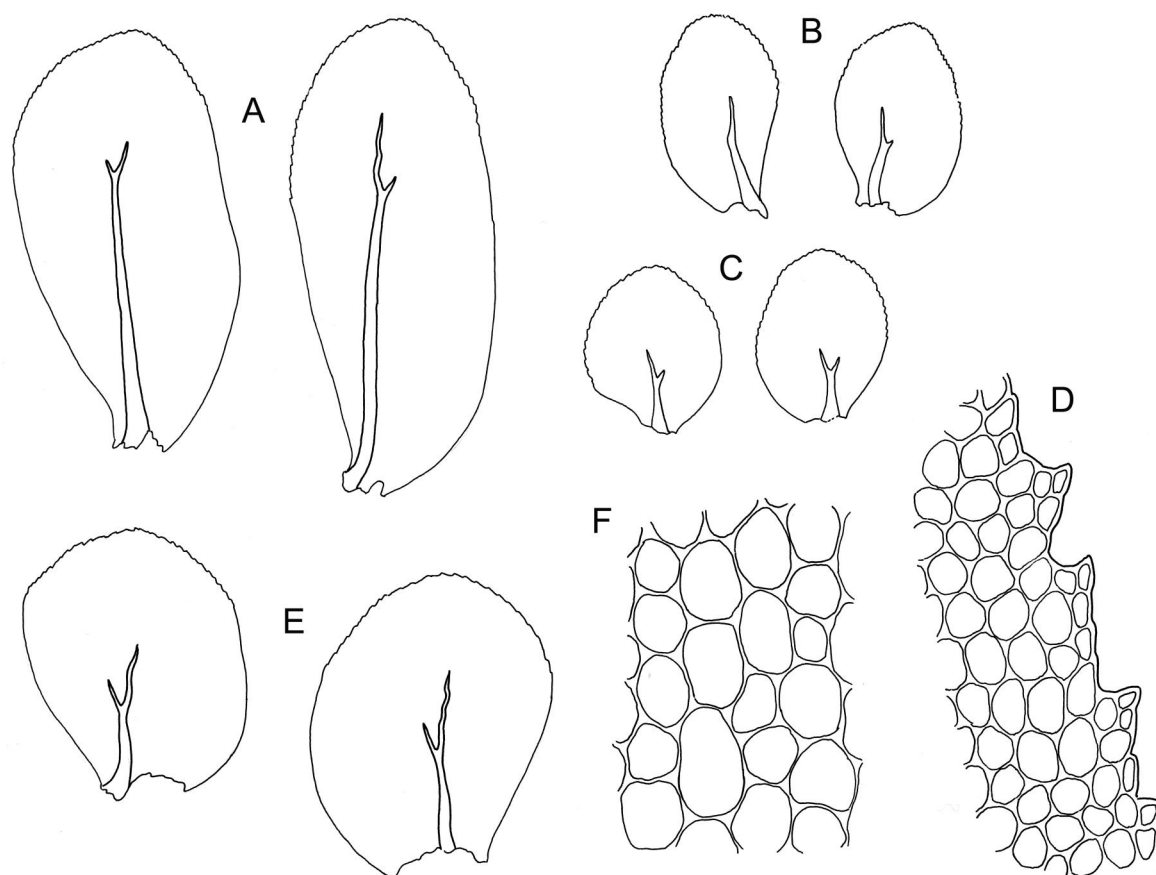


Plate 1: *Achrophyllum*. A–F: *A. dentatum*. A, lateral leaves. B, lateral leaves. C, dorsal leaves. D, upper laminal cells adjacent to margin of lateral leaves. E, dorsal leaves. F, mid laminal cells of lateral leaves. A, D–F drawn from *P. Brownsey s.n.*, 13 June 1984, CHR 466409; B–C drawn from *J. Lewinsky 1449*, CHR 348692.

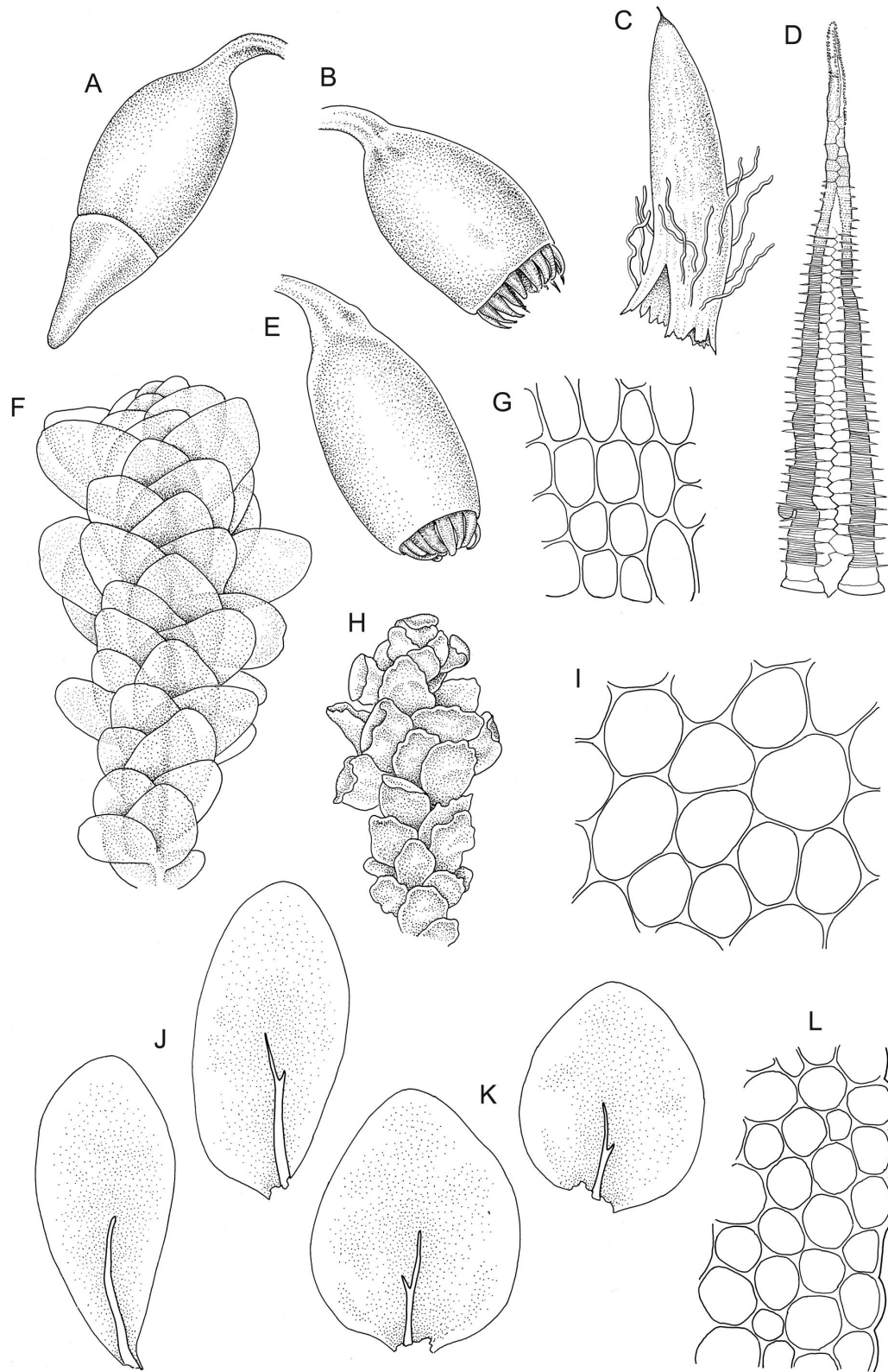


Plate 2: *Achrophyllum*. A–L: *A. quadrifarium*. A, capsule with intact operculum, moist. B, capsule, dry. C, calyptra. D, peristome tooth, outer surface showing furrow. E, capsule, moist. F, portion of shoot. G, exothecial cells. H, portion of shoot, dry. I, mid laminal cells. J, lateral leaves. K, dorsal leaves. L, mid laminal cells adjacent to margin. Drawn from *J.E. Beever* 23-15, CHR 104698, and *V.D. Zotov s.n.*, 27 Aug. 1933, CHR 6861.

