



FLORA OF NEW ZEALAND
MOSSES

BRYACEAE



A.J. FIFE

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Cover image: *Rosulabryum subtomentosum*, habit with capsules. Drawn by Rebecca Wagstaff from *J.E. Beaver* 32-38a, CHR 406070.

Contents

Introduction.....	1
Typification.....	1
Taxa	
<i>Bryaceae</i>	4
<i>Bryum</i> Hedw.	10
<i>Bryum algovicum</i> Müll.Hal.	12
<i>Bryum algovicum</i> var. <i>rutheanum</i> (Warnst.) Crundw.	12
<i>Bryum amblyodon</i> Müll.Hal.	13
<i>Bryum appressifolium</i> Broth.	14
<i>Bryum argenteum</i> Hedw.	15
<i>Bryum caespiticium</i> Hedw.	17
<i>Bryum clavatum</i> (Schimp.) Müll.Hal.	18
<i>Bryum coronatum</i> Schwägr.	21
<i>Bryum crassum</i> Hook.f. & Wilson	23
<i>Bryum creberrimum</i> Taylor	24
<i>Bryum dichotomum</i> Hedw.	25
<i>Bryum duriusculum</i> Hook.f. & Wilson	27
<i>Bryum funkii</i> Schwägr.	29
<i>Bryum harriottii</i> R.Br.bis	30
<i>Bryum laevigatum</i> Hook.f. & Wilson	31
<i>Bryum mucronatum</i> Mitt.	33
<i>Bryum pallescens</i> Schwägr.	34
<i>Bryum preissianum</i> Hampe	35
<i>Bryum pseudotriquetrum</i> (Hedw.) P.Gaertn., E. Meyer & Scherb.	36
<i>Bryum radiculosum</i> Brid.	38
<i>Bryum rubens</i> Mitt.	38
<i>Bryum ruderale</i> Crundw. & Nyholm	39
<i>Bryum sauteri</i> Bruch & Schimp.	40
<i>Bryum tenuidens</i> Dixon & Sainsbury	41
<i>Bryum tenuisetum</i> Limpr.	42
<i>Plagiobryum</i> Lindb.	42
<i>Plagiobryum novae-seelandiae</i> Broth.	43
<i>Rosulabryum</i> J.R.Spence	44
<i>Rosulabryum billardierei</i> (Schwägr.) J.R.Spence	45
<i>Rosulabryum campylothecium</i> (Taylor) J.R.Spence	47
<i>Rosulabryum capillare</i> (Hedw.) J.R.Spence	48
<i>Rosulabryum perlimbatum</i> (Cardot) Ochyra	49
<i>Rosulabryum subtomentosum</i> (Hampe) J.R.Spence	50
References	53
Conventions	57
Acknowledgements	59
Plates	60
Maps	86
Index	88
Image Information	90

Introduction

The Bryaceae are a very large and cosmopolitan family with a well-deserved reputation for taxonomic intractability. They are erect plants growing mostly on soil or rock, usually with nodding capsules and well-developed double peristomes. The singly-costate leaves can be variable in form, but they are usually bordered and reflexed at the margins and have hexagonal or rhombic-hexagonal laminal cells. The occurrence and variability of asexual reproductive structures, if present, are often employed to characterise species or species complexes, particularly in *Bryum*, which is by far the largest genus. A modest number of common species can be readily identified by easily observed gametophytic features. One such common and distinctive taxon has often been regionally termed *Bryum billardierei* var. *platyloma*. For complex reasons, the most appropriate name for this taxon is considered here to be *Rosulabryum subtomentosum*. The recognition of many species requires microscopic examination, often including peristome detail. The beginning student, wishing to come to grips with the more distinctive members of this family, would do well to collect and examine ample and fruiting material only.

Little consensus exists concerning the generic boundaries within the family or even the limits of the family itself. Recent proposed changes to generic limits are due mostly to the incorporation of molecular analyses, which will no doubt continue in the future. The Bryaceae are here conceived in a fairly narrow sense, and are considered to include (in N.Z.) three genera: *Bryum*, *Plagiobryum*, and *Rosulabryum*. A total of 30 species are accepted for N.Z. The generic concepts employed here differ substantially from those presented in a recent treatment of the family for Australia, which recognised eight genera. Several genera included in the family by earlier Australasian workers, namely *Leptobryum*, *Leptostomum*, *Orthodontium*, *Pohlia*, and *Schizymenium*, as well as *Ochiobryum*, are here excluded from the Bryaceae.

Typification

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

***Bryum appressifolium* Broth., Öfvers. Finska Vetensk.-Soc. Förh. 40: 175 (1898)**

Lectotype (designated here): N.Z., Otago, Mt Alfred, Jan. 1892, *W. Bell*, H-Brotherus 686003!

Isolectotype (designated here): CHR 514106! (Syntypes in H cited by Ochi 1970, p. 38.)

***Bryum austropallescens* Broth., Öfvers. Finska Vetensk.-Soc. Förh. 40: 178 (1898)**

Lectotype (designated here): N.Z., Otago, Pine Hill, Nov. 1889, *W. Bell*, H-Brotherus 608009!

***Bryum buchananii* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 450 (1899)**

Lectotype (designated here): N.Z., Kaikōura, Hāpuku River, Jan. 1898, *R. Brown*, CHR 335150! (Cited by Ochi 1984, p. 179.)

***Bryum crassinerve* Hook.f. & Wilson in Wilson, Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II 83 (1854)**

Lectotype (designated here): N.Z., Auckland, *Sinclair (a)*, BM-Wilson! Isolectotype (designated here): BM-Hooker!

***Bryum cuneatum* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 459 (1899)**

Lectotype (designated here): N.Z., Kaikōura, *R. Brown*, CHR 335244! Isolectotype (designated here): CHR 514106!

***Bryum duriusculum* Hook.f. & Wilson in Wilson, Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II 2: 84 (1854)**

Lectotype (designated here): N.Z., North Island, *Lyll* 232, BM-Hooker!

***Bryum foresterii* R.Br.bis, Trans. & Proc. New Zealand Inst. 35: 334 (1903)**

Lectotype (designated here): N.Z., South Island, near Weston, 18 Nov. 1897, *R. Brown*, CHR 335161! (Cited by Ochi 1984, p. 180.)

***Bryum gibsonii* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 448 (1899)**

Lectotype (designated here): N.Z., South Island, near Kaikōura, Jan. 1898, *R. Brown*, CHR 335155!
(Cited by Ochi 1984, p. 181.)

***Bryum gracilithecium* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 453 (1899)**

Lectotype (designated here): N.Z., South Island, West Coast Road, *R. Brown*, CHR 335143! (Cited by Ochi 1984, p. 180.)

***Bryum hapukaense* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 455 (1899)**

Lectotype (designated here): N.Z., South Island, tributary of the River Hapuku ("Hapuka"), near Kaikōura, Jan. 1898, *R. Brown*, CHR 335138! (Cited by Ochi 1984, p. 180.)

***Bryum harriottii* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 453 (1899)**

Neotype (designated here): N.Z., Canterbury, Mt Torlesse, Jan. 1900, *R. Brown s.n.*, WELT M012282!
Paratypes: BM-Dixon!, CHR 514980!

***Bryum heterofolium* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 458 (1899)**

Lectotype (designated here): N.Z., North Island, near Otaihape [Taihape], *R. Brown*, CHR 335246!
(Cited by Ochi 1984, p. 180.)

***Bryum huttonii* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 460 (1899)**

Lectotype (designated here): N.Z., South Island, Styx Marsh, near Christchurch, Oct. 1895, *R. Brown*, CHR 335589!
Isolectotype (designated here): BM 1086517 (Viewed online at JSTOR Global Plants, accessed 15 Jan. 2015.)
Paratype: CHR 516715! (CHR 335589 is cited by Ochi 1984, p. 181.)

***Bryum laevigatum* Hook.f. & Wilson, London J. Bot. 3: 546 (1844)**

Lectotype (designated here): Tasmania, *s. loc.*, 1831, *Lawrence 261* ("Hooker 2856"), BM-Wilson 730494!

***Bryum linearifolium* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 453 (1899)**

Lectotype (designated here): N.Z., South Island, near Ōamaru, *R. Brown*, CHR 335142! (Cited by Ochi 1984, p. 180.)

***Bryum maudii* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 460 (1899)**

Lectotype (designated here): N.Z., Southland, near Lake Manapōuri, *R. Brown*, CHR 335588! (Cited by Ochi 1984, p. 181 and by Ochi 1970, p. 44.)

***Bryum megamorphum* Müll.Hal., Hedwigia 37: 99 (1898)**

Lectotype (designated here): N.Z., Otago, Dunedin, Pelichet Bay, Oct. 1890, *W. Bell*, (herb. T.W.N. Beckett 358), CHR 514101!
The collector given (as Beckett) in Müller's protologue is incorrect.

***Bryum otahapaense* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 448 (1899)**

Lectotype (designated here): N.Z., North I., "near Otahape" [Taihape], *R. Brown*, CHR 335156!

***Bryum ovalicarpum* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 451 (1899)**

Lectotype (designated here): N.Z., Christchurch, Aug. 1898, *R. Brown*, CHR 335147!

***Bryum ovatocarpum* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 451 (1899)**

Lectotype (designated here): N.Z., Governors Bay, Port Lyttelton, Nov. 1889, *R. Brown*, CHR 335148!

***Bryum ovatothecium* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 449 (1899)**

Lectotype (designated here) N.Z., Banks Peninsula, Port Lyttelton Hills, April 1882, *R. Brown*, CHR 335154!

***Bryum petriei* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 450 (1899)**

Lectotype (designated here): N.Z., West Coast Road, *R. Brown*, CHR 335151!

***Bryum searllii* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 459 (1899)**

Lectotype (designated here): N.Z., South Island, near Kaikōura, Jan. 1898, *R. Brown*, CHR 335243!

***Bryum traillii* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 460 (1899)**

Lectotype (designated here): N.Z., Stewart I., Waterfall Run, *R. Brown*, CHR 335587! (Cited by Ochi 1984, p. 181.)
Isolectotype (designated here): BM 1086473 (Viewed online at JSTOR Global Plants, accessed 15 Jan. 2015.)

***Bryum triangularifolium* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 451 (1899)**

Lectotype (designated here): N.Z., North I., "near Otaihape" [Taihape], *R. Brown*, CHR 335149!

***Bryum ventricosum* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 454 (1899)**

Lectotype (designated here): N.Z., South Island, near Kaikōura, *R. Brown*, CHR 335141! (Cited by Ochi 1984, p. 180.)

***Bryum waikariense* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 448 (1899)**

Lectotype (designated here): N.Z., South Island, near Waikari, April 1882, *R. Brown*, CHR 335157!

***Bryum webbianum* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 452 (1899)**

Lectotype (designated here): N.Z., South Island, near Waikari, *R. Brown*, CHR 335146! (Cited by Ochi 1984, p. 180.)

***Bryum webbii* R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 449 (1899)**

Lectotype (designated here): N.Z., near River Ashburton, *R. Brown*, CHR 335153!

Bryaceae

Plants small to robust, erect, extremely variable in size and coloration, mostly forming turves or tufts, perennial, terrestrial or occasionally epiphytic. **Stems** erect, from a few millimetres to several centimetres, usually strongly beset with rhizoids, in cross-section with firm-walled cortical cells and a distinct or rarely weak central strand of narrower thin-walled cells. **Leaves** evenly spaced or becoming larger and crowded above (comose), not complanate, spreading or erect-spreading when moist, often erect when dry, ovate, obovate, spatulate, elliptic, lanceolate, or \pm cochleariform, acute, acuminate, or rarely rounded at apex, \pm concave, often with secondary pigments, margins toothed or entire, mostly bordered and recurved, occasionally decurrent; **upper laminal cells** hexagonal or rhombic-hexagonal, thin- or firm-walled, not thickened at corners, porose or not, becoming more oblong in lower leaf; **marginal cells** mostly prosenchymatous and forming a distinct border of variable width and height. **Costa** strong, mostly excurrent but occasionally percurrent or shorter, with a single abaxial stereid band. **Brood bodies** (gemmae, tubers, or bulbils) often present.

Dioicous or **monoicous**. **Perichaetia** terminal or on short basal shoots. **Perigonia** mostly similar to perichaetia, with numerous filiform paraphyses. **Setae** elongate, single or occasionally multiple, often strongly curved just below the capsule; **capsules** horizontal, cernuous to pendent, rarely \pm erect, pyriform, clavate, cylindrical, or rarely \pm globose, straight or curved, mostly with a well-developed neck; **stomata** numerous, superficial and restricted to neck; **annulus** well developed and revolvable; **operculum** mostly conic. **Peristome** double, often perfect; **exostome teeth** yellow-brown or pale, finely papillose below and mostly hyaline and baculate above, bordered, densely trabeculate on adaxial surface; **endostome** arising from a high or short basal membrane, with well-developed and perforate segments, and with **cilia** in groups of 1–3, these mostly appendiculate or nodose, rarely reduced or absent. **Calyptra** cucullate and smooth. **Spores** spherical and usually $<30 \mu\text{m}$.

Taxonomy: The Bryaceae are a large, cosmopolitan, and taxonomically difficult family. Brotherus (1924, p. 375) estimated that about 800 species belonged in *Bryum* alone, with it being by far the largest genus. The numbers of accepted species have reduced considerably and the accepted concept of the Bryaceae has changed greatly in recent decades. The Bryaceae are considered here to include (regionally) three genera: *Bryum*, *Plagiobryum*, and *Rosulabryum*.

Crum & Anderson (1981) in their treatment for eastern North America presented a broader and more traditional concept of the family than the one presented here. Their concept of the family included the genera *Pohlia*, *Leptobryum*, *Mielichhoferia*, and *Orthodontium* and largely followed the classification of Brotherus (1924). The treatment of the family by Smith (1978), in the first edition of his Moss Flora of Britain and Ireland, also largely followed Brotherus (1924) in his definition of the family (and its subfamilies). In the second edition of his Flora (Smith 2004) he presented a narrower and substantially different concept of the family.

The Bryaceae are conceived here in a fairly narrow sense, largely in accordance with Goffinet et al. (2009). Recent changes in the definition of this family and the generic limits within it are due mostly to the incorporation of molecular analyses (e.g., Pedersen et al. 2007; Cox & Hedderson 2003); such analyses, and their consequent changes in concepts, will undoubtedly continue in the future.

A recent treatment of the Bryaceae for Australia (Spence & Ramsay 2006) recognised eight genera in this family, of which three (*Rosulabryum*, *Gemmabryum*, and *Ochiobryum*) were recently described by one or both of the authors. *Rosulabryum* is accepted here, in the Bryaceae. *Gemmabryum* is not recognised in this Flora (see Excluded genera). *Ochiobryum* is accepted in this Flora but treated in the Mniaceae (see Excluded genera). The previously described *Ptychostomum* Hornsch. was resurrected by Spence (2005); it is not accepted here.

Rosulabryum was erected by Spence (1996), and Spence & Ramsay (1999) provided a key to the Australasian species. *Rosulabryum* was subsequently characterised by Spence & Ramsay (2006, p. 331) as comprising “the rosulate species of *Bryum* s. lat. with unreduced peristomes, generally obovate leaves with serrate margins, rhizoidal tubers and, occasionally, filiform gemmae in the leaf axils”. They treated 14 spp. in the Australian flora in *Rosulabryum*, while four species are accepted here for N.Z.

For those wishing to apply Spence & Ramsey’s generic and species concepts, their keys, descriptions, and illustrations in the Flora of Australia are recommended.

Because of the complexity of the family, and differing opinions concerning familial, generic and species boundaries, all the species are distinguished here in a single key, given below.

Pohlia and *Schizymenium* (the latter roughly equivalent to *Mielichhoferia sensu* Brotherus) as well as *Ochiobryum* are here treated in the Mniaceae and *Leptobryum* in the Meesiaceae. These genera were all treated in the Bryaceae by Sainsbury (1955a), and many students of N.Z. mosses will attempt to name material by assigning them first of all to this family.

A practical rule-of-thumb, quoted here from Crum & Anderson's (1981, p. 503) generic key, is that *Bryum* and its close allies have "leaves relatively broad, elliptic to ovate or ovate-lanceolate, usually distinctly bordered; cells rather broad, generally less than 4:1" whereas *Pohlia*, *Leptobryum*, and *Schizymenium* have "leaves linear to oblong-lanceolate, not distinctly bordered; cells narrow, relatively long, 4:1 or longer". This rule-of-thumb, written with American taxa in mind, is extremely useful but cannot be consistently applied to N.Z. taxa of *Rosulabryum* (which have ± spatulate leaves), *Plagiobryum* (which have rounded-hexagonal laminal cells and strongly bordered leaves), *Ochiobryum* (which have oblong-ovate and weakly bordered leaves) or *Epipterygium* (which has broadly elliptic and weakly bordered leaves).

Key to the genera

- 1 **Upper laminal cells** very thin-walled, not porose, and often lacking chlorophyll; **leaves** ± cochleariform, not bordered, broadly rounded at apex, evenly spaced and imbricate, c. 0.5–0.7 mm (excluding perichaetial leaves); **costa** ending far below leaf apex *Plagiobryum*
- 1' **Upper laminal cells** mostly firm- or thick-walled, often ± porose, nearly always chlorophyllose (except in *B. argenteum*); **leaves** mostly ± ovate, ovate-lanceolate to spatulate or obovate, very rarely ± cochleariform (then larger and with firm-walled cells), often bordered, mostly acute or acuminate; **costa** mostly excurrent, less often percurrent or shorter 2
- 2 **Leaves** spatulate or obovate, widest at or slightly above mid leaf, nearly always comose when bearing sex organs (sometimes evenly spaced on sterile stems); mostly spirally twisted round stem or occasionally (in *R. subtomentosum*) spirally twisted around the leaf axis or little altered when dry *Rosulabryum*
- 2' **Leaves** not widest above mid leaf, ovate, or ovate- to oblong-lanceolate, rarely oblong-spatulate to elliptic (in *Bryum laevigatum* and then not comose), or cochleariform, not or sometimes ± comose when bearing sex organs; erect or variably twisted when dry *Bryum*

Key to the species

In the following key plant size definitions follow Ochi (1970, p. 14) and are based on the length of the largest stem leaves (including perichaetial leaves), but excluding the excurrent portion of the costae. Robust: leaves >4.0 mm; large: leaves 3.0–4.0 mm; medium-sized: 1.5–3.0 mm; small: <1.5 mm.

- 1 **Bulbils** (reduced bulb-shaped branches) ellipsoid or obovate, often present in axils of upper vegetative leaves; **capsules** <2 mm, when mature with necks as wide as or wider than the urn and strongly wrinkled when dry 2
- 1' **Bulbils** in axils of upper vegetative leaves very rare; **capsules** mostly >2 mm (excluding *B. argenteum*), when mature with necks narrower than the urn, moderately wrinkled or smooth when dry (excluding *B. argenteum*) 3
- 2 **Leaves** mostly with distinct red pigmentation; **bulbils** lacking apical primordial leaves; **endostome segments** fenestrate; **spores** 8–10 µm; **operculum** shortly apiculate *Bryum coronatum*
- 2' **Leaves** lacking red pigmentation; **bulbils** with several apical primordial leaves; **endostome segments** narrowly perforate; **spores** c. 15–18 µm; **operculum** not apiculate *Bryum dichotomum*
- 3 **Plants** hoary when dry; **costa** failing far below the leaf apex; **upper laminal cells** colourless, usually markedly thinner-walled than cells of lower leaf, rarely not differentiated (and then leaves broadly rounded apically) 4
- 3' **Plants** not hoary when dry; **costa** nearly always percurrent to long-excurrent (except in *B. harriottii*); **upper laminal cells** with chlorophyll, not markedly thinner-walled than cells of lower leaf 5

4	Leaves mostly acute, shortly apiculate or acuminate, only occasionally obtuse to rounded at apex; laminal cells near leaf apex and upper margins markedly thinner-walled than in lower leaf; capsules 0.85–2.0 mm, pendent, obovoid to oblong-cylindric, with poorly defined necks c. ¼ the total length and wrinkled when dry; spores 9–15 µm, smooth, lacking trilete scars; plants very common and weedy in wide variety of terrestrial habitats	<i>Bryum argenteum</i>
4'	Leaves consistently cochleariform and broadly rounded at apex; laminal cells near leaf apex not clearly differentiated from cells in lower leaf, thin-walled throughout the leaf; capsules elongate and curved, c. 5–6 mm, horizontal or nearly so (sometimes pendulous when dry), with narrow necks c. ½ the capsule length and not markedly wrinkled when dry; spores 27–33 µm, papillose, often with trilete scars; plants less common, not weedy and usually associated with base-rich rock	<i>Plagiobryum novae-seelandiae</i>
5	Leaf apex broadly obtuse or rounded (<i>Ochiobryum blandum</i> will also key here; it has upper laminal cells thin-walled and mostly 5–7:1; delicate costae, cerise or black colouration (at least in part), and is aquatic or nearly so; it is treated here in the Mniaceae)	6
5'	Leaf apex acute or acuminate	7
6	Plants julaceous, small; stems nearly always <10 mm; vegetative leaves c. 1 mm or less, broadly ovate to ± cochleariform; spores >20 µm	<i>Bryum harriottii</i>
6'	Plants not julaceous, robust; stems often >20 mm; vegetative leaves >1.5 mm, oblong-spathulate to broadly elliptic; spores <20 µm	<i>Bryum laevigatum</i>
7	Plants robust and strongly comose, at least some usually plurisetose; well-developed leaves mostly >4 mm excluding excurrency, with apices mostly strongly reflexed; setae with a characteristic hook below the capsule	<i>Rosulabryum subtomentosum</i>
7'	Plants not robust, comose or not, not plurisetose; well-developed leaves <3.2 mm excluding excurrency, with apices not strongly reflexed (leaves rarely to 5 mm, but then with apices not reflexed); setae not hooked below the capsule	8
8	Leaf border in widest part of leaf ≥10 cells wide; leaves comose, apically reflexed, spiralled around stem when dry	<i>Rosulabryum perlimbatum</i>
8'	Leaf border in widest part of leaf ≤8 cells wide; leaves if comose not spiralled around stem when dry	9
9	Endostomal cilia well-developed and appendiculate; spores usually <20 µm	10
9'	Endostomal cilia not appendiculate (cilia may be absent or present and nodose or rudimentary); spores more variable in size, usually >20 µm (<i>Rosulabryum campylothecium</i> is likely to cause difficulty here. It is characterised by its golden colouration, serially comose habit, and strongly awned leaves little altered when dry. It mostly lacks capsules and is coastal. Its capsules are banana-shaped, with nodose cilia and spores ≤ c. 20 µm diam. <i>Bryum preissianum</i> may also cause difficulty here; it has no cilia or rudimentary ones but spores are 8–12 µm diam.)	30
10	Leaves closely imbricate; plants catkin-like, ≤7 mm high, very pale green	<i>Bryum funkii</i>
10'	Leaves not imbricate (except in <i>Bryum appressifolium</i>); plants not catkin-like, usually larger, coloration various	11
11	Costa of upper leaves strongly excurrent	12
11'	Costa of upper leaves percurrent, subpercurrent, or short-excurrent to form a cusp	27
12	Leaves decurrent at base (especially obvious in sterile plants); synoicous	<i>Bryum pseudotriquetrum</i>
12'	Leaves not decurrent; mostly dioicous	13

13	Stems obscured by leaves; leaves densely erect-imbricate, with a single plication on one or both sides of the costa (best visible when leaves are removed from the stem); margins strongly recurved	<i>Bryum appressifolium</i>
13'	Stems not obscured by leaves; leaves not densely erect-imbricate, lacking plications; margins variably recurved or plane	14
14	Leaves moderately to strongly spiralled around stem when dry; upper laminal cells thin- or firm-walled	15
14'	Leaves not spiralled around stem when dry; upper laminal cells firm-walled	17
15	Leaves ± spatulate (widest above the middle and narrowed at base); upper laminal cells thin-walled; cilia markedly appendiculate; spores <15 µm; tubers often present	<i>Rosulabryum capillare</i>
15'	Leaves ± ovate (widest below or near middle and not narrowed at base); upper laminal cells firm-walled; cilia appendiculate or sometimes merely nodose; at least some spores >15 µm; tubers absent	16
16	Synicous ; capsules ≤2.5 mm, narrowly pyriform; spores >20 µm; cilia paired and nodose to weakly appendiculate	<i>Bryum pallescens</i>
16'	Autoicous or polygamous ; capsules 2.5–3 mm, oblong-cylindric; spores mostly <20 µm; cilia mostly in 3's, appendiculate	<i>Bryum creberrimum</i>
17	Leaves with a weakly to moderately reflexed cusp, not or sometimes weakly comose; tubers lacking	<i>Rosulabryum billardierei</i>
17'	Leaves lacking a reflexed cusp, not comose; tubers often present	18
18	Excurent part of costa mostly entire; capsules inclined to horizontal and distinctly curved in neck; spores >20 µm diam.	<i>Bryum clavatum</i>
18'	Excurent part of costa denticulate (rarely ± entire); capsules pendent, not curved in neck; spores <20 µm diam. (rarely c. 20 µm in <i>Bryum sauteri</i>)	19
19	Tubers present on rhizoids	20
19'	Tubers absent from rhizoids	26
20	Tubers mostly 2 cells wide, pyriform or ellipsoid, mostly <100 µm in length, with cell walls not protruding; cilia mostly single [<i>B. erythrocarpum</i> complex" <i>pro parte</i>]	<i>Bryum sauteri</i>
20'	Tubers more than 2 cells wide, globose, oblong, or irregular, mostly >100 µm in greater diam. (or, if less, then irregular in outline and plants with entire leaf margins), with cell walls protruding or not; cilia paired or in 3s	21
21	Tubers irregular in outline, (60–)70–90(–105) µm in greater diameter; leaf margins entire; spores mostly >20 µm	<i>Bryum clavatum</i>
21'	Tubers mostly globose, occasionally oblong, or ± irregular in outline; leaf margins mostly denticulate (costal excurrency, at least, always denticulate); spores 9–15 µm [<i>B. erythrocarpum</i> complex" <i>pro parte</i>]	22
22	Mid laminal cells 14–18 µm wide, thin-walled; tubers often produced on short rhizoids arising in axils of lower leaves	<i>Bryum rubens</i>
22'	Mid laminal cells c. 10 µm wide, mostly firm-walled; tubers not on short axillary rhizoids	23
23	Tubers mostly >200 µm diam., with cell walls protruding	24
23'	Tubers mostly <200 µm diam., with cell walls not protruding	25
24	Tubers brown or red-brown (by reflected light), mostly 260–350 µm diam.; mid laminal cells firm-walled	<i>Bryum duriusculum</i>
24'	Tubers bright yellow-brown (by reflected light), mostly 210–250 µm diam.; mid laminal cells thin-walled	<i>Bryum tenuisetum</i>
25	Tubers bright orange and attached to purple rhizoids (by reflected light)	<i>Bryum ruderale</i>
25'	Tubers red-brown and attached to brown or red-brown rhizoids (by reflected light)	<i>Bryum radiculosum</i>

26	Plants serially comose; laminal cells adjacent to costa at mid leaf obliquely oriented; costa concolourous with lamina, short-excurrent	<i>Bryum crassum</i>
26'	Plants not serially comose; laminal cells adjacent to costa at mid leaf not obliquely oriented; costa red at base and long-excurrent	<i>Bryum caespiticium</i>
27	Leaves comose (often serially)	28
27'	Leaves evenly spaced on stem	29
28	Leaves little altered when dry; leaf border weak and often obscured by revolute margins; capsules oblong-cylindric, ≤ 2.7 mm long; spores 8–10 μm	<i>Bryum crassum</i>
28'	Leaves much altered (often spiralled around leaf axis) when dry; leaf border obvious; capsules narrowly cylindric, usually >4 mm long; spores >10 μm , often variable in single capsule	<i>Rosulabryum subtomentosum</i> (small forms)
29	Leaves much altered when dry, decurrent at base (especially obvious in sterile plants); upper laminal cells moderately thick-walled, not obliquely oriented; synoicous in N.Z.	<i>Bryum pseudotriquetrum</i>
29'	Leaves scarcely altered when dry, not decurrent; upper laminal cells strongly incrassate, mostly obliquely oriented; dioicous (but males inconspicuous)	<i>Bryum laevigatum</i>
30	Exostome teeth with lamellae joined by longitudinal and oblique thickenings; peristome appearing single under low magnification (endostome adhering to teeth and often fugacious)	<i>Bryum algovicum</i> var. <i>rutheanum</i>
30'	Exostome teeth lacking longitudinal thickenings between lamellae; peristome obviously double under low magnification (endostome not adherent)	31
31	Costa excurrent to form a slender awn; leaves moderately to strongly comose	32
31'	Costa short-excurrent to form a mucro or percurrent; leaves not or weakly comose	34
32	Dioicous ; leaves indistinctly bordered, the border not extending to apex (and usually obscure at mid leaf shoulder); upper laminal cells firm-walled; costa yellow-brown throughout; cilia elongate, nodose; spores 15–21 μm	<i>Rosulabryum campylothecium</i>
32'	Synoicous ; leaves distinctly bordered to apex; upper laminal cells thin-walled; costa red at base or nearly throughout; cilia rudimentary; spores always >20 μm	33
33	Plants small and catkin-like, with stems mostly <7 mm; leaves not decurrent, those of comae <2.5 mm; setae to c. 15 mm; capsules c. 2 mm long; exostome teeth with c. 12–14 adaxial lamellae	<i>Bryum tenuidens</i>
33'	Plants not catkin-like, stems mostly >15 mm; leaves weakly decurrent, those of comae mostly >3 mm; setae mostly >35 mm; capsules c. 4 mm; exostome teeth with c. 25 or more adaxial lamellae	<i>Bryum amblyodon</i>
34	Capsules horizontal to suberect, obovoid-cylindric; spores 8–12 μm ; dioicous ; setae 7–10 mm	<i>Bryum preissianum</i>
34'	Capsules nodding or inclined, not obovoid-cylindric; spores larger, mostly >20 μm (except in some populations of <i>B. clavatum</i>); sexuality various; setae nearly always ≥ 15 mm	35
35	Neck c. $\frac{1}{3}$ the total capsule length; capsules ≤ 2.5 mm, narrowly pyriform, not curved, strongly pendent	<i>Bryum pallescens</i>
35'	Neck c. $\frac{1}{2}$ the total capsule length; capsules nearly always 3–5 mm long, clavate or narrowly pyriform, curved or straight, inclined to pendent	36

- 36** **Capsules** asymmetric and curved, clavate, (2.5–)3.5–5 mm long; **upper laminal cells** firm-walled, c. 27–45 × 9–12 µm; **dioicous**; **tubers** sometimes present, red-brown, irregular, mostly 75–150 µm in greater diam.; **plants** widespread at elevations below c. 1220 m *Bryum clavatum*
- 36'** **Capsules** symmetric or nearly so, narrowly pyriform, 3–5 mm long; **upper laminal cells** thin-walled, 69–90 × 24–27 µm; **synoicous**; **tubers** not known; **plants** known from few localities from c. 1100–1800 m
..... *Bryum mucronatum*

Excluded Taxa: The genus *Anomobryum* Schimp. was recorded from N.Z. by Dixon (1926) to accommodate the species treated here as *Bryum harriottii*. The placement of this species in *Bryum* agrees with both Ochi (1992) and Spence & Ramsay (2006).

The genus *Brachymenium* Schwägr. has been used by several authors (Dixon 1926; Sainsbury 1955b; Ochi 1970) to accommodate the Australasian species treated here as *Bryum preissianum*. The rationale for placing this species in the genus where it was originally described is provided under the species discussion, below. *Brachymenium* is represented in Australia by two species (Spence & Ramsay 2006), neither of which occurs in N.Z.

The genus *Gemmabryum* was described by Spence & Ramsay (2005) as a segregate of *Bryum*. Those authors (2006, p. 287) characterised species of *Gemmabryum* as having “*Bryum*-like areolation” and stems that are bud-like or elongate and non-julaceous, and leaves mostly with weak costae that do not reach the leaf apex. Contrary to this characterisation, many of the species they illustrate have excurrent costae. They recognised three distinct types of gemmae in *Gemmabryum* and placed 25 Australian species (of which 12 are accepted from N.Z. in *Bryum*, sometimes under differing epithets) in this genus. The genus *Gemmabryum* is not accepted here because of its apparent heterogeneity and my inability to recognise it in the field.