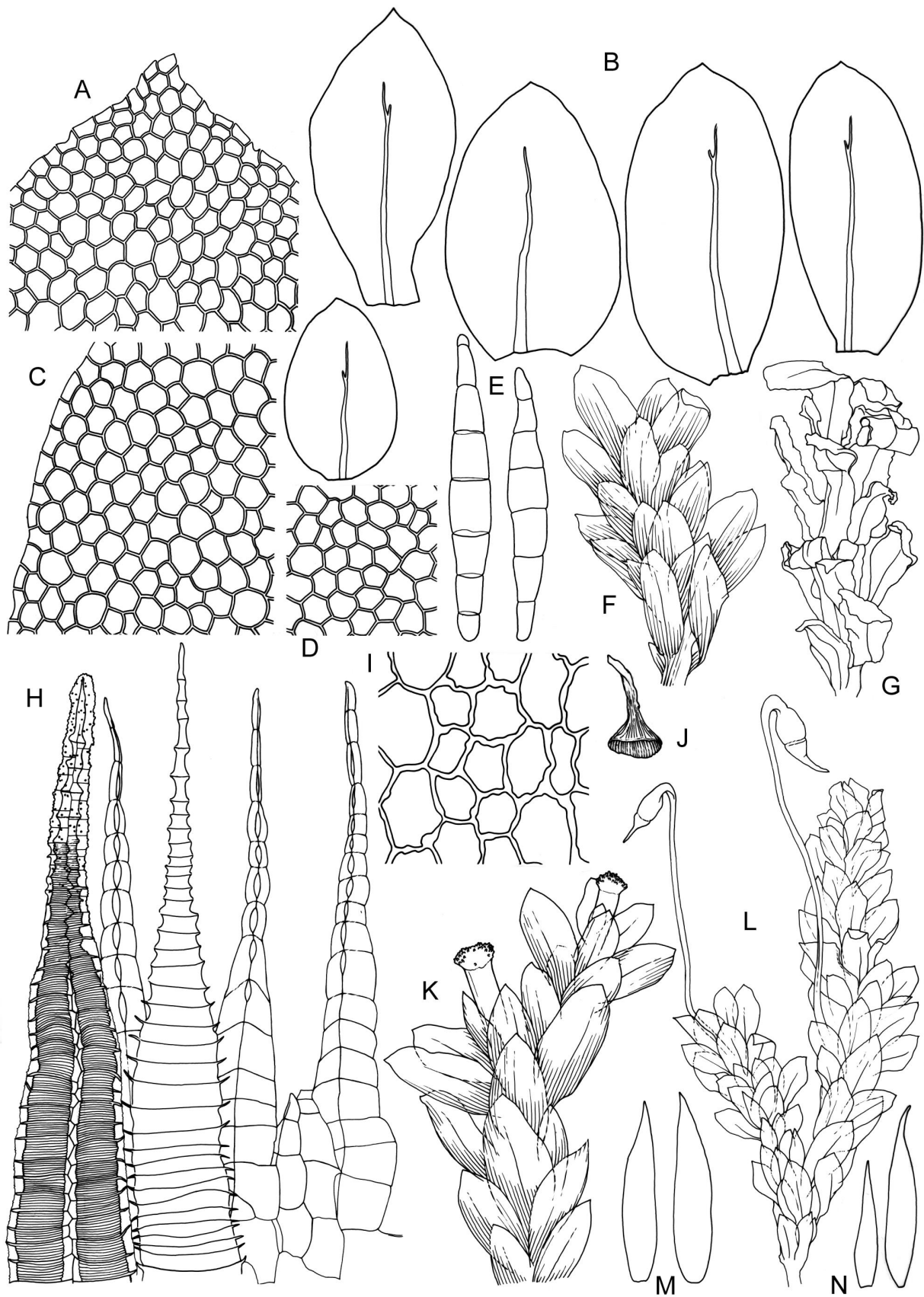


Plate 3: *Beeveria*. A–N: *B. distichophylloides*. A, leaf apex. B, five leaves. C, mid laminal cells at margin. D, upper laminal cells. E, gemmae. F, portion of sterile shoot lacking pseudopodia, moist. G, portion of sterile shoot lacking pseudopodia, dry. H, peristome detail. I, exothelial cells. J, operculum, dry. K, portion of shoot with pseudopodia, moist. L, habit with capsules. M–N, perichaetial leaves. A–G drawn from A.J. Fife 6068, CHR 405584; H–N drawn from G.O.K. Sainsbury 4388, CHR 466907.