The genus *Imbribryum* was described by Pedersen (2005) with *Bryum alpinum* With. as its type. Spence & Ramsay (2013) recently transferred five Australasian species to this genus, which is neither accepted nor considered further here.

The genus *Leptobryum* (Bruch & Schimp.) Wilson was treated in the Bryaceae by Sainsbury (1955a). In this Flora it is treated in the Meesiaceae, following Goffinet et al. (2009).

The genus *Leptostomum* R.Br. was treated in the Bryaceae by Sainsbury (1955a), but its placement there has long been controversial (Ramsay 2006). In this Flora it is treated in the monotypic family Leptostomataceae in the Bryales, in accordance with its treatment by both Ramsay (2006) and Goffinet et al. (2009).

The genus *Mielichhoferia* Nees & Hornsch. was treated in the Bryaceae by Sainsbury (1955a). Shaw & Crum (1984) examined the peristome structure of North American species placed in *Mielichhoferia*, and Shaw (1985) subsequently resurrected the genus *Schizymenium* Harv. for species excluded from a narrowly-defined *Mielichhoferia* by their monoicous sexuality, and by peristomes entirely endostomal in nature or double and with unornamented teeth. The relevant N.Z. species are referred to *Schizymenium*, and are discussed in this Flora in the family Mniaceae, following the family placement of Goffinet et al. (2009).

The genus *Ochiobryum* was described by Spence & Ramsay (2005), based on *Bryum blandum* Hook.f. & Wilson, a species with a Campbell I. type. This species occurs in both Australia and N.Z. and has been retained in *Bryum* by Australasian authors since its original description. However, as pointed out by Spence & Ramsay (2006), it is highly anomalous there and deserves generic isolation. Spence & Ramsay (2006, p. 320) characterised *Ochiobryum* as having “frequently complanate foliation, shiny pink to red colouration, elongate, pohlioid laminal areolation with a distinct border, and inclined to pendulous pyriforme capsules with complete peristomes and small spores”. The genus *Ochiobryum* is accepted here but is placed in the family Mniaceae, in accordance with Goffinet et al. (2009).

The genus *Orthodontium* Schwägr. was treated in the Bryaceae by Sainsbury (1955a). In this Flora it is treated in the Orthodontiaceae, following its placement by Goffinet et al. (2009).

The genus *Pohlia* Hedw. was treated in the Bryaceae by Sainsbury (1955a). In this Flora it is treated in the Mniaceae, following Goffinet et al. (2009) and other recent authors (e.g., Smith 2004).

The genus *Ptychostomum* Hornsch. was resurrected by Spence (2005) and Spence & Ramsay (2006) subsequently placed five Australian species in this genus, two of them accepted from N.Z. They (p. 323) characterised members of *Ptychostomum* as having “rhodobryoid laminal areolation, peristome reduction associated with nutant capsules, and a lack of asexual propagules other than occasional axillary filiform gemmae”. The genus *Ptychostomum* is not accepted here.

***Bryum* Hedw., Sp. Musc. Frond., 178 (1801)**

Type taxon: *Bryum argenteum* Hedw.

Plants small to robust, extremely variable in size and coloration, forming turves or tufts, terrestrial or occasionally epiphytic. **Stems** from a few millimetres to several centimetres, mostly red-brown, usually strongly beset with rhizoids, in cross-section with firm-walled cortical cells and a well-developed or rarely weak central strand of smaller thinner-walled cells. **Leaves** evenly spaced on stem or crowded and enlarged at stem apex (comose), erect or erect-spreading when moist, round, elliptic, ovate, or lanceolate, acute, acuminate, or rarely rounded at apex, \pm concave, not complanate, often with secondary pigments, toothed or entire, bordered, recurved or less often plane, sometimes decurrent; **upper laminal cells** hexagonal or rhombic-hexagonal, thin- or firm-walled, porose or not, becoming more oblong in lower leaf; **marginal cells** differentiated, linear, usually forming a strong or weak border. **Costa** strong, excurrent, percurrent or occasionally shorter, with a single abaxial stereid band. **Brood bodies** (gemmae, tubers, or bulbils) often present.

Dioicous or **monoicous**. **Perichaetia** terminal on main shoot or on short shoots arising near the stem base, very often overtopped by subperichaetial innovations (and thus appearing lateral); **perichaetial leaves** mostly moderately differentiated. **Perigonia** with numerous filiform paraphyses and antheridia. **Setae** elongate, flexuose to cygneous, one per perichaetium in N.Z. species; **capsules** cernuous, pendent or rarely suberect, variable in form, mostly pyriform, clavate, cylindrical, or rarely \pm globose, mostly with a well-developed neck, straight or curved; **stomata** numerous, superficial, and restricted to neck; **annulus** well developed and revoluble; **operculum** conic, sometimes apiculate. **Peristome** double and often perfect; **exostome teeth** yellow-brown or pale, finely papillose below and mostly hyaline and baculate above, bordered, densely trabeculate on adaxial surface; **endostome** with a high basal membrane, with well-developed, perforate or fenestrate segments, and with **cilia** in groups of 1–3, appendiculate, nodose, or occasionally reduced or absent. **Calyptra** cucullate and smooth. **Spores** spherical and nearly always $<30 \mu\text{m}$.

Taxonomy: *Bryum* is one of the largest and taxonomically most difficult genera of mosses. While some estimates of its size extend to 800 species (Brotherus 1924), or even to c. 1050 species (Smith 1978), such estimates are probably excessive. Ochi (1992), a noted authority on the genus, estimated the genus to include c. 180 or more species distributed worldwide. Twenty-four species are accepted for N.Z. in this treatment. A useful treatment of the genus for Australasia was provided by Ochi (1970, 1973, 1984). Ochi also (1992) provided an extremely useful synopsis of his classification of the Bryaceae, to which the interested student is referred. Because of rapidly changing concepts of the genus and its parent family, and lack of consensus on intra-generic relationships, no synopsis is presented here.

John Spence (often in association with Helen Ramsay) has proposed, in many publications, beginning with Spence (1987), radical changes in the classification of *Bryum* s.l. Spence & Ramsay (2006) assigned Australian species traditionally placed in *Bryum* to five genera while retaining only five Australian species within a narrowly circumscribed *Bryum* s.s. Their segregate genera are briefly discussed above; some of them under “Excluded Taxa” under the family treatment.

A comparatively conservative and enlarged view of *Bryum* is adopted here.

At its most highly-developed, the peristome in *Bryum* is sometimes termed “perfect”. This terminology signifies a double peristome with the following characteristics: 1. exostome teeth with a distinct median zig-zag abaxial divisural line, finely papillose on the lower abaxial surface, mostly hyaline and baculate above, bordered, and densely trabeculate adaxially; and 2. an endostome arising from a high basal membrane, with well-developed, keeled, and perforate segments, and appendiculate cilia in groups of 1–3. This so-called “perfect peristome” (which is similar to that occurring in some *Hypnum* spp. and their allies) provides a reference point in the study of moss morphology. Characters of the peristome have historically been much used in the construction of moss classifications and only in recent years have they assumed a less important role, with the development of classifications based primarily on molecular characteristics.

The examination of peristome details is accomplished best by selecting a recently dehisced capsule and making a longitudinal cut through the peristome followed by a transverse cut slightly below the peristome insertion. The endostome (attached to the spore sac) usually then can be separated from the exostome using fine forceps. If spores obscure the peristomal structures, a drop of 95% ethanol will disperse the spores before the peristome is mounted in water. Treatment with ethanol also promotes the separation of the exostome and endostome, facilitating their dissection and observation. If no dehiscent capsules are available, peristome details often can be observed by removing the operculum from a nearly mature capsule by immersing the capsule in water on a microscope slide, adding a cover slip, and boiling gently, and sometimes repeatedly, causing the operculum to dehisce.

The variability of many of the species of *Bryum* makes identification of some material, especially if sterile, exceedingly difficult. Vegetative features are used to the greatest extent possible in the above key to N.Z. species. The key is intended as a guide to identification, but comparison to the descriptions, illustrations and, ideally, reliably determined specimens are often necessary for accurate identification. Many of our species have a distinct facies which permits their ready recognition. However, some of these features are difficult to incorporate into a conventional identification key. A fraction of *Bryum* collections will thus prove unidentifiable for even the most determined student. The initial collection of ample material with mature sporophytes is recommended for those wishing to become familiar with this genus. The production of an interactive key to regional representatives of *Bryum* would be a challenging and worthwhile project.

Many N.Z. *Bryum* spp. possess rhizoidal tubers in some populations and these can often facilitate species recognition. Tuber morphology is of particular taxonomic significance in the differentiation of species included in the “*B. erythrocarpum* complex” (see discussion under *B. duriusculum*). Examination of rhizoidal tubers may be accomplished by saturating a clump of several plants with water, and gently teasing apart the plant bases. Alternatively, tubers may be picked off the underside of a dry clod with damp forceps under a dissecting microscope. Where rhizoids are running adjacent to hard surfaces (e.g., a stone in the substrate) tubers are usually more abundant. Tubers can be sparse, even in species reputed to bear them consistently. Observations on tubers should be made in water mounts since some mounting media (notably Hoyer’s solution) alter their appearance, mainly by exaggerating the degree of cellular protrusions.

The recognised species are presented here in alphabetical order. However, a general discussion of the features of the distinctive “*B. erythrocarpum* complex” *sensu* Crundwell & Nyholm (1964) is given under the discussion of *B. duriusculum*, which is the most widespread member of the complex in N.Z. Six species of the “*B. erythrocarpum* complex” are accepted for N.Z.: *B. duriusculum*, *B. radiculosum*, *B. ruderale*, *B. sauteri*, *B. rubens*, and *B. tenuisetum*.

Although sharing features with other genera in either the Bryaceae or the Mniaceae (notably *Brachymenium* and *Pohlia*), the genus *Bryum* usually is easily distinguished by its rhombic-hexagonal laminal cells, mostly percurrent or excurrent costae, usually bordered and recurved leaf margins, and often cernuous or pendent capsules. Plants belonging to *Pohlia* generally have longer and narrower laminal cells and lack leaf borders, whereas *Brachymenium* (a genus not accepted for N.Z.) is predominantly epiphytic and more robust and has erect capsules with highly reduced endostomes.

A key to the N.Z. species of *Bryum* and its allied genera is presented above under the discussion of the family. In the descriptions, plant size definitions follow Ochi (1970, p. 14), and are based on the length of the largest stem leaves (including perichaetial leaves, but excluding the excurrent portion of the costa) as follows: robust, leaves >4.0 mm; large, leaves 3.0–4.0 mm; medium-sized, leaves 1.5–3.0; and small, leaves <1.5 mm.

Alternative keys to Australasian species of *Bryum* are provided by Ochi (1970) and Spence & Ramsay (2006).

Etymology: *Bryum* is derived from *bryon*, the Greek word for moss. It was “used by Dioscorides to refer to an unknown cryptogamic plant [and] applied to this genus and its relatives by Dillenius” (Crum & Anderson 1981).

Excluded Taxa: The names *Bryum affine* Lindb. & Arn. and *B. bimum* Scherb. have been used as a “dumping ground” for several disparate species in N.Z. The correct application of these and other names associated with them has been the source of taxonomic and nomenclatural confusion for some time (see Dixon 1926, p. 207; Smith 1973; Smith 2004, p. 564; Crum & Anderson 1981, pp. 553–558). The resolution of this taxonomic and nomenclatural tangle (also involving *B. creberrimum*, q.v.) is beyond the scope of the present work.

The name *Bryum chrysoneuron* Müll.Hal. was applied by several N.Z. workers (including Dixon, Sainsbury, Allison, and Linzey) to at least three tuber-bearing species (*B. duriusculum*, *B. sauteri*, and *B. clavatum*). Ochi (1970) attempted to refine the application of the name *B. chrysoneuron* but was unable to locate type material (collected by S. Mossman “ad flumen Wairoa-river prope portum Kaipara” in 1850). The holotype was probably destroyed in the WWII burning of the Berlin herbarium. Efforts to locate potential type material for this name in other herbaria have failed. Given the lack of identifiable type material, and uncertainty surrounding the application of Müller’s name, *B. chrysoneuron* is considered a *nom. dub.* and it is not applied in this work. A large proportion of the collections previously named as *B. chrysoneuron* are referable to *B. duriusculum*.

The highly variable *Bryum microerythrocarpum* Müll.Hal. & Kindb. has a Canadian type, is widespread in the northern hemisphere, and is recorded from N.Z. by Crundwell & Nyholm (1964). It is likely a later name for *B. duriusculum* Hook.f. & Wilson, which has a N.Z. type. The relationship between these two

species is best examined in a monographic context and *B. microerythrocarpum* is not discussed further in this work.

The name *Bryum obconicum* Hornsch. was applied to N.Z. material by Hooker & Wilson (1854, p. 85). That name has been applied to numerous collections in N.Z. herbaria that are referred here to *Rosulabryum capillare*. Syed (1973, p. 318) considered much material named as *B. obconicum* Hornsch. to belong to *B. torquescens* Bruch. In this treatment *Bryum obconicum* is not accepted as a member of the N.Z. flora.

***Bryum algovicum* Müll.Hal. in Müller, *Syn. Musc. Frond.* 2, 569 (1851)**

Etymology: The species epithet refers to the Algäu district in Bavaria.

***Bryum algovicum* var. *rutheanum* (Warnst.) Crundw., *Trans. Brit. Bryol. Soc.* 6: 137 (1970)**

≡ *Bryum pendulum* var. *rutheanum* Warnst., *Verh. Bot. Vereins Prov. Brandenburg* 14: 84 (1873)
Type: Europe. Not seen.

= *Bryum pendulum* (Hornsch.) Schimp., *Coroll. Bryol. Eur.*, 70 (1856) nom. illeg.

= *Bryum cuneatum* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 459 (1899)
Lectotype: N.Z., Kaikōura, R. Brown, CHR 335244!

Plants yellow- or brown-green, weakly lustrous, forming loose turves. **Stems** red-brown, c. (5–)10–30 mm, branching by subperichaetial innovation, beset below with moderately papillose brown rhizoids, in cross-section with 2–3 layers of thick-walled cortical cells and a distinct central strand. **Leaves** moderately crowded and larger at stem apices, erect-spreading when moist, becoming more erect when dry, ovate- or oblong-lanceolate, tapered to a slenderly acuminate apex, c. 1.8–2.2 × 0.7–0.8 mm (sometimes smaller on innovative branches) and with lamina c. 0.9 the total leaf length, concave, green throughout (except basal cells), weakly serrulate near apex but entire below, bordered by several rows of narrow but weakly differentiated cells, narrowly revolute, weakly decurrent; **upper laminal cells** rhombic-hexagonal to ± oblong, firm-walled (45–)51–60 × 15–18 μm and mostly 3–4:1, becoming longer (and merging with border) near apex, and longer (to c. 90 μm) and more oblong in lower leaf; **marginal cells** linear and ± thicker-walled to form a weakly defined border c. 5–6 cells wide and extending nearly to apex; **basal cells** ± shorter and broader, often red. **Costa** rather stout, usually red at base, excurrent. **Brood bodies** (including tubers) absent.

Synoicous. Perichaetia near base of plant; **perichaetial leaves** not differentiated. **Setae** c. (10–)20–35 mm, red-brown, cygneous just below capsule; **capsules** pendent, pyriform, 1.5–2.0 × c. 1.0 mm, with a weakly defined neck c. 1/3 the total length and scarcely wrinkled when dry; **operculum** conic. **Exostome teeth** yellow-brown, with adaxial lamellae joined by longitudinal or oblique thickenings; **endostome** adhering to the teeth; **segments** fragile in N.Z. material; **cilia** absent or rudimentary. **Spores** 21–36 μm (variable in a single capsule), nearly smooth.

Illustrations: Plate 1. Limpricht 1890–1895, p. 294; Crum & Anderson 1981, fig. 249; Smith 2004, fig. 181, 5–8.

Distribution: SI: Marlborough (Kaikōura), Canterbury (Waiau River, Cave Stream), Otago (Waikouaiti River estuary, Naseby, Cardrona Valley, Lake Wanaka).

Bipolar. Widespread in the northern hemisphere.

Habitat: On sand and silt at margins of streams and lakes. Collected once from a damp sand slack between sand hills in an estuary (at Waikouaiti River). Apparently common in abandoned gold sluicing channels at Naseby. From near sea level to 730 m. A frequent association with *Drepanocladus aduncus* suggests a preference for calcareous substrates.

Notes: The most striking macroscopic feature of this species is a peristome that appears single under the hand lens due to the adherence of the endostomal segments to the adaxial surface of the exostome teeth. The rather short (c. 2 mm), pyriform capsules are somewhat narrowed (but not constricted) at the mouth, providing an additional aid to recognition. Under the microscope the presence of longitudinal and oblique thickenings that extend between adjacent exostomal lamellae make this species unmistakable in a N.Z. context. The inter-lamellar thickenings result in the inner surface of the tooth appearing as a highly irregular lattice. *Bryum algovicum* var. *rutheanum* is not recognisable in a sterile condition.

New Zealand material has capsules somewhat shorter than descriptions in northern hemisphere floras suggest (cf. Crum & Anderson 1981, p. 542; Limpricht 1890–1895, p. 293). Crundwell (1970) indicated that the preferred name for synoicous forms of this species is *B. algovicum* var. *rutheanum* (Warnst.) Crundw. New Zealand material appears to be consistently synoicous and Crundwell's view is adopted here. Crum & Anderson (1981) presented an argument in favour of recognising a single inclusive taxon (*B. algovicum* Müll.Hal.) of variable sexuality.

The type material of *B. cuneatum* R.Br.bis was cited as a doubtful species by Ochi (1984), who referred the type to "*B. algovicum* or one of its allies." This collection is the sole Marlborough L.D. record of *B. algovicum* var. *rutheanum*. The gametophytic features of the type specimen (including its synoicous sexuality) and general capsule form are consistent with the present species. The precise nature of the exostome teeth ornamentation is not observable in the type, due to immaturity.

Sterile shoots or stems with elongate innovations could be confused with *B. pseudotriquetrum*, due to the decurrent leaf bases; however, the nature of the leaf apex and costae (more acuminate and elongate) differs from that species. *Bryum amblyodon* is another species with decurrent leaf bases and long-excurrent costae; the differences between *B. algovicum* var. *rutheanum* and *B. amblyodon* are discussed under the latter species.

Etymology: The identity of "Ruth" commemorated by the varietal epithet is unknown to me.

***Bryum amblyodon* Müll.Hal., *Linnaea* 42: 293 (1879)**

Type: Tucuman, Argentina. Not seen.

= *Bryum inclinatum* (Brid.) Blandow, *Uebers. Mecklenb. Moose*, (1809) nom. illeg.

= *Bryum stenotrichum* Müll.Hal., *Flora* 70: 219 (1887)

Plants bright- or yellow-green above, tinged with red below, forming compact turves. **Stems** red, c. 15–23 mm, branching (often repeatedly) by innovation, densely beset with red-brown, papillose rhizoids, in cross-section with firm-walled cortical cells and a very strong central strand. **Leaves** becoming larger and more crowded in comal tufts, erect when moist, twisted around stems and ± reflexed when dry, oblong-lanceolate, abruptly acuminate and finely awned, mostly 2–4 × 0.8–1 mm and with lamina c. 0.8 total length, concave, red at base, entire (or finely and distantly denticulate above), distinctly bordered and recurved at margins, weakly decurrent; **upper laminal cells** oblong-hexagonal, thin-walled, weakly porose, c. 48–66(–75) × 15–18 µm and 3–4:1, becoming longer near apex (and ± fusing with border near apex) and longer and more oblong in lower leaf; **marginal cells** linear and forming a well-defined border extending to apex; **basal cells** distinctly pigmented but not otherwise differentiated. **Costa** red below or nearly throughout, long-excurrent and filling the slender awn, which is entire or remotely denticulate. **Brood bodies** (including tubers) absent.

Synoicous. Perichaetia mostly several on each plant and overtopped by innovation, enclosed by enlarged comal tufts. **Setae** 35–45 mm, red, cygneous just below the capsule; **capsules** pendent, broadly clavate, c. 4 mm, with a well-defined neck c. ½ the total length, little altered when dry; **operculum** conic, not apiculate. **Exostome teeth** pale yellow-brown, often dark at base, acuminate at apices, with c. 25 or more lamellae; **endostome** from a high membrane, with fenestrate **segments** ± equal the teeth, and **cilia** rudimentary or lacking. **Spores** (20–)24–30 µm, finely papillose.

Illustrations: Plate 2.

Taxonomy: *Bryum stenotrichum* Müll.Hal. is treated as a synonym with reservation.

Distribution: SI: Nelson (Hoary Head, Mt Owen, Hopeless Creek), Canterbury (Arthur's Pass).

Apparently bipolar. Widespread in northern hemisphere. Recorded from Kerguelen and "higher altitudes and latitudes of South America" by Ochi (1982).

Habitat: On thin humus over marble, on outcrops, in talus, or boulder fields. The few documented Nelson L.D. collections are from 1220–1470 m elevation, while the single Canterbury collection came from an artificial habitat (crevices in concrete) at c. 750 m.

Notes: Microscopic examination of the peristome, and confirmation of synoicous sexuality is essential to the recognition of this species. The specimen recorded by Bartlett (1984) as *Bryum inclinatum* (Brid.) Blandow from Winter Peak (a subsidiary peak of Mt Arthur, Nelson L.D.) has not been available for study, but the identification is reasonable, given the known range and habitat of this species.

The type specimen of *B. amblyodon* has not been available for study. The name *B. imbricatum* (Schwägr.) Bruch & Schimp. was given to this species in Britain (Smith 2004). The application of the name *B. amblyodon* Müll.Hal. to N.Z. material of "*B. inclinatum*" was first suggested by H. Ochi (*pers.*

comm., July 1983). Anderson et al. (1990) cited *B. amblyodon* Müll.Hal. as the preferred name for "*B. inclinatum*" in their revised North American checklist.

The relationship of N.Z. *B. amblyodon* to *B. archangelicum* Bruch & Schimp. is not clear and is beyond the scope of this Flora. The latter species, and its highly confused synonymy and southern hemisphere distribution, is discussed by Ochyra et al. (2008, p. 484).

Recognition: Other synoicous species that have decurrent leaf bases and pigmented, excurrent costae (e.g., *B. pseudotriquetrum* and *B. algovicum* var. *rutheanum*) could be confused here, especially in the absence of peristome characters. *Bryum pseudotriquetrum* has shorter excurrencies and stouter costae, thicker-walled upper laminal cells, and smaller spores, as well as well-developed and appendiculate endostomal cilia. It occurs in generally wetter habitats than those favoured by *B. amblyodon*.

Bryum algovicum var. *rutheanum* is a taxon with a shorter (c. 1.5–2 mm) and more distinctly pyriform capsule with a less defined neck. The oblique thickenings between exostome teeth lamellae and the adherent nature of the endostome make *B. algovicum* var. *rutheanum* quite distinct from the present species. Also, *B. algovicum* var. *rutheanum* occurs mostly on sand and silt at stream and lake margins (rather than on calcareous rock) and at lower elevations than *B. amblyodon*.

The much commoner *B. clavatum* generally has more stoutly awned leaves, leaves evenly spaced (not comal) on its stems, and capsules often inclined to horizontal rather than pendent. It is usually associated with seepages, while *B. amblyodon* is more restricted in distribution and occurs in drier sites.

Etymology: The epithet *amblyodon* means blunt-toothed; it is perhaps a reference to the rudimentary cilia.

***Bryum appressifolium* Broth., Öfvers. Finska Vetensk.-Soc. Förh. 40: 175 (1898)**

Lectotype: N.Z., Otago, Mt Alfred, Jan. 1892, *W. Bell*, H-Brotherus 686003! Isolectotype: CHR 514106! (Syntypes in H cited by Ochi 1970, p. 38.)

= *Bryum buchananii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 450 (1899)

Lectotype: N.Z., Kaikōura, Hāpuku River, Jan. 1898, *R. Brown*, CHR 335150! (Cited by Ochi 1984, p. 179).

Plants brown- or olive-green, lustrous, forming loose turves on soil. **Stems** not visible through leaves, dark brown, 5–25 mm (rarely more), sparsely branched by innovation, beset with dark brown, very coarsely papillose rhizoids, in cross-section with firm-walled cortical cells and a distinct central strand. **Leaves** evenly spaced on stem, erect and imbricate when moist, only slightly more erect when dry, ovate-lanceolate, acuminate, with a single, weak plication on one or both sides of the leaf, 1.6–2.1 × 0.45–0.55 mm and with lamina 0.8–0.9 the total leaf length, moderately concave, ± olive-green throughout, entire, weakly bordered, not decurrent, and with margins strongly but narrowly revolute from base nearly to apex; **upper laminal cells** rhomboid-hexagonal, thick-walled, mostly 18–30 × 7–10 μm and 2–4:1, becoming more oblong but similar in size in lower leaf; **marginal cells** longer than adjacent cells to form a weak border at mid leaf, with a large but ill-defined group of ± quadrate cells near the lower margin; **basal cells** not differentiated, weakly brown- or rarely ± red-pigmented. **Costa** brown throughout or rarely red below, often with an adherent "tail" of cortical cells when removed from the stem, long-excurrent to form a concolourous awn. **Brood bodies** (including tubers) absent.

Dioicous. Perichaetia appearing lateral due to innovation; **perichaetial leaves** not differentiated.

Perigonia on short (c. 1 mm) lateral branches, the inner bracts c. 1 mm, enclosing numerous antheridia and filiform paraphyses. **Setae** 15–25 mm, red, cygneous just below capsule; **capsules** pendent, broadly obovoid, c. 2 × 1.0–1.2 mm, dark red-brown, with a wrinkled neck c. 1/3 the total length; **operculum** mammillate, bluntly apiculate, dark red at maturity. **Exostome teeth** yellow-brown, connate at base; **endostome** with broad, widely-perforate segments ± equal the teeth, and 3 well-developed, appendiculate **cilia**. **Spores** 8–10 μm, smooth.

Illustrations: Plate 3. Sainsbury 1955a, pl. 40, fig. 2; Ochi 1970, fig. 21 (as *B. australe*); Eddy 1996, fig. 419 (as *B. australe*); Spence & Ramsay 2006, fig. 43, i–o (as *Gemmabryum australe*).

Distribution: NI: N Auckland (Woodhill), S Auckland (Horahora, Waimangu Valley), Gisborne (Lake Waikaremoana, Hopuruahine River, Mt Maungapōhatu, Ruakituri River), Wellington (Okupata Caves); SI: Nelson, Marlborough (Hāpuku River), Canterbury, Westland, Otago, Southland (Longwood Range, Eyre Range, Waiau River); St.

Australasian? The extra-N.Z. distribution of this species is poorly documented. It was reported from Australia and Tasmania by Ochi (1970, as *B. australe*) and from New Guinea by Eddy (1996, p. 131, as *B. australe*). Spence & Ramsay (2006, as *Gemmabryum australe*) recorded it as rare from Australia, including Tasmania and also from South America. Records from Tasmania are particularly doubtful and are discussed below.

Habitat: On sand or silt in open river beds or over rock, often locally abundant and sometimes forming turves of several square metres. Also on glacial detritus, and generally in insolated and disturbed sites. Occurring in areas of various bedrock including limestone, schist, and greywacke. *Ceratodon purpureus*, *Breutelia pendula*, various *Bryum* spp., *Tridontium tasmanicum*, and *Racomitrium crispulum* s.l. are frequent associates. Occurring from near sea level to at least 830 m (and probably to 1000 m or more). *Bryum appressifolium* is a widespread and common species on the South I. The North I. distribution appears to be more localised and about half the collections from that island are from near Lake Waikaremoana.

Notes: The olive- or brown-green plants with elongate stems and densely spaced, erect-imbricate leaves with strongly recurved margins make *B. appressifolium* one of the most recognisable of N.Z. *Bryum* spp. The presence of a single rather weak plication on one or both sides of the leaf, mostly clearly visible when leaves are removed from the stem, facilitates recognition. The costae and basal leaf cells of *B. appressifolium* usually lack red pigmentation, but such pigmentation is present in a minority of populations. The dark red operculum is large in relation to the capsule.

Collections from the Godley Valley, Mt Cook N.P., Canterbury L.D. (CHR 241102) have more elongate stems (to c. 50 mm) and more slender and shorter (c. 1.5 mm) leaves than usual for the species. This material was probably collected from a wet habitat.

The Bell collection from Mt Alfred is selected from several syntypes (in H-Brotherus) as the most appropriate lectotype of *B. appressifolium* because it is, in addition to conforming with the protologue, representative of the species, amply fruiting, represented by an isolectotype in CHR, and bears some habitat information.

Ochi's (1970, p. 38) placement of *B. appressifolium* as a synonym of *B. australe* Hampe is not accepted; the type of *B. australe* (Preiss, Swan River, Western Australia, BM!) is a different species. *Bryum australe* differs from *B. appressifolium* by its non-imbricate leaves that do not obscure the stems, denticulate leaf margins, a stouter costa, and the absence of leaf plications.

Records of the present species in Tasmania are particularly doubtful. A duplicate of the single Tasmanian specimen that Ochi (1970) cited from there (as *B. australe*; *Weymouth 838*, CHR 630889) has been determined as *B. caespiticium*. Dalton et al. (1991) also excluded this species from the Tasmanian flora.

Recognition: *Bryum appressifolium* is sometimes confused with *B. caespiticium*. *Bryum caespiticium* has generally shorter stems (usually <5 mm), more elongate setae (commonly c. 40 mm), longer capsules (to c. 3.5 mm), and rhizoids that are more red-brown (compared to dark, ± chocolate brown) and less coarsely papillose than *B. appressifolium*. Its leaves also lack plications, are more narrowly recurved at their margins, lack a group of ± quadrate cells near the lower margin, have longer (to c. 60 µm) lower laminal cells, and red lower costae.

Confusion occasionally occurs between *B. appressifolium* and *B. dichotomum*. The latter is a less lustrous plant with nearly plane leaf margins and no plications; it normally produces axillary propagula, has red-brown rhizoids, larger (15–18 µm) spores, and nodose cilia.

The distinction between *B. appressifolium* and *B. crassum* is discussed under the latter species.

Etymology: The epithet *appressifolium* refers to the erect and imbricate leaves which obscure the stems.

***Bryum argenteum* Hedw., Sp. Musc. Frond., 181 (1801)**

Type: Europe. Not seen.

Plants silver and hoary, forming low, loose or ± dense cushions. **Stems** pale green, orange, or pink, sometimes darker below, c. 5–20 mm, much branched (often with numerous short, fragile, bud-like branches), sparsely beset below with pale brown, nearly smooth rhizoids, in cross-section with firm-walled cortical cells and a distinct central strand. **Leaves** not comose, gradually more crowded and larger near tip of stem, closely imbricate both moist and dry, broadly ovate and acute, shortly apiculate, acuminate or rounded-obtuse at apex, 0.6–0.8(–0.9) × c. 0.4 mm (when not compressed) and with lamina 100% the total leaf length, strongly concave, green or pink at base, hyaline above (rarely to mid leaf), entire or rarely denticulate at apex of acumen, not bordered, plane, not decurrent;

upper laminal cells rhomboid-hexagonal, colourless, and thin-walled near apex, firmer-walled below, c. 45–66 × 12–15 µm and 3–5:1, short-rectangular or quadrate in lower leaf; **marginal cells** not differentiated; **basal cells** quadrate and ± extending up margin, green. **Costa** rather thin, green, mostly ½ to ⅔ the leaf length, occasionally disappearing in acumen. **Brood bodies** (including tubers) absent in N.Z. material.

Dioicous. Perichaetia in branch axils; **perichaetial leaves** ovate-lanceolate, c. 1.2 mm long.