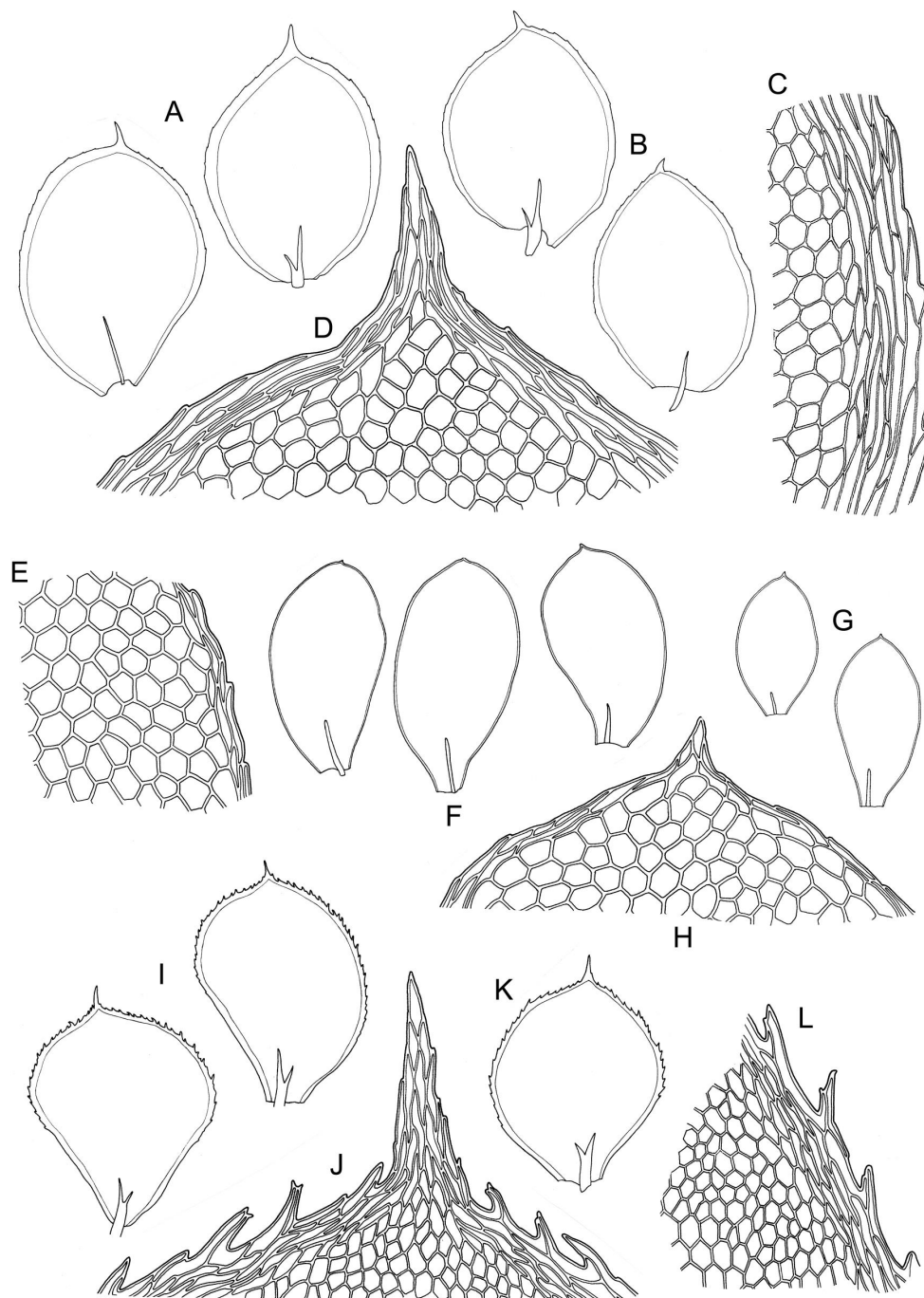


Plate 4: *Calypstrochaeta*. A–D: *C. apiculata*. A, two lateral leaves. B, two dorsal leaves. C, marginal cells at mid lateral leaf. D, apex of lateral leaf. E–H: *C. brownii*. E, marginal cells at mid lateral leaf. F, three lateral leaves. G, dorsal leaves. H, apex of lateral leaf. I–L: *C. flexicollis*. I, two lateral leaves. J, apex of lateral leaf. K, ventral leaf. L, marginal cells at mid lateral leaf. *C. apiculata* drawn from *W. Martin* s.n., 26 Dec. 1949, CHR 465851. *C. brownii* drawn from *L.B. Moore* 646, CHR 465864, *B.H. Macmillan* 87/128, CHR 414499, and *B.H. Macmillan* 74/128, CHR 241680. *C. flexicollis* drawn from *A.J. Fife* 6092, CHR 103470.

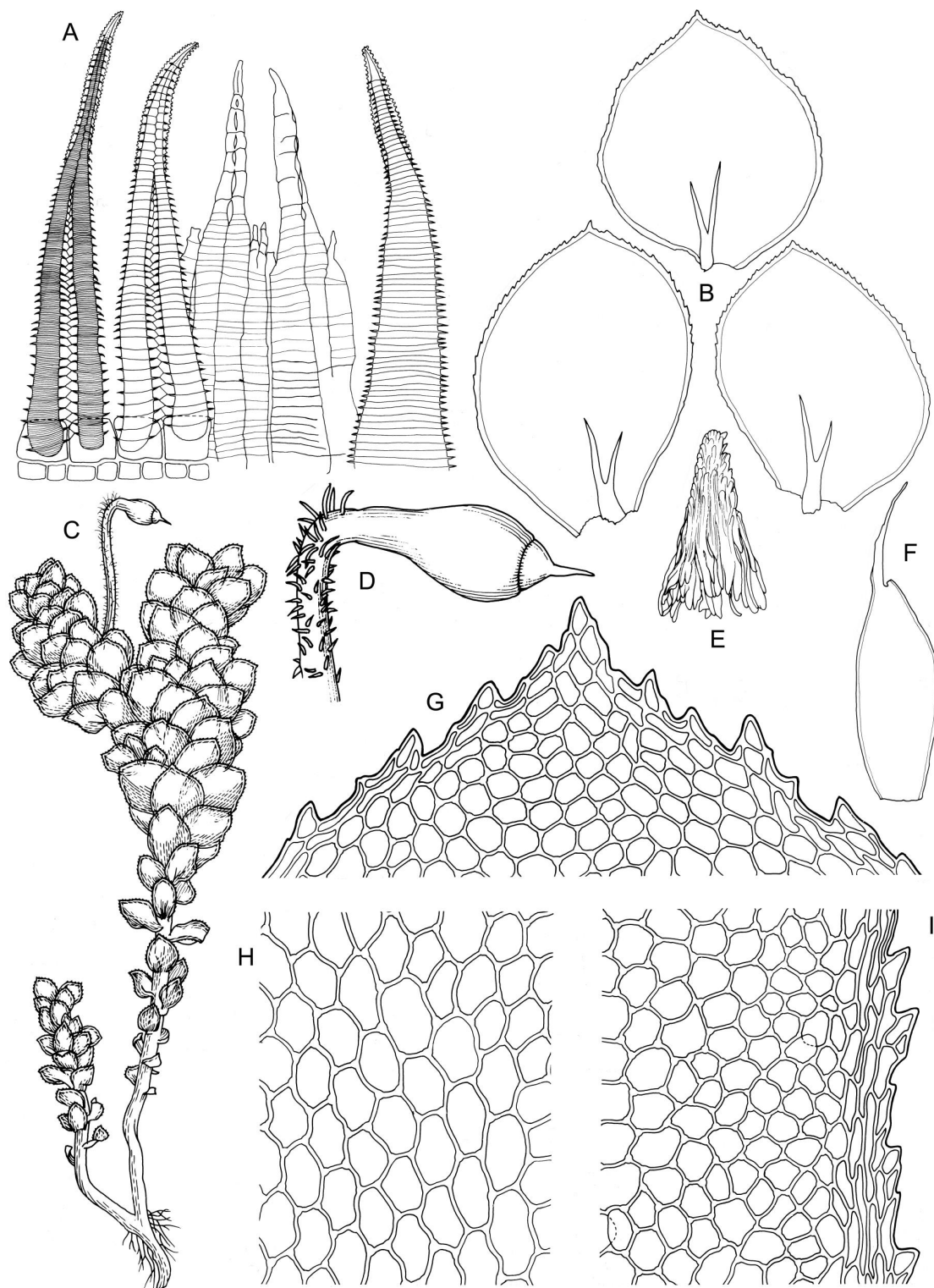


Plate 5: *Calypstrochaeta*. A–I: *C. cristata*. A, peristome detail. B, three lateral leaves. C, habit with capsule, moist. D, capsule. E, calyptra. F, perichaetial leaf. G, leaf apex. H, upper laminal cells. I, marginal cells at mid lateral leaf. Drawn from V.D. Zotov s.n., 27 Aug. 1933, CHR 6867.

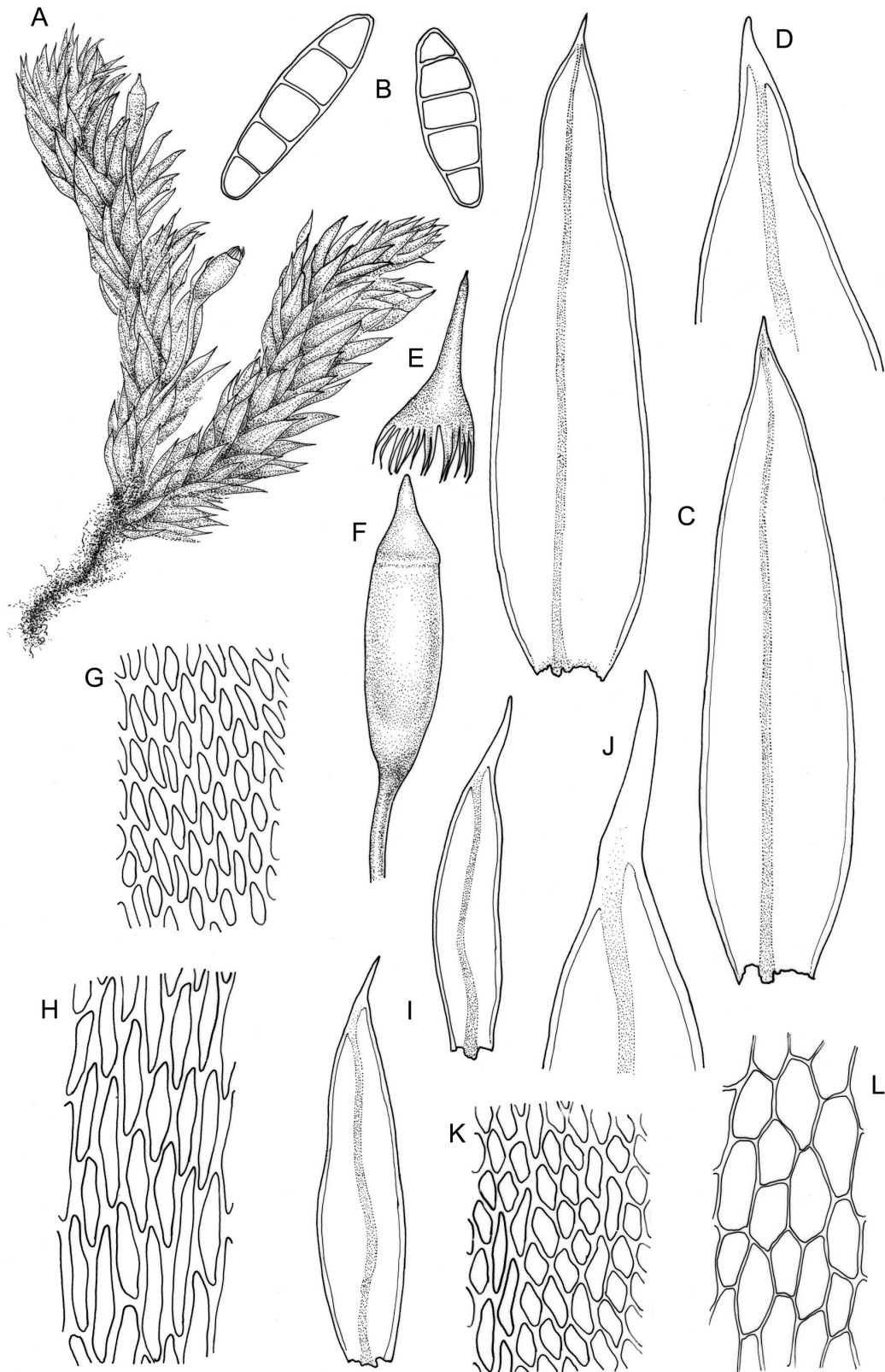


Plate 6: *Crosbya*. A–H: *C. straminea*. A, habit with capsules, moist. B, gemmae. C, two leaves. D, leaf apex. E, calyptra. F, capsule. G, upper laminal cells. H, basal laminal cells. I–L: *C. nervosa*. I, two leaves. J, leaf apex. K, upper laminal cells. L, basal laminal cells. *C. straminea* drawn from A.J. Fife 5245, CHR 103507, and J.E. Beever 31-7, CHR 406187. *C. nervosa* drawn from D.S. Horning SA-450A, CHR 242316.

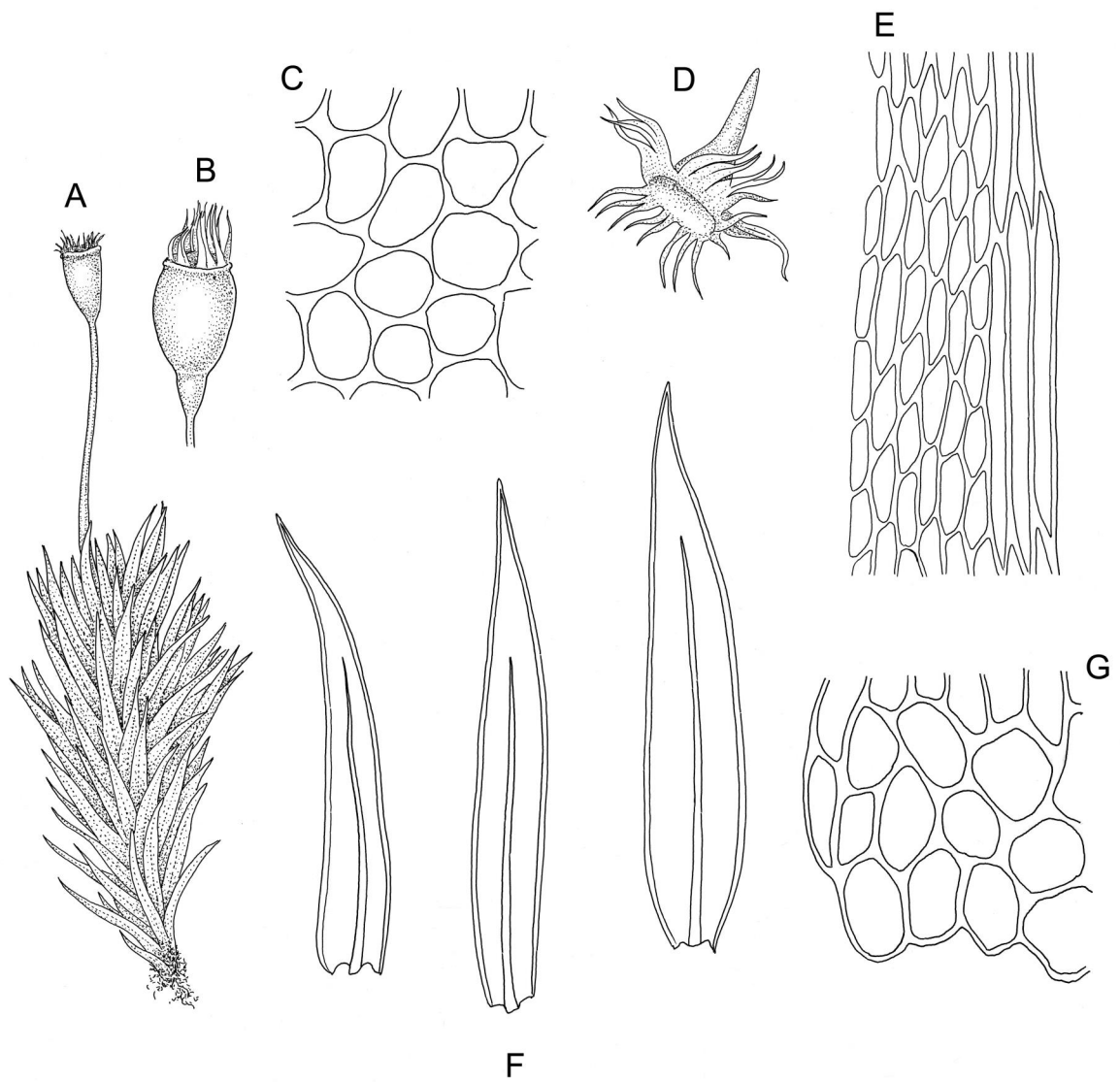


Plate 7: *Daltonia*. A–G: *D. splachnoides*. A, habit with capsule, moist. B, capsule, dry. C, exothecial cells. D, calyptra. E, upper laminal cells at margin. F, three leaves. G, undifferentiated alar cells. Drawn from A.J. Fife 7144, CHR 406014.