Perigonia terminal (but often appearing lateral due to innovations), bud-like, with the inner bracts brown, but otherwise scarcely differentiated and enclosing numerous antheridia and sparse, filiform paraphyses. **Setae** 7–15 mm, red, cygneous just below capsule; **capsules** pendent, obovoid to oblong-cylindric, 0.85–2.0 × (0.5–)0.7–0.8 mm, with a poorly defined neck c. ¼ the total length and wrinkled when dry; **operculum** conic, apiculate. **Exostome teeth** yellow-brown below, pale and finely baculate above; **endostome** with narrowly perforate segments nearly equal the teeth, and paired, nodose or weakly appendiculate **cilia**. **Spores** 9–15 µm, smooth.

Illustrations: Plate 3. Crum & Anderson 1981, fig. 265; Seppelt 2004, fig. 36; Smith 2004, fig. 185, 1–3; Spence & Ramsay 2006, fig. 37, a–g.

Distribution: K; NI: N Auckland, S Auckland, Gisborne, Hawke's Bay, Taranaki, Wellington; SI: Nelson, Marlborough, Canterbury, Otago, Southland; St; Ch; Ant; M. Reported from A (Vitt 1979) and C (Vitt 1974).

Cosmopolitan.

Habitat: A weedy species occurring in a wide variety of terrestrial habitats (soil, peat, rock, mortar, concrete, asphalt, roofs, decomposed animal remains, etc.). Often associated with nitrogen enriched habitats. Common throughout, and especially common in urban areas. From sea level to at least 2300 m.

Notes: The smooth or nearly smooth rhizoids of this species are anomalous in a N.Z. context.

Given the variability of terrestrial habitats occupied by *B. argenteum*, its considerable variability in respect to leaf form and degree of pigmentation of the laminal cells is not surprising. The so-called “variety *lanatum*” is considered here to be a mere environmental growth form whose slenderly acuminate leaf apices are associated with drier habitats. In some such material (e.g., G.O.K. *Sainsbury 1556* ex Lake Waikaremoana, Gisborne L.D., CHR 515869) the costa merges with the base of a denticulate acumen and appears excurrent.

Material of *B. argenteum* with rounded-obtuse leaf apices occurs very occasionally in N.Z. Such material (e.g., *D.R. Given 12350* from Acheron Valley, Marlborough L.D., CHR 267940) is lax in its growth form, often has fragile stems, and has a large group of chlorophyllose cells at the leaf base. This material is considered here to be a growth form associated with shaded habitats and to be unworthy of taxonomic segregation.

Apparently similar material with rounded-obtuse leaf apices from various sites in Australia was discussed by Spence & Ramsay (2006) under the name *B. subrotundifolium* A.Jaeger. They described this taxon as having “obtuse leaf apices, often cucullate leaves, broad laminal cells, the absence of a hair-point or apiculus, and basal laminal cells that are rectangular rather than quadrate”. However, an apparent isotype of *B. subrotundifolium* A.Jaeger (*D. Sullivan s.n.* from Mt Ararat, Victoria, CHR 637423) is wholly representative of *B. argenteum* and does not conform with Spence & Ramsay’s description. Seppelt (2004, p. 96) considered the relationship between *B. argenteum* and *B. subrotundifolium* in mainland Australia and continental Antarctica to require further study; it is considered here to be a taxon of dubious value. Ochyra et al. (2008) placed *B. subrotundifolium* A.Jaeger in the synonymy of what they termed *B. argenteum* var. *muticum* Brid. Further investigation of the identity and of the relationships of *B. subrotundifolium* are beyond the scope of this treatment.

Recognition: The most characteristic feature of *B. argenteum* is the colourless, thin-walled cells of the upper lamina. These dead cells are readily observed at low magnifications in both living and herbarium material, but become more difficult to see when dried herbarium material is moistened. The dead cells give the plants its distinctive silvery appearance. Crum and Anderson (1981, p. 572) aptly describe the “silvery *Bryum*” as having leaves “tightly crowded on small, catkin-like innovations”, which contrast with the pink or red capsules.

Bryum argenteum could be confused with the rare, pale, and often bud-like *B. funkii*; the differences between them are detailed under the latter species.

Etymology: The epithet *argenteum* refers to the silver colouration produced by the thin-walled and hyaline cells of the upper lamina.

***Bryum caespiticium* Hedw., Sp. Musc. Frond., 180 (1801)**

≡ *Gemmabryum caespiticium* (Hedw.) J.R.Spence, *Phytologia* 91: 497 (2009)

Type: Europe. Not seen.

= *Bryum austrobimum* Broth., *Öfvers. Finska Vetensk.-Soc. Förh.* 40: 177 (1898) — as *austro-bimum*

≡ *Bryum caespiticium* var. *austrobimum* (Broth.) Sainsbury, *Bull. Roy. Soc. New Zealand* 5: 272 (1955)
— as *austro-bimum*

Type: N.Z., Otago, Mt Alfred, Jan. 1892, *W. Bell*, H-Brotherus 608007! (Cited by Ochi 1970, p. 36.)

= *Bryum cylindrothecium* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 452 (1899)

≡ *Ptychostomum cylindrothecium* (R.Br.bis) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 63 (2005)

Lectotype: N.Z., South Island, Waikari, April 1882, *R. Brown*, CHR 335145! Isolectotype: BM-Dixon! (Cited by Ochi 1984, p. 180.)

= *Bryum torlessense* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 458 (1899)

Lectotype: N.Z., South Island, Mt Torlesse, Jan. 1886 and 1887, *R. Brown*, CHR 335245!
(Designated by Ochi 1984, p. 179.)

Plants yellow-green, ± lustrous, forming compact turves or tufts, comose. **Stems** red, to c. 8 mm, with numerous subperichaetial innovations but otherwise unbranched, beset below with brown, finely papillose rhizoids, in cross-section with 1–2 layers of firm-walled cortical cells and a distinct central strand. **Leaves** comose, erect-spreading when moist, moderately contorted when dry, oblong- or ovate-lanceolate, gradually tapered to a long-acuminate apex, c. 1.5–2.8 mm and with lamina 0.8–0.9 the total leaf length, concave, not plicate, ± red at base, entire or rarely finely denticulate near acumen base, bordered, narrowly recurved in lower $\frac{2}{3}$ of leaf or nearly to apex, not decurrent; **upper laminal cells** rhombic-hexagonal, firm-walled, mostly 45–60 × 12–15 µm and 3–5:1, often becoming longer at base of acumen (and merging there with cells of the border), becoming longer, thinner-walled and ± porose in lower leaf; **marginal cells** ± linear, forming a border 3–5 rows wide at mid leaf that usually extends to the leaf apex where it merges with elongate cells of the acumen; **basal cells** ± oblong in a few rows, usually red, a few cells in alar angles inflated in comal leaves. **Costa** red at base, excurrent (usually long-excurrent) to fill acumen. **Brood bodies** (including tubers) absent.

Dioicous. Perichaetia on short basal shoots, overtopped by few to several subtending innovations.

Perigonia terminal, the inner bracts c. 1 mm, enclosing numerous antheridia. **Setae**

c. 15–25(–45) mm, cygneous just below capsule, red; **capsules** pendent, oblong-clavate, 2–3 mm long, with a poorly defined neck c. $\frac{1}{3}$ the total length; **operculum** conic, apiculate, red-brown.

Exostome teeth yellow, hyaline near apex, finely papillose below, baculate near apex; **endostome** segments fenestrate; **cilia** (2–)3, appendiculate. **Spores** 9–12(–16) µm.

Illustrations: Plate 4. Catcheside 1980, fig. 154; Crum & Anderson 1981, fig. 257 I–N; Smith 2004, fig. 184, 7–10.

Distribution: NI: S Auckland (Te Akatea, Ātiāmuri, Murupara, Maungapōhatu), Gisborne (Marumaru), Wellington (Tangiwai); SI: Marlborough (Kaikōura, Inland Kaikōura Range), Canterbury, Westland, Otago, Southland (Franklin Range); Ch.

Cosmopolitan.

Habitat: On bare soil, often calcareous, in either dry or moist situations. Often in tussock grasslands and on river beds; sometimes in lawns. Occurring from 200 m to at least 950 m. *Ceratodon purpureus*, *Didymodon torquatus*, *Hypnum cupressiforme*, and *Weissia controversa*, as well as *Syntrichia* spp. (including *S. antarctica*) are common associates.

Notes: The yellow colouration, comose habit, relatively long upper laminal cells, long-excurrent costae, recurved and entire margins and pigmented basal cells combine to give this weedy species a distinct facies. The elongate upper laminal cells merge with the more elongate cells of the leaf border at the base of the awn (not illustrated here) in a manner that is distinctive.

Type material of *B. austrobimum* is aberrant by having larger (18–21 µm) than normal spores for this species. In other respects, however, it lies near the lower end of the range of continuous variability (e.g., setae c. 15 mm long) but is not remarkable for *B. caespiticium*. Despite its unusually large spores, *B. austrobimum* is not recognised here at any taxonomic level; this conforms with the opinion given by Ochi (1970, p. 36).

Ochi annotated the lectotype of *B. cylindrothecium* as *B. caespiticium* but apparently changed his mind concerning its identity, deciding to recognise it as distinct (cf. Ochi 1984, p. 180). *Bryum cylindrothecium* is not recognised here.

For unclear reasons Spence & Ramsay (2006) treated *B. caespiticium* as a heterotypic synonym of *Ptychostomum angustifolium* (Brid.) J.R.Spence & H.P.Ramsay. However, the basionym of the latter name is *B. angustifolium* Brid. (1817), which was published many years later than *B. caespiticium* Hedw. Spence & Ramsay's suggested nomenclature is not followed here.

Recognition: The golden coloration, crowded (comose) leaves, non-decurrent leaf bases, narrower upper laminal cells, more strongly excurrent costae (to c. 0.2 the total leaf length), dioicous sexuality and generally shorter capsules distinguish between the present species and *B. pseudotriquetrum*, a species with which it is sometimes confused.

Confusion sometimes occurs with *B. appressifolium*, but that species can normally be distinguished by the non-comose arrangement of its leaves, its shorter capsules with large, bright red opercula, and its lack of secondary pigmentation at the leaf base. *Bryum crassum* differs by having serial comae, less excurrent costae, and strongly incrassate laminal cells, which overall give the plant a much more robust and sturdy appearance.

Etymology: The species epithet means growing in tufts.

***Bryum clavatum* (Schimp.) Müll.Hal., *Syn. Musc. Frond.* 1, 292 (1848)**

- ≡ *Pohlia clavata* Schimp., *Ann. Sci. Nat., Bot. sér.* 2 6: 148 (1836)
- ≡ *Gemmabryum clavatum* (Schimp.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 66 (2005)
- ≡ *Imbribryum clavatum* (Schimp.) J.R.Spence & H.P.Ramsay, *Telopea* 15: 146 (2013)
 - Type: Chile, Quillota, *Bertero*, PC 136536. Not seen. (Image viewed online, JSTOR Global Plants, accessed 15 Jan. 2015.)
- = *Bryum clavatum* var. *extenuatum* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II* (Fl. Nov.-Zel.) Part II 84 (1854)
- ≡ *Bryum curvicolium* var. *extenuatum* (Hook.f. & Wilson) Hook.f., *Handb. New Zealand Fl.*, 442 (1867)
 - Holotype: N.Z., East Cape, A. *Sinclair*, BM-Wilson!
- = *Bryum erythrocarpoides* Müll.Hal. & Hampe, *Linnaea* 26: 495 (1855)
 - Type: Australia felix, Lofty Ranges near the third cataracts, F. *Müller*, BM 518198!; MEL 1000386!
- = *Bryum curvicolium* Mitt. in Hooker, *Handb. New Zealand Fl.*, 442 (1867)
 - Syntype: N.Z., Bay of Islands, *Logan* ("Hooker 2813"), BM-Wilson!
- = *Bryum varians* Müll.Hal., *Bot. Jahrb. Syst.* 5: 87 (1884)
 - Type: N.Z. Not seen.
- = *Bryum laevigatum* Broth., *Öfvers. Finska Vetensk.-Soc. Förh.* 40: 176 (1898)
 - Type: N.Z., Waingaro, 1896, D. *Petrie*, herb. Beckett 817, CHR 514102!
- = *Bryum levieri* Müll.Hal., *Hedwigia* 37: 92 (1898)
 - Type: N.Z. Not seen.
- = *Bryum macroerythrocarpum* Müll.Hal., *Hedwigia* 37: 92 (1898) — as macro-erythrocarpum
 - Type: N.Z., South Island, Ashley Gorge, April 1890, T.W.N. *Beckett* 374, CHR 514097! (Duplicate cited by Ochi 1970, pp. 29–30.)
- = *Bryum gracilithecium* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 453 (1899)
 - Lectotype: N.Z., South Island, West Coast Road, R. *Brown*, CHR 335143! (Cited by Ochi 1984, p. 180.)
- = *Bryum hapukaense* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 455 (1899)
 - Lectotype: N.Z., South Island, tributary of the River Hapuku ("Hapuka"), near Kaikōura, Jan. 1898, R. *Brown*, CHR 335138! (Cited by Ochi 1984, p. 180.)
- = *Bryum heterofolium* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 458 (1899)
 - Lectotype: N.Z., North Island, near Otaihape [Taihape], R. *Brown*, CHR 335246! (Cited by Ochi 1984, p. 180.)
- = *Bryum kirkii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 454 (1899) nom. illeg. non *Bryum kirkii* Broth. 1898
- = *Bryum linearifolium* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 453 (1899)
 - Lectotype: N.Z., South Island, near Ōamaru, R. *Brown*, CHR 335142! (Cited by Ochi 1984, p. 180.)

- = *Bryum macrocarpum* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 455 (1899) nom. illeg. non *Bryum macrocarpum* Hedw. 1801
- = *Bryum ventricosum* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 454 (1899)
Lectotype: N.Z., South Island, near Kaikōura, *R. Brown*, CHR 335141! (Cited by Ochi 1984, p. 180.)
- = *Bryum webbianum* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 452 (1899)
Lectotype: N.Z., South Island, near Waikari, *R. Brown*, CHR 335146! (Cited by Ochi 1984, p. 180.)
- = *Bryum schauinslandii* Müll.Hal., *Abh. Naturwiss. Vereins Bremen* 16: 502 (1900)
Type: Chatham I., von der grossen Lagune, *H. Schauinsland*. Not seen.
- = *Bryum forsterii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 35: 334 (1903)
Lectotype: N.Z., South Island, near Weston, 18 Nov. 1897, *R. Brown*, CHR 335161! (Cited by Ochi 1984, p. 180.)
- = *Bryum luteolimbatum* Broth., *Proc. Linn. Soc. New South Wales* 41: 589 (1916)
Type: N.Z., Auckland, Aug. 1896, *D. Petrie*, herb. Beckett 818, CHR 514100!

Misapplications: *Non Bryum clavatum* Hook.f. & Wilson, *hom. illeg.* (1854)

Plants brown- or red-green or bright green, small to medium-sized, not or slightly lustrous. **Stems** red-brown, to c. 5–10 mm, much branched below (often by subperichaetial innovation), beset with brown, papillose rhizoids below, in cross-section with firm-walled cortical cells and an ill-defined central strand. **Leaves** evenly spaced on stem, erect when moist and little altered when dry, oblong-lanceolate, acute and mostly stoutly cuspidate at apex, variable in size (mostly 1.0–1.8(–2.0) mm in fertile stems; mostly 0.7–1.2 mm on innovative branches and in sterile material) and with lamina mostly ≥ 0.85 the total leaf length, weakly concave, not plicate, variably coloured, entire or less often weakly denticulate, bordered, narrowly recurved on one or both sides or occasionally plane, not decurrent; **upper laminal cells** oblong hexagonal, firm-walled, c. $27\text{--}45 \times 9\text{--}12 \mu\text{m}$ and $3\text{--}4:1$, \pm shorter near apex, more oblong and slightly longer (to c. $54 \mu\text{m}$) below; **marginal cells** linear and thick-walled, forming a border of variable width (mostly (1–)3–6 cells wide at mid leaf), extending to near leaf base, becoming obscure near apex; **basal cells** subquadrate in a few rows, not pigmented. **Costa** stout, yellow- or red-brown, or occasionally golden-pink, excurrent to form a stout, acute, and entire cusp, less often percurrent. **Bulbils** sometimes present in upper leaf axils, broadly ellipsoid, c. $250 \times 100 \mu\text{m}$, red-brown at base and with 4–5 apical primordial leaves. **Tubers** sometimes present, red-brown, irregular, mostly 75–150 μm in greater diam., with protuberant cells.

Dioicous. Perichaetia in branch axils, usually near base of plant; **perichaetial leaves** triangular-lanceolate. **Perigonia** budlike in the axils of lower branches, c. 0.5 mm, the inner bracts smaller and more concave than vegetative leaves, with filiform, 5–6-celled paraphyses. **Setae** (7–)15–22(–40)mm, red-brown; **capsules** inclined, horizontal or cernuous, dark purple, narrowly clavate, with a well-defined neck (not well-illustrated here) c. $\frac{1}{2}$ the total length, strongly curved, and wrinkled when dry, (2.5–)3.5–5(–7.0) mm long; **operculum** conic, apiculate. **Exostome** pale; **endostome** not adhering to teeth, with broad, perforate segments c. the height of exostome teeth, **cilia** rudimentary, lacking, or well developed and nodose or rarely appendiculate (highly variable even in single capsule) 1–3(–4) in number. **Spores** (12–)20–27 μm .

Illustrations: Plate 5. Dixon 1926, pl. 9, p.p. (as *B. curvicollum*); Ochi 1970, figs 13–16 (as *B. erythrocarpoides*); Spence & Ramsay 2006, pl. 40, A–G (as *Gemmabryum clavatum*). The illustration in Seppelt 2004 (fig. 37, as *B. clavatum*) may be from anomalous material, with some costae shown as ending well below the leaf apices.

Distribution: K; NI: N Auckland, S Auckland (Waingaro), Gisborne, Hawke's Bay, Taranaki, Wellington; SI: Nelson, Marlborough, Canterbury, Westland (Barrack Creek, Franz Josef), Otago; Ch; A. Reported from M by Seppelt (2004) and Spence & Ramsay (2006).

Austral. Tasmania*, mainland Australia*, southern South America. Reported from South Africa by Ochi (1970, as *B. erythrocarpoides*). Spence & Ramsay (2006) treated *B. clavatum* in *Gemmabryum*, and recorded a wider distribution that included New Guinea, Lord Howe I., and the South Pacific.

Habitat: In seepages on outcrops of a wide variety of rock types (including basalt, greywacke, papa, limestone, and ultramafics) and on soil; often in wet road cuttings. Frequently coastal, but also common away from coastal influence. Forming dense cushions to at least 150 mm diameter. On North I. from sea level to c. 1220 m and to at least 850 m on South I. *Dicranella cardotii* is a frequent associate.

Notes: The commonly produced, narrowly clavate and strongly curved capsules (poorly illustrated here), in association with the stoutly excurrent costa, firm-walled laminal cells, entire and bordered leaves, and its usual occurrence on irrigated or damp ledges facilitate the recognition of *B. clavatum*. In its most common expression, with curved, inclined, dark purple capsules exceeding 4 mm in length, and relatively short setae, there is no species in N.Z. likely to be confused with *B. clavatum*. However, *B. clavatum* is an extraordinarily variable species and worthy of more detailed study. Microscopically, the relatively large spores are a useful recognition feature. Capsule dimensions and degree of endostomal cilia development vary considerably, even in single capsules. Endostome cilia range from nearly absent to 2–3, moderately developed, and nodose (the most frequent pattern), to rarely 3–4 and appendiculate.

Coastal material of *B. clavatum*, when sterile, tends to form distinctive compact cushions, usually on irrigated outcrops. A distinct appearance is provided by much-branched and closely packed stems with firm, dark green leaves scarcely exceeding 1 mm in length and stoutly excurrent, smooth costae. In such material the leaf border can be obscure (only 1–2 cells wide) and upper laminal cells somewhat smaller (c. 20–24 µm long) than in the description.

Ochi's (1970) extensive illustrations (as *B. erythrocarpoides*) convey an impression of the variability of this species. In his illustrations, the costae are invariably percurrent to excurrent; these illustrations accord with my own observations.

However, according to Beever et al. (1992) the costae of this species are "quite variable in length, and may fail before the apex or be excurrent in a stout point". According to J. Beever (pers. comm. 8 Apr. 2015) the late John Linzey also believed that leaves of this species, particularly those of innovative branches, could have costae failing in or below the leaf apices. Such leaves are illustrated from Macquarie I. by Seppelt (2004, fig. 37).

Confusion remains concerning the best name for what is here termed *B. clavatum* (Schimp.) Müll.Hal. The confusion is due mostly to questions surrounding the typification of the Chilean basionym *Pohlia clavata* Schimp. Schimper's protologue is clear that the type of *P. clavata* Schimp. was collected by Bertero in Quillota province in Chile in 1829. Type material is present in PC (PC 136536) and in BM (BM 517977); both can be viewed online (at JSTOR Global Plants).

Ochi annotated, in 1973, the fragmentary type in BM (517977); as: "Isotype of *Bryum clavatum* (Schimp.) C.Muell. *Bryum erythrocarpoides* C.Muell. & Hamp. seems to be conspecific with this species". The limited detail of this specimen observable online is consistent with Ochi's suggestion that the two taxa are conspecific.

The Schimper name was also applied to Australian material by Spence & Ramsay (2006, p. 297, as *Gemmabryum clavatum* (Schimp.) J.R.Spence & H.P.Ramsay), although they incorrectly based their concept of *Pohlia clavata* Schimp. on an early N.Z. collection by Logan, rather than the Bertero collection. Despite these irregularities, Spence and Ramsay's application of this name to Australasian material, albeit neither of their proposed nomenclatural combinations for it, is adopted here.

Of the four syntypes of *B. curvicolium* Mitt. (the name applied to *B. clavatum* by Sainsbury 1955a), only the ample material collected by Logan in BM has been seen. A duplicate of the Logan collection in herb. Mitten would be the most appropriate lectotype for this name.

Material to which J.T. Linzey (unpublished) and some subsequent workers gave the unpublished name "*Bryum ACC*" is confusing but is here treated as *B. clavatum*. One of the features of so-called "*B. ACC*" is its irregular red-brown tubers of 60–105 µm diam., with individual cells moderately protruding. These are indistinguishable from tubers in some populations of *B. clavatum* and some non-N.Z. species (especially *B. klinggraeffii* Schimp.) of the "*B. erythrocarpum* complex". Material of "*B. ACC*" can differ from the usual forms of *B. clavatum* by several loosely correlated features, including: a denticulate leaf awn, more compact basal leaf cells, pendent, shorter, and more symmetric capsules, longer and appendiculate endostomal cilia (often in groups of 3), more widely perforate segments, and smaller spores (c. 12–16 µm diam.). All these features, as well as tuber production, are associated with the "*B. erythrocarpum* complex". This, indeed, is the relationship that Linzey (unpublished) proposed for "*B. ACC*". However, the correlation between these character states is not strong. The confusing variety of character state combinations is not unlike what might occur in a hybrid swarm, although it does not result in malformed spores. The overall range of variation suggests that "*B. ACC*" should be included within *B. clavatum*.

Recognition: Species of the "*B. erythrocarpum* complex" have shorter, more pendent capsules with broader endostomal segments and better developed, more appendiculate cilia than the usual expressions of *B. clavatum*. Sterile material of some members of the "*B. erythrocarpum* complex" (e.g., *B. duriusculum*, *B. sauteri*) can also be difficult to distinguish from *B. clavatum*, but the denticulate vs the normally entire (in *B. clavatum*) leaf awn usually allows distinction. The shape and

diameter of the frequently produced red-brown, ± isodiametric tubers of *B. clavatum* clearly distinguish it from those two species.

Confusion between *B. clavatum* and other *Bryum* species can also occur. *Bryum caespiticium* (which can produce tubers) has more finely excurrent costae, consistently appendiculate cilia, broadly perforate endostomal segments, and smaller spores than *B. clavatum*. Sterile material of *B. dichotomum* can be difficult to differentiate from *B. clavatum* and the most reliable differences are the lack of a leaf border in the former, and the differing leaf shape.

The confusing variability of *B. clavatum* and the lack of clearly delimiting morphological boundaries between it and other species suggest that further study, perhaps using molecular techniques, would be worthwhile, but such investigations are beyond the scope of this Flora.

Etymology: The epithet refers to the typically narrowly clavate form of the capsule in this species.

***Bryum coronatum* Schwägr., Sp. Musc. Frond. Suppl. 1(2), 103 (1816)**

≡ *Gemmabryum coronatum* (Schwägr.) J.R.Spence & H.P.Ramsay in Spence, *Phytologia* 87: 66 (2005)

Syntypes: South America and Jamaica. Not seen.

= *Bryum pachytheca* Müll.Hal., *Syn. Musc. Frond.* 1, 307 (1848)

≡ *Gemmabryum pachytheicum* (Müll.Hal.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 64 (2005)

Type: Nova Hollandia “prope York”, *Preiss* 2466, BM-Hampe!

= *Bryum otahapaense* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 448 (1899)

Lectotype: N.Z., North I., “near Otahape” [Taihape], *R. Brown*, CHR 335156!

= *Bryum triangularifolium* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 451 (1899)

Lectotype: N.Z., North I., “near Otahape” [Taihape], *R. Brown*, CHR 335149!

Misapplications: *Bryum bicolor sensu* Ochi (1970)

Plants red- or yellow-green, dull, forming loose turves on soil. **Stems** red-brown, 7–10 mm, sparsely branched, beset below with red-brown, papillose rhizoids, in cross-section with firm-walled cortical cells and an ill-defined central strand. **Leaves** evenly distributed on stem, erect-spreading when moist, erect-appressed when dry, oblong- or ovate-lanceolate, acute, (0.6–)1.0–1.5 × 0.4–0.6 mm and with lamina 0.7–0.95 the total leaf length, concave, with secondary pigmentation restricted to costa, entire, very weakly bordered and narrowly recurved at margins, not decurrent; **upper laminal cells** hexagonal-rhomboid, firm-walled, mostly 4–5: 1 and 54–60 µm long, becoming slightly shorter and more irregular near apex, and more oblong in lower leaf; **marginal cells** longer (to c. 120 µm) and narrower in 2–4 rows to form a weak and ill-defined border at mid leaf; **basal cells** short and oblong, mostly red. **Costa** stout, not or variably tapered above, mostly red or red-brown, occasionally concolourous, long-excurrent to form a long and denticulate cusp. **Bulbils** (reduced bulb-shaped branches) often present in upper leaves, ellipsoid, mostly c. 2: 1, c. 200–240 µm long, mostly lacking primordial leaves.

Diocious. Perichaetia at base of plant; perichaetial leaves longer (to c. 1.8 mm) and more lanceolate than vegetative leaves. **Perigonia** not seen. **Setae** 8–14 mm, red-brown, strongly curved just below capsule; **capsules** pendent, broadly obovoid to elliptic, not constricted below the mouth when dry, with a short, rounded neck that is c. 1/3 the total capsule length, as wide or usually wider than the urn, strongly wrinkled when dry, and much darker than the urn (at least when fresh), c. 1.6–1.8 × 1.0–1.4 mm; **operculum** conic, large in relation to the capsule, usually minutely apiculate. **Exostome teeth** pale; **endostome** with fenestrate segments ± equal the teeth, and 2–3 well-developed, nodose or appendiculate **cilia**. **Spores** 8–10 µm.

Illustrations: Plate 6. Ochi 1970, figs. 8–9 (as *B. bicolor*); Scott & Stone 1976, pl. 52 (as *B. pachytheca*); Crum & Anderson 1981, fig. 264; Spence & Ramsay 2006, fig. 42, H–N (as *Gemmabryum coronatum*); Spence & Ramsay 2006, fig. 41, J–P (as *Gemmabryum pachytheicum*); McCarthy 2006, frontispiece (as *Gemmabryum pachytheicum*).

Distribution: NI: N Auckland (Epsom, Auckland Domain), S Auckland (Rotorua, Te Akatea), Wellington (Manawatū Gorge, Taihape); SI: Nelson (Nine Mile Beach), Otago (Herbert).

Cosmopolitan or nearly so.

Habitat: Occurring on bare or disturbed soil, sometimes with *Campylopus introflexus*, *Funaria hygrometrica*, *Weissia controversa* and other weedy species. From sea level to c. 500 m elevation.

Notes: N.Z. material that has been named as *B. pachythea* (Dixon 1929, p. 209; Sainsbury 1955a, p. 274; Fife 1995) is here referred to *B. coronatum* Schwägr.; N.Z. material does not differ significantly from reliably determined northern hemisphere specimens in CHR, or from descriptions in modern floras (e.g., Crum & Anderson 1981, p. 568).

The relationship between *B. coronatum* and the northern hemisphere *B. bicolor* is obscure and could be clarified only in a monograph. The name *B. bicolor* has generally not been applied to N.Z. material; in his discussion of Australasian *Bryum* spp., Ochi (1970, p. 21) applied the name *B. bicolor* Dicks. only to Australian material, yet, in the same paper, expressed the opinion that *B. pachythea* and *B. bicolor* were synonymous. Subsequently Ochi (1973) published a difficult-to-interpret statement suggesting he had changed his mind concerning this synonymy. *B. bicolor* is not considered further here, except to note that the concept of it presented by European authors (Wilczek & Demaret 1976; Smith & Whitehouse 1978) does not accord well with the concept for Australasia presented by Ochi (1970).

Dixon's (1926, p. 209) observations on this species (as *B. pachythea*) deserve repetition here: this species "is known at once from all its congeners by the capsule, which is turgidly elliptic or barrel-shaped with a short conical lid, with no tapering neck; the base of the capsule passes abruptly into the setae, and is when ripe and dry corrugate, often slightly wider than the sporangium, so that the whole bears no slight resemblance to an acorn in its cup; the capsule when properly matured is a deep purple-red."

Some herbarium material of *B. coronatum* appears to have the neck paler than the urn; this is apparently an artefact of drying, occurring when the capsules are not fully mature.

The invalid name *B. coronatum* var. *minus* Par. (based, apparently, on *B. coronatum* f. *minus* Hampe) has been applied to a small number of N.Z. collections in WELT. The specimens to which this name has been applied are not exceptional. The provenance of the type of the Hampe *forma* is obscure and these dubious taxa are not considered further.

Comparison of the lectotypes of *B. otahapaense* and *B. triangularifolium* suggests that they were likely segregated by R. Brown from a single collection made at or near Taihape (Wellington L.D.). The type of *B. otahapaense* is particularly fragmentary (with only one partial capsule) and difficult to name confidently. The features observable in the two specimens all suggest that they are referable to *B. coronatum*. One of the relevant specimens (CHR 335149) was annotated as *B. pachythea* by Ochi 1984, p. 181) while the other (CHR 335156) was cited by him (p. 180) as "*Bryum* cf. *coronatum*". Ochi's citation appears to be the only modern record of *B. coronatum* in the literature dealing with the N.Z. flora and the citation in Fife (1995) is based on it.

Recognition: Confusion is most likely between *B. coronatum* and *B. dichotomum*, with the latter being a more widely distributed and common plant in N.Z. In addition to the distinctive neck (wider and darker than the urn, and very strongly wrinkled) in mature material of *B. coronatum*, the fenestrate endostome segments, the smaller diameter spores, and the shortly apiculate operculum provide reliable diagnostic features. Gametophytic features are less reliable, but normally corroborate sporophytic features. Gametophytic features that help to distinguish *B. coronatum* (but no one of them sufficient alone) from *B. dichotomum* include narrowly recurved leaf margins, the mostly pigmented (red) basal leaf cells and costae, and axillary brood bodies, when present, that lack apical primordial leaves. In most plants, leaves in the lower portions of the stems are more strongly red pigmented than those of the upper stems; pigmentation can be restricted to the leaf bases and costae or may be diffused throughout the leaf. Most of the differentiating features cited here have been mentioned by earlier Australasian workers (e.g., Sainsbury 1955a; Ochi 1970; Scott & Stone 1976, all as *B. pachythea*). I concur with Ochi (1973, p. 23) that sterile material is often impossible to name confidently.

Etymology: According to Crum & Anderson (1981, p. 569), the species epithet "refers to its most distinctive feature, the curiously rounded neck of the capsules, which Schwägrichen likened to a crown".