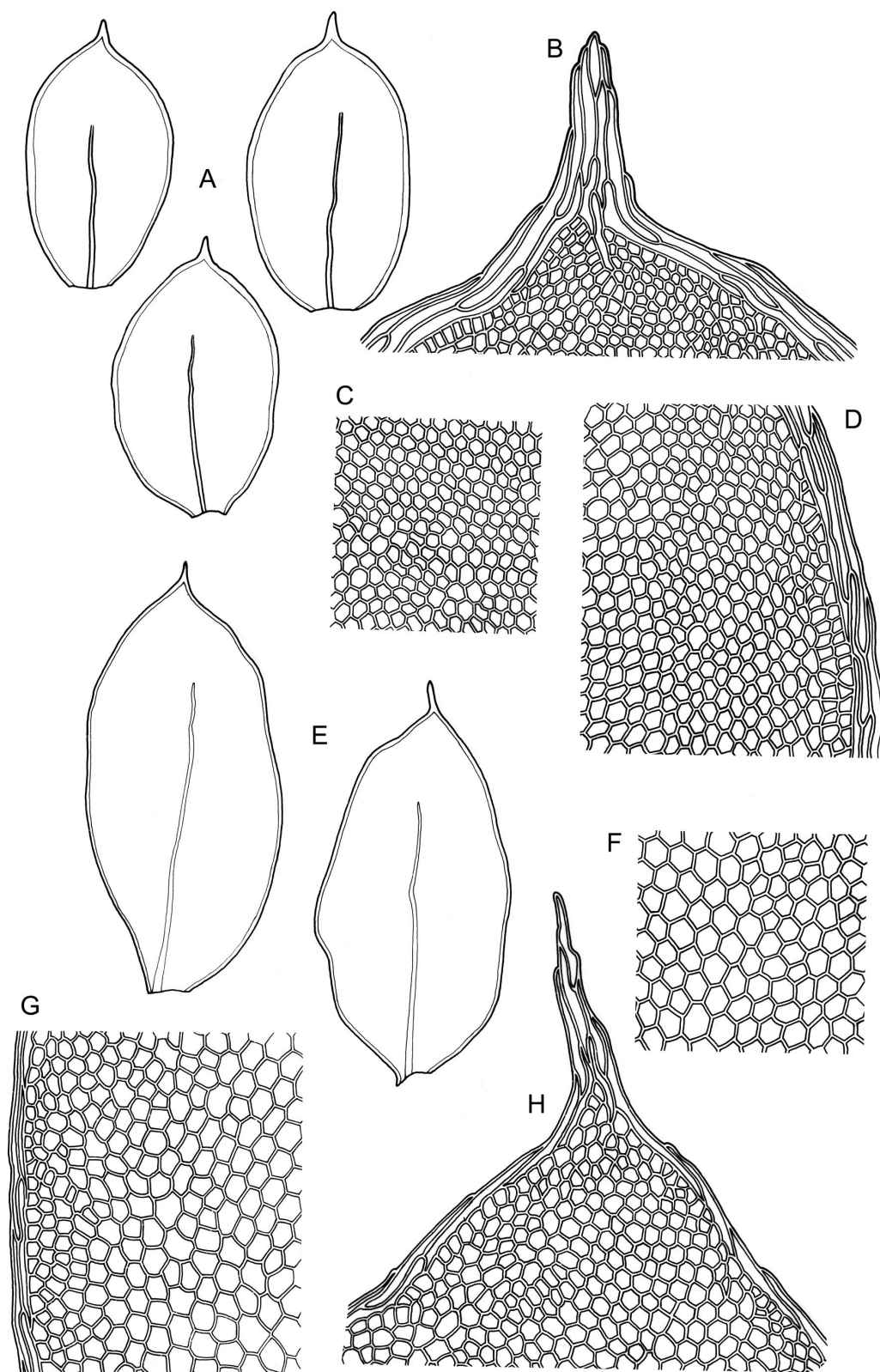


Plate 8: *Distichophyllum*. A–D: *D. crispulum* var. *crispulum*. A, three leaves. B, leaf apex. C, upper laminal cells. D, laminal cells and border at mid leaf. **E–H: *D. crispulum* var. *adnatum*.** E, two leaves. F, upper laminal cells. G, laminal cells and border at mid leaf. H, leaf apex. *D. crispulum* var. *crispulum* drawn from J.E. Beever 32-72, CHR 406088. *D. crispulum* var. *adnatum* drawn from K.W. Allison 721, CHR 463319.