***Bryum crassum* Hook.f. & Wilson in Wilson, Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II 86 (1854)**

≡ *Gemmabryum crassum* (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 66 (2005)

≡ *Imbribryum crassum* (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay, *Telopea* 15: 146 (2013)

Holotype: N.Z., "near Manukau Bay, west coast," *W. Colenso* 136, BM-Wilson! Isotypes: BM-Hooker!, WELT M003951!

Plants yellow-brown above, often red-brown below, not or scarcely lustrous, serially comose, forming rather compact turves. **Stems** red-brown, to c. 17 mm, usually branching by innovation but often with single branches arising from within a comal (perichaetial) whorl, densely beset with brown, coarsely papillose rhizoids, in cross-section with 2–4 layers of very thick-walled cortical cells and a distinct central strand. **Leaves** strongly comose, usually serially, erect-spreading when moist, tightly appressed but otherwise little altered when dry, oblong-ovate, gradually tapered to an acute, ± cuspidate apex, those of comae 2.0–2.5 × 0.6–0.75 mm and with lamina ± equal the total leaf length, concave, not plicate, lacking red secondary pigments, bluntly serrate or occasionally nearly entire (as illustrated here) near apex and entire below, very weakly bordered and strongly revolute at margins, not decurrent; **upper laminal cells** oblong-rhombic, thick-walled, not porose, c. 21–30 × 7–8 μm and mostly 3–4:1, not altered at apex, becoming longer (to c. 54 μm) in lower half of leaf, those adjacent to the costa (at mid leaf) oriented obliquely; **marginal cells** ± elongate in c. 5 rows at mid leaf to form a very weak border (obscured by revolute margins); **basal cells** shortly rounded-oblong in several rows, the lowermost ± brown (never red). **Costa** concolourous with lamina, mostly short-excurrent in a small cusp. **Brood bodies** (including tubers) absent.

Diocious. Perichaetia usually hidden by 2–4 innovative branches; **perichaetial leaves** ± larger than vegetative leaves but not otherwise differentiated. **Perigonia** terminal, the inner bracts much smaller than surrounding comal leaves, enclosing numerous antheridia. **Setae** c. 15–25 mm, red-brown, cygneous just below capsule; **capsules** horizontal or pendent, oblong-cylindric, 2.0–2.7 × c. 0.8 mm, with an ill-defined neck c. 1/3 the total length and scarcely altered when dry; **operculum** conic and bluntly apiculate. **Exostome teeth** pale throughout, finely striolate below, weakly baculate near apices; **endostome** with perforate (not fenestrate) segments equal the teeth, and well-developed appendiculate **cilia** in groups of 3. **Spores** 8–10 μm, smooth.

Illustrations: Plate 6. Wilson 1854, pl. 86, fig. 1; Ochi 1970, fig. 23.

Distribution: NI: N Auckland (Manukau Harbour) including offshore islands (RT), S Auckland, Gisborne (Te Tiki), Hawke's Bay (Wairoa), Wellington (Mt Ruapehu); SI: Nelson (Cobb Valley), Otago (Wānaka).

Australasian. Tasmania*. Reported from mainland (south-eastern) Australia by Scott & Stone (1976) and others.

Habitat: This species is common and widespread on the central volcanic plateau (S Auckland L.D.) but is less well known elsewhere. On soil, mostly in dry, open situations in tussock grassland or manuka (*Leptospermum scoparium*) and/or *Dracophyllum* scrub. Commonly associated species include *B. caespiticium*, *Campylopus introflexus*, *Ceratodon purpureus*, *Chrysoblastella chilensis*, and the lichen *Cladia aggregata*.

Notes: The serially comose habit together with strongly but narrowly recurved leaf margins, and short-excurrent costae give *B. crassum* a distinctive aspect. Microscopically, the very incrassate and non-porose laminal cells, together with the obliquely oriented juxtacostal cells provide distinction from all other N.Z. species. The leaf dimensions given are for well-developed leaves in the comae. Generally, the leaves of the lower stem are much smaller (often <1 mm) and increase in size abruptly in the comal whorls, with only the best-developed leaves >2 mm in length. The peristome teeth typically have c. 25–30 trabeculae. This feature was given some emphasis by Scott & Stone (1976, p. 284), but appears to have little diagnostic value.

Recognition: *Bryum crassum* differs from *B. appressifolium* (which also has strongly revolute leaf margins) by having a strongly comose habit, much less strongly excurrent costae, and the peculiar oblique orientation of the juxtacostal laminal cells. *Rosulabryum subtomentosum* and *R. billardierei* both differ from *B. crassum* in having porose, non-obliquely oriented laminal cells, stronger leaf borders of elongate cells, and more spreading leaves with recurved apices.

Confusion is also possible between *B. crassum* and *B. campylothecium* but the latter species (q.v.) differs by a number of features, including excurrent costae that form stout, elongate awns.

Etymology: The epithet *crassum* means thick and probably refers to the incrassate nature of the laminal cells.

***Bryum creberrimum* Taylor, London J. Bot. 5: 54 (1846)**

≡ *Ptychostomum creberrimum* (Taylor) J.R.Spence & H.P.Ramsay in Spence, *Phytologia* 87: 23 (2005)
Lectotype: Australia, Western Australia, Swan River, 1843, *J. Drummond*, FH-Taylor!
(Designated by Demaret 1986).

= *Bryum austropallescens* Broth., *Öfvers. Finska Vetensk.-Soc. Förh.* 40: 178 (1898) — as *austropallescens*
Lectotype: N.Z., Otago, Pine Hill, Nov. 1889, *W. Bell*, H-Brotherus 608009!

Misapplications: *B. affine sensu* Sainsbury (1955a), *pro parte*

Plants yellow-green, forming rather dense turves. **Stems** red, to at least 23 mm, branching repeatedly by innovation, beset below with brown, papillose rhizoids, in cross-section with a distinct central strand. **Leaves** evenly spaced on sterile stems and innovations, larger and ± crowded at tips of male branches, erect-spreading when moist, spiralled around the stem when dry, ovate-lanceolate (widest below mid leaf), abruptly tapered to an acute apex, c. 1.3–2.3 mm long (excluding perichaetial) and with the lamina ≥0.9 the total leaf length, moderately concave, with red pigments restricted to costa, entire, bordered, and recurved at margins, not decurrent; **upper laminal cells** rhombic-hexagonal, firm-walled, not or weakly porose, c. 40–65 µm long and c. 4–5:1, scarcely differentiated near apex, more oblong but not larger in lower leaf; **marginal cells** distinctly or weakly differentiated, usually forming a well-defined border c. 3–5 cells wide at mid leaf and extending to apex; **basal cells** not pigmented. **Costa** stout (c. 60 µm wide at mid leaf), red at base, excurrent to form a short or elongate and denticulate awn (sometimes percurrent in smaller leaves). **Brood bodies** (including tubers) absent.

Autoicous (with unisexual perichaetia and terminal perigonia) or less commonly polygamous. **Perichaetia** basal, often 2 or more on one plant, overtopped by innovations, sometimes with a few intermixed antheridia in N.Z. material; **perichaetial leaves** more narrowly lanceolate and with more excurrent costa than vegetative leaves. **Perigonia** terminal on innovative branches, with bracts ± comal and more spreading than adjacent leaves, enclosing numerous antheridia and filiform paraphyses. **Setae** mostly 25–35 mm, red, cygneous just below the capsule; **capsules** pendent, 2.5–3 mm, oblong-cylindric, narrowed below mouth when dry, with a well-defined neck c. 1/3 the total length; **operculum** low-conic and apiculate. **Exostome teeth** pale brown; **endostome** with broadly perforate segments separated by groups of 3 mostly appendiculate **cilia**. **Spores** 10–18(–24) µm, nearly smooth.

Illustrations: Plate 7. Catcheside 1980, fig. 149; Demaret 1986, fig. 2.

Distribution: SI: Canterbury (Broad Stream, Mt Cook Range), Otago (Kinloch, Pine Hill, Naseby). Bipolar? The species boundaries and consequently the distribution of this species are poorly understood. Spence & Ramsay (2006, p. 326, as *Ptychostomum creberrimum*) record it from Tasmania and several mainland Australian states and indicate it to be “a pantemperate species in both hemispheres”.

Habitat: The habitat preferences of this species are poorly known in N.Z.; several collections from Naseby are from c. 610 m. Catcheside (1980, p. 260) indicates this species grows on basic substrates in South Australia.

Notes: In N.Z. *B. creberrimum* and its ally *B. pallescens* are both variable and poorly represented in herbaria. *Bryum creberrimum* is here treated to include material with a considerable range of spore size. The Western Australian type collection has smaller spores, more excurrent costae, and less distinct leaf borders than most N.Z. populations. The lack of correlation between sexuality and spore size characters makes some N.Z. material difficult to name confidently.

Intermediate material occurs from, e.g., Mt Owen, Nelson L.D. (*A.J. Fife* 5103, CHR 185996 and *J.K. Bartlett* 22532, CHR 350050) and near Homer Tunnel, Southland L.D. (*W. Martin* 924, CHR 579237). These collections have some or all plants synoicous, and relatively large (c. 3 mm) oblong-cylindric capsules. The Homer Tunnel collection was recorded by Sainsbury (1955a, p. 271) as *B. affine* (Bruch) Lindb., but no purpose is served by recognizing yet another “species” allied to this intergrading and confusing species pair.

The confusion surrounding *B. creberrimum*, and the several taxa that have been confused with it in Australasia, was discussed nearly a century ago by Dixon (1926, p. 207). Sainsbury (1955a) appears to have followed Dixon; he treated the material considered here to be *B. creberrimum* and

B. pallescens as *B. austropallescens* Broth. and *B. affine* (Bruch) Lindb., respectively. The detail of the relationship between *B. creberrimum* and its close allies remains poorly understood in N.Z., and in other regions where it occurs.

Ochi (1970, p. 48) considered *B. creberrimum* Taylor to be a synonym of what he termed *B. capillare*, and this was followed by Fife (1995), while Syed (1973, p. 318) seems to have been the first to propose that *B. creberrimum* Taylor is the earliest name for a widespread species known "by the illegitimate name *B. affine* Lindb." Examination of the lectotype of *B. creberrimum* in the Taylor herbarium confirms that it is not *R. capillare*. Whether *B. creberrimum*, based on an Australian type, is conspecific with northern hemisphere material of "*B. affine* Lindb." is a problem requiring monographic study and is beyond the scope of this Flora.

Recognition: *Bryum creberrimum* in N.Z. is most readily recognizable by its ovate-lanceolate, entire leaves with firm-walled laminal cells, which are non-comose and twisted spirally around the stem when dry. The endostome has appendiculate cilia, usually in 3s (sometimes in 2s or with some cilia nodose). Most of the material is autoicous (i.e., with unisexual perichaetia at or near the plant base, and unisexual perigonia at the apex of elongate innovations), as is the sexuality of the lectotype.

The spirally twisted dry leaves of *B. creberrimum* invite confusion with *Rosulabryum capillare*. *Bryum creberrimum* has vegetative leaves that are widest below the middle (\pm ovate-lanceolate), with firmer-walled and wider laminal cells, and stouter, less strongly excurrent costae. No rhizoidal tubers have been seen and the sexuality is \pm consistently autoicous. By comparison, *R. capillare* has \pm spatulate leaves with thinner-walled and generally narrower laminal cells, narrower and long-excurrent costae, and conspicuous rhizoidal tubers. Most N.Z. *R. capillare* is synoicous.

Etymology: The meaning of the epithet is unclear. *Creber* means pressed together and the epithet may allude to its forming rather dense turves.

***Bryum dichotomum* Hedw., Sp. Musc. Frond., 183 (1801)**

\equiv *Gemmabryum dichotomum* (Hedw.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 66 (2005)
Lectotype: N.Z. (Designated by Ochyra et al. 2008, p. 462.) Not seen.

= *Bryum kirkii* Broth., *Öfvers. Finska Vetensk.-Soc. Förh.* 40: 179 (1898)

Isotype: N.Z., Canterbury, Otarama, April 1892, *T.W.N. Beckett* 517, CHR 514099!

= *Bryum ovalicarpum* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 451 (1899)

Lectotype: N.Z., Christchurch, Aug. 1898, *R. Brown*, CHR 335147!

= *Bryum ovatocarpum* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 451 (1899)

Lectotype: N.Z., Governors Bay, Port Lyttelton, Nov. 1889, *R. Brown*, CHR 335148!

= *Bryum ovatothecium* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 449 (1899)

Lectotype: N.Z., Banks Peninsula, Port Lyttelton Hills, April 1882, *R. Brown*, CHR 335154!

= *Bryum petriei* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 450 (1899)

Lectotype: N.Z., West Coast Road, *R. Brown*, CHR 335151!

= *Bryum waikariense* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 448 (1899)

Lectotype: N.Z., South Island, near Waikari, April 1882, *R. Brown*, CHR 335157!

= *Bryum webbii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 449 (1899)

Lectotype: N.Z., near River Ashburton, *R. Brown*, CHR 335153!

= *Bryum urceolatum* Schimp. in Dixon, *Bull. New Zealand Inst.* 3: 217 (1926) nom. inval.

Plants yellow- or bright green, usually rather dull, forming loose turves on soil. **Stems** pale or red-brown, 7–15(–20) mm, sparsely branched, sparsely beset with red-brown, papillose rhizoids, in cross-section with firm-walled cortical cells and a distinct central strand. **Leaves** evenly spaced on stem, erect both moist and dry, ovate or ovate-lanceolate, acute, 0.7–1.4(–1.6) \times 0.3–0.7 mm (lamina rarely >1.2 mm long) and with lamina 0.75–1.0 the total leaf length, concave, lacking secondary pigmentation, entire or nearly so, not or very weakly bordered and \pm plane at margins, not decurrent; **upper laminal cells** hexagonal or rhombic, firm-walled, 27–39(–60) μ m long and 3–5:1, becoming slightly shorter and more irregular near apex and more oblong in lower leaf; **marginal cells** somewhat longer (to c. 54 μ m) and narrower in 2–4 rows to form a very weak and ill-defined border; **basal cells** short and oblong, not coloured. **Costa** stout, scarcely tapered, green or green-brown, short- or long-excurrent, or percurrent, usually forming a rigid, concolourous or apically hyaline, smooth or denticulate elongate cusp. **Brood bodies (bulbils)** usually present in upper leaf axils, obovoid or ellipsoid, variable in size (to c. 425 μ m long) but mostly 1.5–2:1, with several primordial leaves occupying $\frac{1}{3}$ to $\frac{1}{2}$ the bulbil length; **tubers** absent (but see discussion below).

Dioicous. **Perichaetia** at base of plant; **perichaetial leaves** longer and more ovate-lanceolate and with costa more strongly excurrent (to c. $\frac{1}{4}$ the total leaf length). **Perigonia** terminal or overtopped by innovation, the inner bracts more concave and pigmented, but otherwise similar to vegetative leaves, enclosing antheridia and filiform (c. 6-celled) paraphyses. **Setae** c. 6–10 mm, red-brown, strongly curved just below capsule; **capsules** pendent or horizontal, obovoid, strongly constricted below the mouth when dry, c. $1-1.5(-2.0) \times 0.7-1.1$ mm, with an ill-defined concolourous neck c. $\frac{1}{3}$ the total capsule length, as wide as or wider than the urn and strongly wrinkled when dry (poorly illustrated here); **operculum** lowly conic, not apiculate. **Exostome teeth** pale; **endostome** with narrowly perforate segments, \pm equal the teeth, and moderately well developed, paired, and nodose **cilia**. **Spores** c. 15–18 μm .

Illustrations: Plate 8. Hedwig 1801, tab. 42, figs. 8–12; Ochi 1970, figs. 5–7; Seppelt 2004, fig. 38; Spence & Ramsay 2006, fig 42, x–ee (as *Gemmabryum dichotomum*); Ochyra et al. 2008, fig. 211.

Distribution: K; NI: N Auckland, S Auckland (Te Kowhai, Coromandel Peninsula, Kaingaroa Plains), Gisborne (Arakihi, Marumaru, Lake Waikaremoana), Hawke's Bay (Ruakituri Valley, Napier), Taranaki (Mt Messenger), Wellington; SI: Nelson, Marlborough (Waima River), Canterbury, Westland (Franz Josef Glacier, Fox Glacier), Otago, Southland (Doubtful Sound); Ch. The above distribution is based on fertile collections only and undoubtedly understates the occurrence of this species.