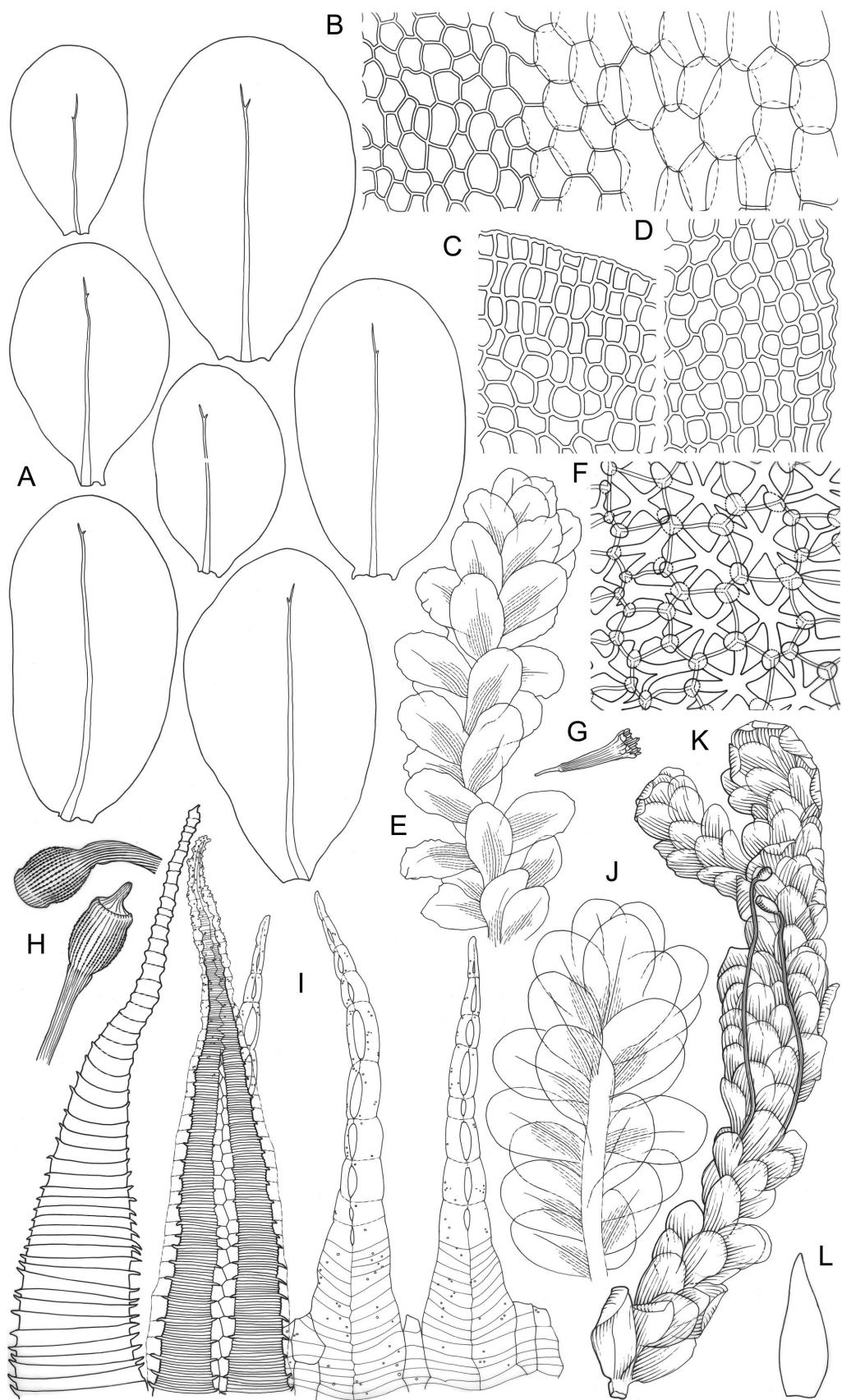


Plate 9: *Distichophyllum*. A–L: *D. microcarpum*. A, seven leaves. B, juxtacostal cells (at right) at mid leaf. C, marginal cells of upper portion of lateral leaf. D, marginal cells of mid portion of lateral leaf. E, portion of shoot, dry. F, exothecial cells. G, calyptra. H, capsules, dry. I, peristome detail. J, portion of shoot, moist. K, portion of shoot with capsules, moist, ventral view. L, perichaetial leaf. Drawn from J.E. Beever 22-04, CHR 104543.

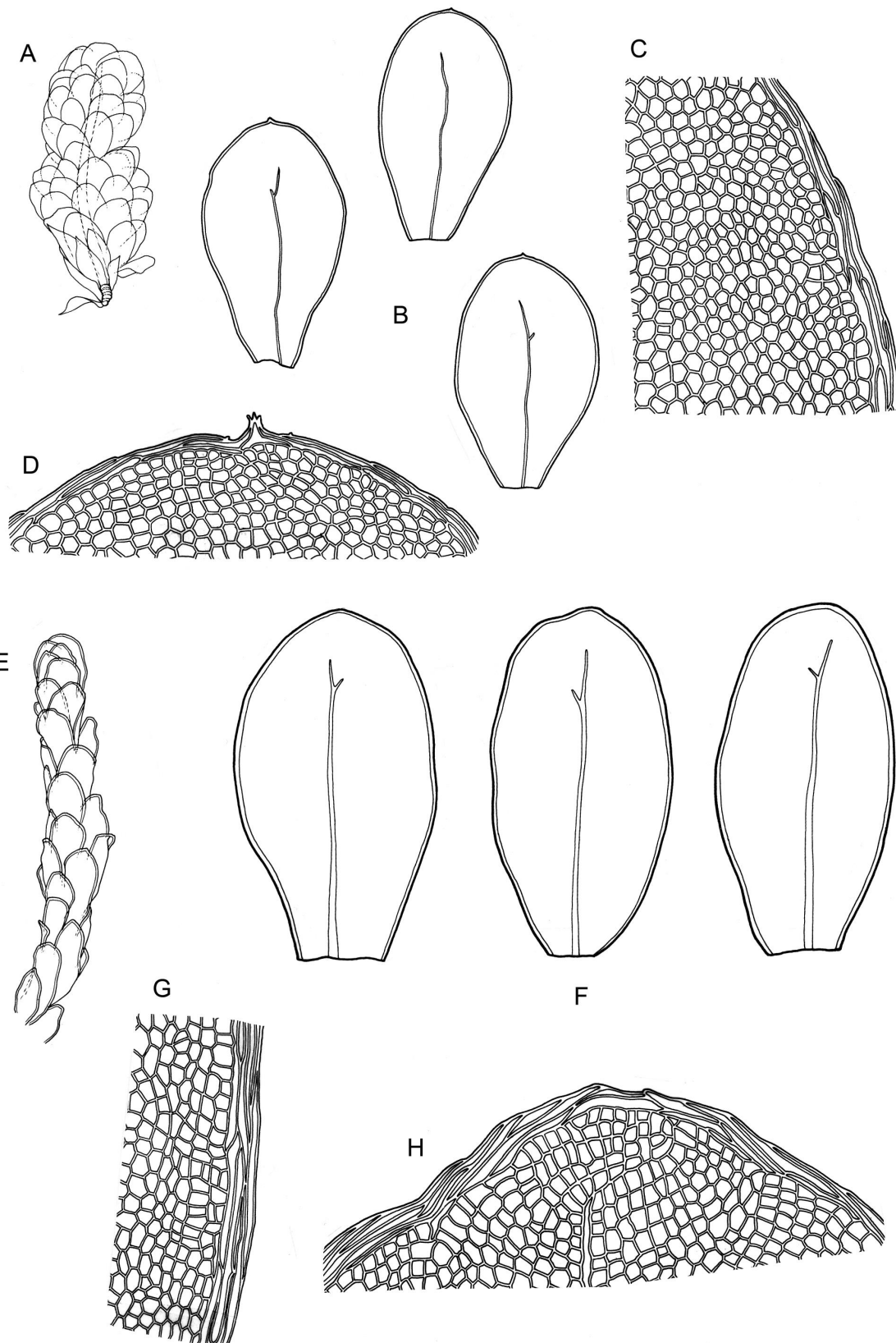


Plate 10: *Distichophyllum*. A–D: *D. pulchellum* s.s. A, habit, moist. B, three leaves. C, laminal cells and border at mid leaf. D, leaf apex. **E–H: *D. pulchellum* "kraussei" growth form.** E, habit, moist. F, three leaves. G, laminal cells and border at mid leaf. H, leaf apex. *D. pulchellum* s.s. drawn from *W. Martin* 179.18, CHR 464387. *D. pulchellum* "kraussei" growth form drawn from *A.J. Fife* 6908, CHR 405799.

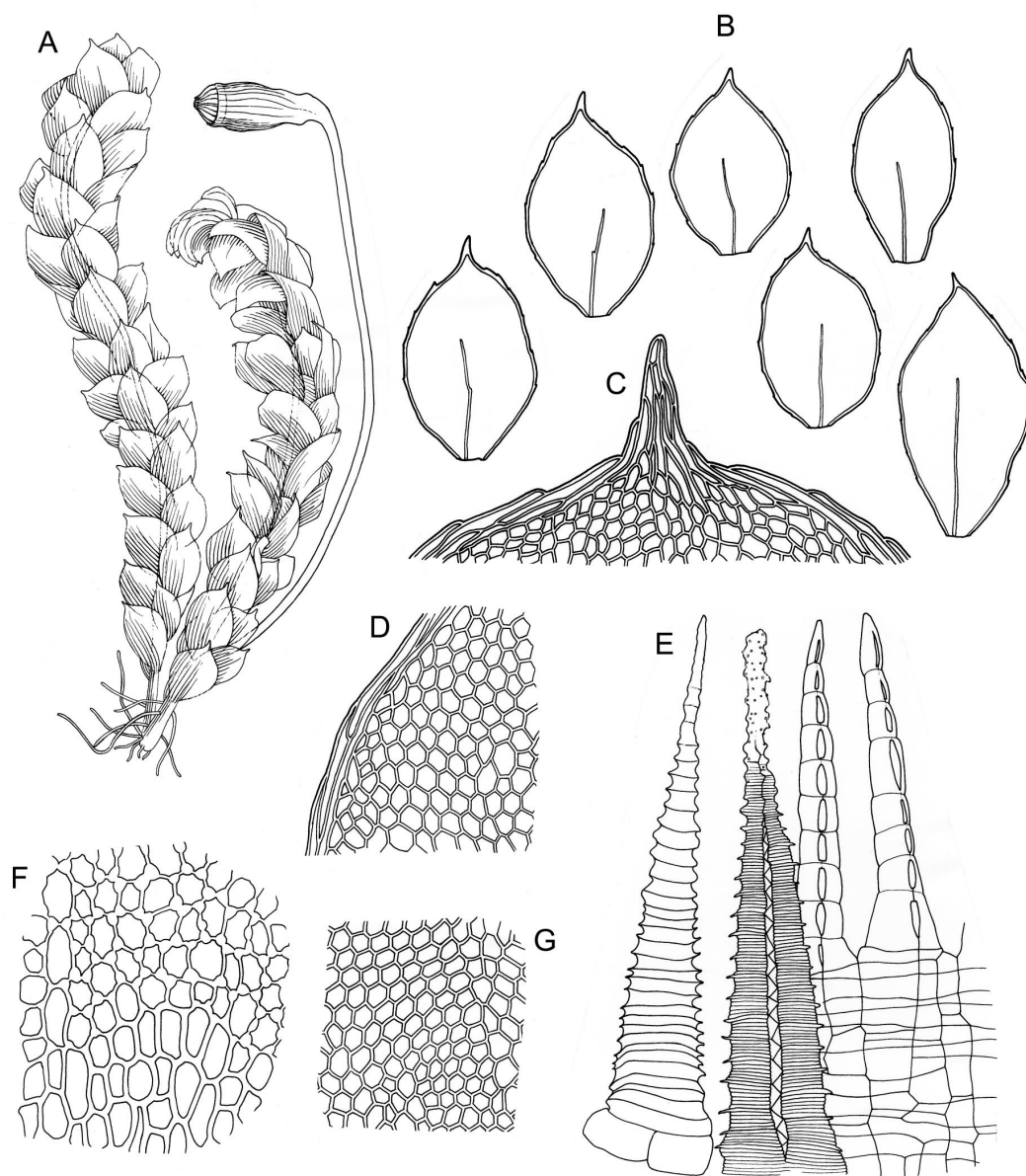


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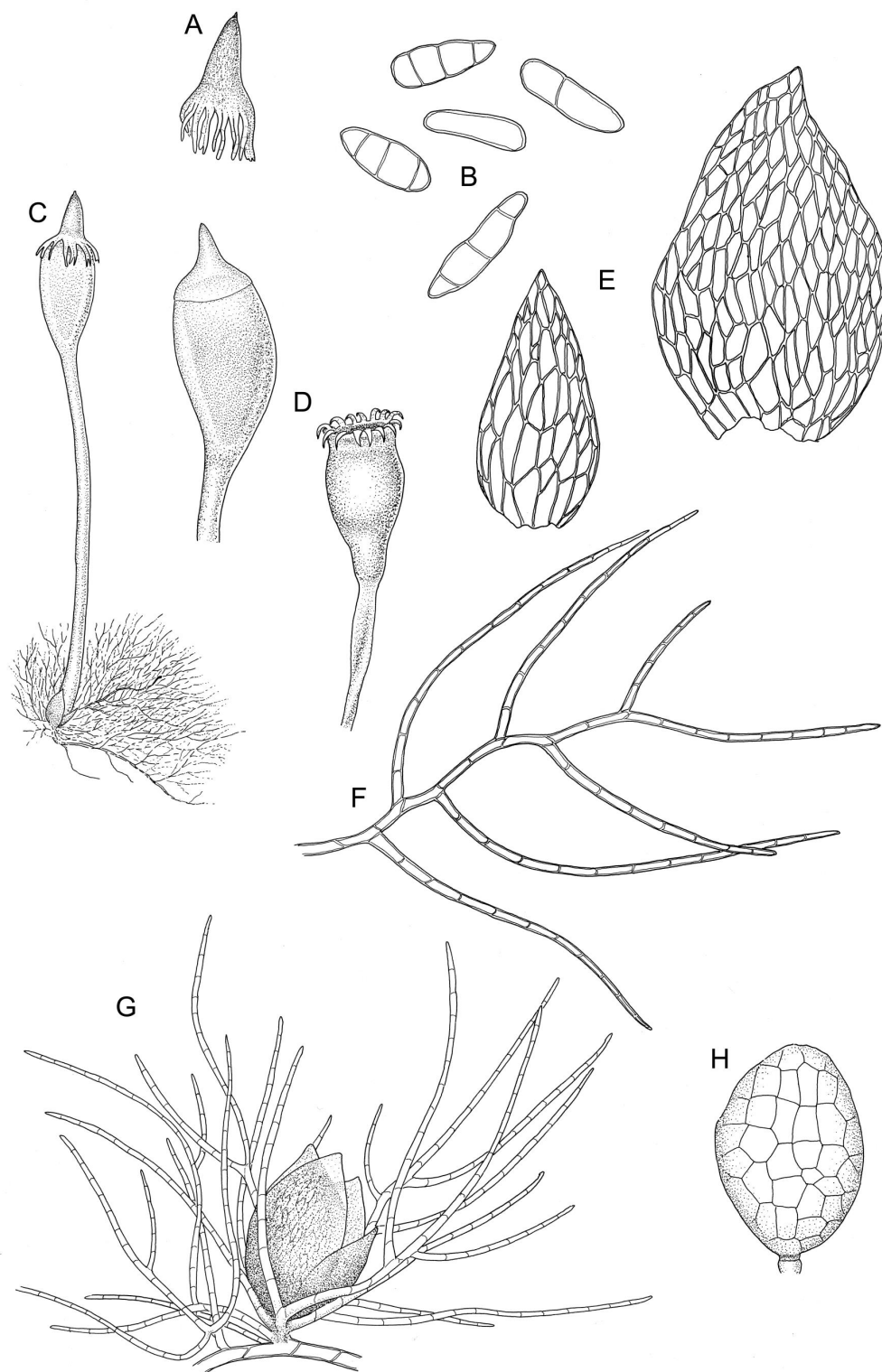
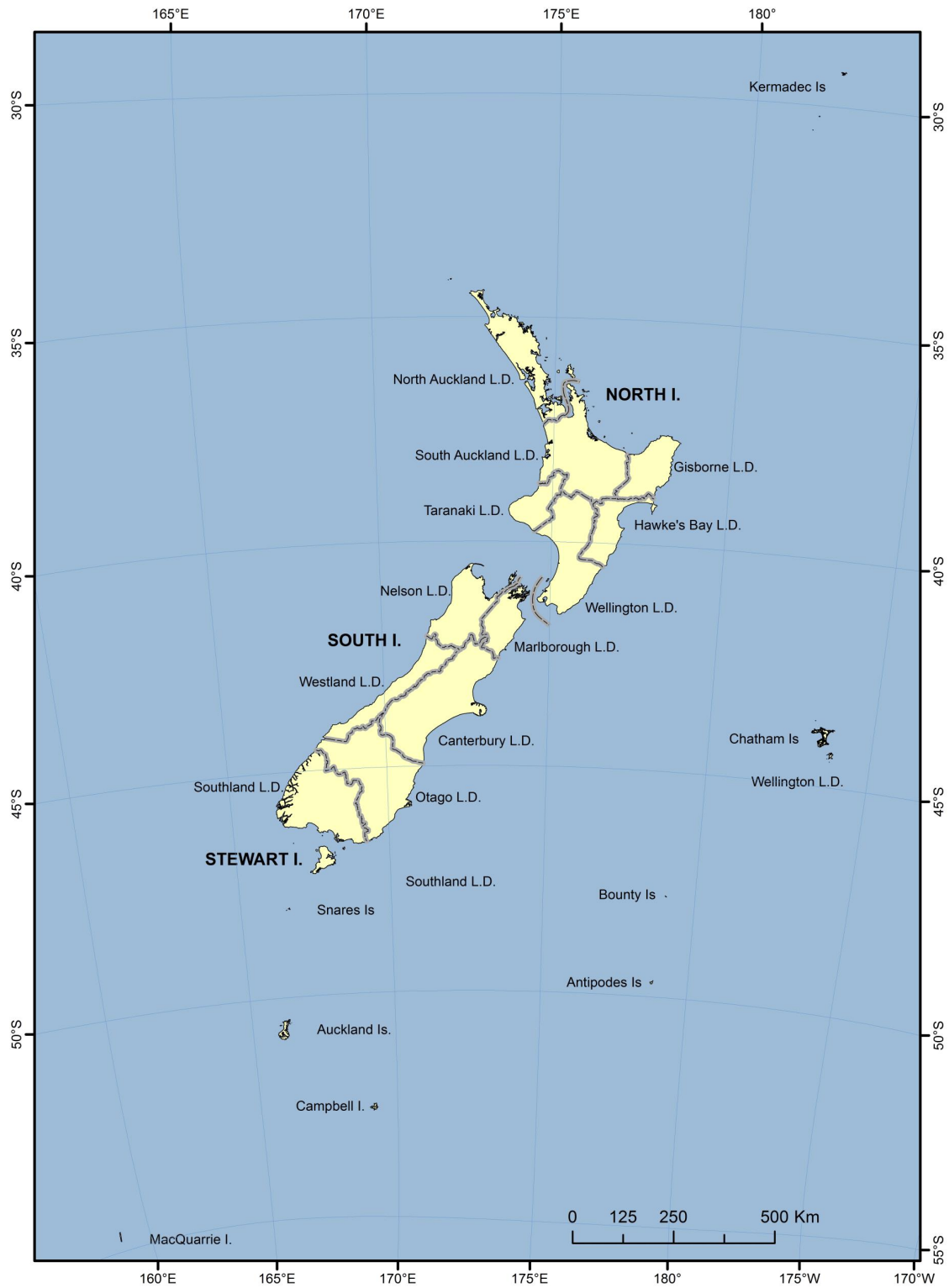
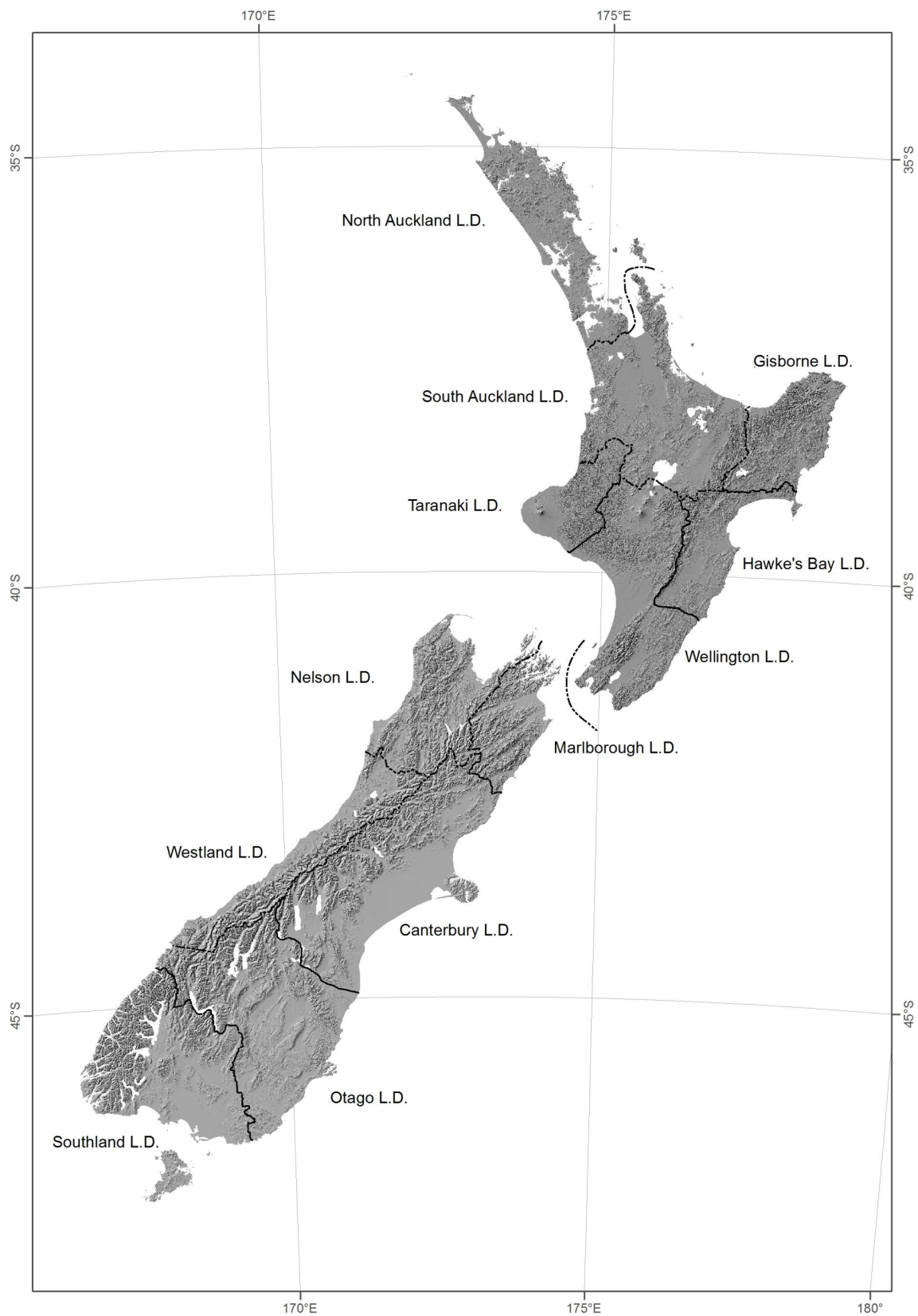


Plate 12: *Ephemeropsis*. A–H: *E. trentepohlioides*. A, calyptra. B, spores. C, habit with capsule, moist. D, capsules, moist. E, two perichaetial leaves. F, protonema. G, protonema with perigonium. H, antheridium. Drawn from A.J. Fife 7340, CHR 406491.



Map 1: Map of New Zealand and offshore islands showing Land District boundaries



Map 2: Map of main islands of New Zealand showing Land District boundaries

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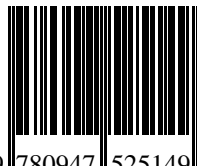
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