Cosmopolitan. Tasmania*, mainland Australia*. Ochi's (1985) assessment that this species is "widespread in every continent throughout the world" is accepted here. The range given by Ochyra et al. (2008, p. 464–467) for the "whole *B. dichotomum* complex" accords with Ochi.

Habitat: On bare soil generally, including road cuts, sand dunes, and coastal banks; especially common on calcareous substrates. Also occurring in urban situations (footpaths, disturbed soil, etc.). On South I. this species ranges from sea level to at least 730 m. Frequently associated moss species include *B. laevigatum*, *Ceratodon purpureus*, *Desmatodon convolutus*, *Funaria hygrometrica*, *Philonotis tenuis*, *Tortula muralis*, and *Weissia controversa*.

Bryum dichotomum is a member of the so-called "*B. bicolor* complex" (*sensu* Wilczek & Demaret 1976).

Notes: The name *B. dichotomum* has been used as a catch-all for difficult *Bryum* material by many N.Z. botanists, and collections assignable to at least (but probably more than) three species have been incorrectly assigned to this species. Even with the removal of the clearly misnamed material, the morphological variability of this species is perplexing and other allied species (of the "*B. bicolor* complex") may be present.

Sterile material that is probably referable to *B. dichotomum* (e.g., *B.H. Macmillan 89/140 ex* Christchurch, CHR 413677) tends to bright yellow-green, with stems usually c. 10–14 mm and plants often rather lax in appearance. The leaves have plane, unbordered margins; green and percurrent to excurrent costa (usually more excurrent near the stem apices); green leaf bases; and abundant bulbils. While such material has a characteristic facies, a large proportion of sterile material cannot be named confidently and sterile collections are not incorporated into the above distribution. Several sterile collections from Marlborough L.D. can be only tentatively named. Sterile material from St, Sol, A, and C, differs from the usual form by having distinctly but narrowly recurved, bordered leaf margins. A sterile collection from the Longwood Range, Southland L.D. (*W. Martin*, 1 Sep. 1950, CHR 515105), allied to the *B. bicolor* complex, is of special interest. The presence of distinct leaf borders, decurrent leaf bases, and unusual bulbil morphology precludes its placement in either *B. dichotomum* or *B. coronatum*. The material has stems 10–15 mm, with leaves that are ovate-lanceolate to lanceolate, c. 1.2–2 mm long, plane at margins, distinctly bordered (c. 4 cells wide at mid leaf), and decidedly decurrent. The upper laminal cells are firm-walled and mostly 30–45 μm long. The upper leaf axils bear 3–5 broadly obovoid bulbils, each c. $235-290(-380) \times 140-150$ μm , and with 3–4 leaf primordia occupying c. $\frac{1}{2}$ their total length. This material may represent a species previously unrecorded from N.Z. or be undescribed, but it is too sparse to justify formal description.

Recognition: When fruiting, the extremely short, obovoid, horizontal to pendent capsules provide distinction for *B. dichotomum* from other congeneric N.Z. species, with the exception of *B. coronatum*. My experience is that the capsule neck in *B. dichotomum* can be quite rough when dry, in contrast to the observations of Ochi (1970, p. 20) that it is "relatively smooth and never corrugate". This is not accurately illustrated in Plate 8, A. In *B. dichotomum*, however, the capsule neck in fresh material is concolourous with the urn at maturity, distinguishing it from *B. coronatum*, where the neck is usually much darker than the urn. Microscopically, the width of the endostomal segment perforations (narrow in *B. dichotomum* vs fenestrate in *B. coronatum*) and spore diameter (c. 15–18 μm in *B. dichotomum* vs 8–10 μm in *B. coronatum*) facilitate distinction between these two species. The nature of the leaf

margins, the degree of secondary pigmentation of the leaves, and the presence of primordial leaves on bulbils also provide helpful distinctions from *B. coronatum*.

Confusion can occur (with sterile material) with *B. clavatum*, but the very weak leaf border and plane or nearly plane margins in *B. dichotomum* allow distinction in all but a few instances. When fruiting, capsule morphology readily distinguishes the two species.

Confusion sometimes occurs between *B. dichotomum* and *B. sauteri*; both form compact, bright yellow-green turves when sterile, and often occur in coastal situations. Like *B. dichotomum*, *B. sauteri* has stout, usually excurrent costae, and firm-walled upper laminal cells, but the more strongly bordered and recurved leaf margins, and the nearly constant presence of rhizoidal gemmae in *B. sauteri* allow separation in most instances. Also, *B. sauteri* lacks bulbils and has pyriform capsules with the neck narrower than the urn, which is a useful character when it is fruiting. In my experience, *B. dichotomum* lacks rhizoidal tubers. However, tubers (differing in morphology from those of *B. sauteri*) are recorded and illustrated from this species in Britain (Porley 2008, p. 61). J. Beever (pers. comm. 5 Mar. 2009) informs me that she has seen tuber-bearing material of *B. dichotomum* from N.Z. Spence & Ramsay (2006, p. 301) stated that “red globose [tubers are] sometimes present” in this species in Australia. Gall-like swellings on rhizoids also occur in some populations of *B. dichotomum*.

Bryum appressifolium, sometimes confused with *B. dichotomum*, is a more lustrous plant with leaves erect-imbricate and strongly recurved leaf margins.

Etymology: The meaning of the epithet is unclear; Hedwig’s (1801) protologue provides no hint as to its meaning.

***Bryum duriusculum* Hook.f. & Wilson in Wilson, Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II 84 (1854)**

Lectotype: N.Z., North Island, *Lyall* 232, BM-Hooker!

= *Bryum bellii* Müll.Hal., *Hedwigia* 37: 93 (1898)

Type: N.Z., Otago, Pine Hill, Nov. 1890, *W.Bell*, herb. T.W.N. Beckett 373, CHR 514098!

= *Bryum malacodictyon* Müll.Hal., *Hedwigia* 37: 92 (1898)

Type: N.Z., Westland, prope Greymouth, *R. Helms* 58, herb. T.W.N. Beckett 760, CHR 515517!

Misapplications: *Bryum microerythrocarpum sensu* Scott & Stone (1976); *sensu* Beever et al. (1992)

Stems to c. 15 mm, beset below with red-brown rhizoids. **Leaves** evenly spaced on stem, erect-spreading when moist, becoming more erect and narrowed when dry, ovate- or elliptic-lanceolate, acute, denticulate above, weakly bordered and ± recurved at margins, neither plicate nor decurrent, 1.0–1.6 × 0.3–0.5 mm, with lamina forming 0.85–0.9 of entire length; **mid laminal cells** firm-walled, c. 30–60 × 9–12 µm; **marginal cells** elongate in 1–2 rows and forming a very weak border. **Costa** stout and excurrent to form a denticulate awn. **Tubers** ± spherical, oblong, or somewhat irregular, (225–)260–350 µm diam., brown or red-brown, c. 10 cells across, with cells strongly or scarcely protruding (a few tubers sometimes on short rhizoids in leaf axils).

Dioicous. Perichaetia 1–3 per shoot, often appearing axillary due to innovation, with leaves narrowly lanceolate or deltoid. **Perigonia** not seen. **Setae** c. 20–45 mm, red; **capsules** weakly constricted below mouth when dry, (1.8–)2.0–3.5 mm long; **operculum** conic and apiculate. **Exostome teeth** red-brown below, pale and finely baculate above; **endostome** with 2–3 appendiculate **cilia**. **Spores** 9–12 µm.

Illustrations: Plate 9. Beever et al. 1992, fig. 40 h (as *B. microerythrocarpum*).

Distribution: K (sterile material only); NI: N Auckland, S Auckland, Gisborne (Lake Waikaremoana, Mt Manuoha, Ōhinepākā), Hawke’s Bay (Wairoa, Matamau), Wellington (Ruahine Range, Akatarawa); SI: Nelson (Farewell Spit), Marlborough (Kenepuru and sterile material from Blue Duck Reserve), Canterbury (Arthurs Pass), Westland (Ōtira, Lake Brunner, and sterile material from Hokitika); Otago (Dunedin, Pine Hill), Southland (Mosburn, Puysegur Point); St (fertile and sterile material); Ch (sterile material only); C (fertile and sterile material). Localities given are for fertile material unless specified.

Probably widespread outside N.Z. but no attempt has been made to summarise the extra-N.Z. distribution because the relationship to *B. microerythrocarpum* Müll.Hal. & Kindb. needs monographic study for clarification.

Habitat: On sandy or humic soil, sometimes in bogs, often beneath manuka (*Leptospermum scoparium*) and sometimes on charred soil; from low elevation to at least 1130 m (on Mt Ruapehu,

Wellington L.D.). *Bryum duriusculum* occurs on acidic and often coarsely grained soil. Rarely epiphytic on accumulated humus. Very often growing mixed with *Ceratodon purpureus*, as well as *Campylopus introflexus*, *Funaria hygrometrica*, and *Leptobryum pyriforme*.

Notes: *Bryum duriusculum* is the most widespread and commonly collected representative of the “*B. erythrocarpum* complex” (discussed below) in N.Z. Much of the N.Z. material referred by previous workers to *B. chrysoneuron* Müll.Hal. (see “Excluded Taxa” above) is referable here. *Bryum duriusculum* is the earliest typifiable name for N.Z. material of the complex with large (c. 260–350 µm), spherical, red-brown tubers.

Wilson's citations of *B. duriusculum* syntypes are difficult to interpret. However, in Wilson's herbarium, his handwritten description refers clearly to *Lyll* 232 and *Colenso* 67b. Neither of these collections are attached to the same sheet as the description, however material of *Lyll* 232, annotated by Wilson, is present in the Hooker herbarium. This material bears both capsules and the rhizoidal tubers necessary for the confident determination of a species in the *B. erythrocarpum* complex, and is therefore designated the lectotype. *Bryum duriusculum* is probably an earlier name for the widespread *B. microerythrocarpum* Müll.Hal. & Kindb., which is discussed under “Excluded Taxa” above.

Material from the Pongakawa River (S Auckland L.D.; *K.W. Allison* 2466, CHR 490334) has very sparse tubers with morphology typical of the species, but its overall habit is laxer than other collections. It grew immersed or nearly so in a permanent spring and is referred here with reservation.

Recognition: *Bryum duriusculum* has upper leaf margins more denticulate and costae and basal laminal cells more consistently suffused with red pigment than *B. sauteri*, which is also widespread in N.Z.

Etymology: The epithet *duriusculum* means hard or somewhat hard; its meaning is not apparent.

Additional Notes: *Bryum duriusculum* is considered here to be a member of the “*B. erythrocarpum* complex” *sensu* Crundwell & Nyholm (1964). The six species belonging to this complex documented from N.Z. are: *B. duriusculum*, *B. radiculosum*, *B. rubens*, *B. ruderale*, *B. sauteri*, and *B. tenuisetum*. The delineation of these species is largely reliant on tuber morphology. Crundwell & Nyholm's (1964) revision of the European members of the complex remains useful, even in N.Z. Considerable emphasis was placed by Crundwell & Nyholm on whether or not the individual cells of water-mounted tubers protrude beyond the general outline of the tuber, and tuber shape, diameter, and pigmentation. An excellent series of photographs of tubers of British members of the complex is provided by Porley 2008, p. 62 et seq.).

N.Z. collections with well-developed tubers can be named confidently and the distinctions between the six accepted species are convincing. However, the tubers can be sparse or rarely absent and hence not all material can be named to species level. Members of the complex have a recognisable facies deriving from their rather small shoots, non-comose, erect-spreading, weakly bordered, and denticulate leaves, usually firm-walled laminal cells, stout and short-excurrent costae, and pendent, pyriform capsules. Because of their distinctive facies, a supplementary description applicable to all members of the complex is given here.

“*Bryum erythrocarpum* complex” *sensu* Crundwell & Nyholm

Plants bright, yellow-green or bronze, forming turves. **Stems** ± red below or throughout, branching by innovation, beset with red-brown, purple or yellow-brown, coarsely papillose rhizoids, in cross-section with firm-walled cortical cells and a weak central strand. **Leaves** not or weakly crowded at stem apices, erect-spreading, becoming more erect and narrowed when dry, ovate- or elliptic-lanceolate, acute, <1–c. 2.5 mm, concave, denticulate above (rarely only near apex), weakly bordered, mostly ± recurved, not decurrent; **upper laminal cells** narrowly hexagonal, firm-walled or rarely thin-walled, longer and more oblong below; **marginal cells** longer, forming an ill-defined or rarely distinct border 1–4(–5) cells wide at mid leaf; **basal cells** short, ± oblong, with or without secondary pigments. **Costa** stout or rarely thin, variably coloured (red, brown, or pale below), short- or long-excurrent, usually forming a denticulate awn. **Brood bodies** (rhizoidal tubers) nearly constantly present.

Dioicous and infrequently fruiting. **Perichaetia** 1-3 per shoot, often appearing axillary due to innovation, with leaves narrowly lanceolate or deltoid. **Perigonia** terminal or on short lateral branches. **Setae** cygneous just below capsule; **capsules** pendent, narrowly pyriform, constricted below mouth when dry, with a neck c. 1/3 the total length and only weakly wrinkled; **operculum** lowly conic, mostly apiculate (non-apiculate in *B. radiculosum*). **Exostome teeth** red-brown below, pale and coarsely baculate above; **endostome** with fenestrate segments and well-developed, appendiculate **cilia**. **Spores** <20 µm diam.

The late J.T. Linzey took a special interest in the “*B. erythrocarpum* complex” in N.Z. His results were never published but his still useful manuscript is preserved at AK and is referred to here.

Confusion occurs between the members of the “*B. erythrocarpum* complex” and *B. clavatum*, particularly with sterile material. The toothed leaf apices and the weaker leaf borders in the complex provide some distinction, as do the short-oblong basal leaf cells. When fertile, the pendent and symmetric capsules in species of the complex contrast with the usually inclined and curved capsules of *B. clavatum*. The distinctions are discussed further under *B. clavatum*.

Linzey (unpublished) recognised, but never formally described, what he considered a distinctive species in this “species complex”, which he termed “*Bryum* ACC” (after the British bryologist Alan C. Crundwell). These plants have red-brown tubers 60-105 µm diam., ± irregular in outline and with individual cells moderately protruding. The bulk of material so-named by Linzey is considered here not to be a member of the complex but to be aberrant *B. clavatum* (q.v.); it is discussed further under that species.

Numerous collections, mostly sterile and apparently belonging to this complex, cannot be named with confidence. Among the most distinctive are two North Auckland L.D. (CHR 106581 & 106609) and two Nelson L.D. (CHR 406023 & 405538) collections made from marl soil. These four specimens have lanceolate, distinctly bordered, and entire leaves with long-excurrent costae (to 1/3 the total leaf length), and abundant, irregular, brown tubers 90-180 µm diameter with cells moderately to strongly protruding. Further study may show this material to be worthy of description. Other aberrant and indeterminable material has been seen from Mt Ruapehu, Wellington L.D. (*J.E. Beever* 31-01, CHR 405923); Nile River, Nelson L.D. (*A.J. Fife* 6015, CHR 405539); and Raramai Tunnel, Marlborough L.D. (*J. Lewinsky* 1087, CHR 348510).

Ochi's (1992, p. 235) concept of the subsect. *Apalodictyon* roughly corresponds to the “*B. erythrocarpum* complex” as treated here.

***Bryum funkii* Schwägr., Sp. Musc. Frond. Suppl. 1(2), 89 (1816)**

≡ *Ptychostomum funkii* (Schwägr.) J.R.Spence, *Phytologia* 89: 113 (2007)

Type: Germany. Not seen.

Plants very pale green, catkin-like, occurring as isolated stems among other mosses. **Stems** red-brown, very short, ≤7 mm, ± branched at base, in cross-section with firm-walled cortical cells and an ill-defined central strand. **Leaves** larger and crowded near stem apex (but ± uniformly distributed on sterile innovations), erect and imbricate moist and dry, broadly ovate, finely acute, c. 0.8–1.1 mm long (near stem apex) and with lamina 0.9–1.0 the total leaf length, concave, red at base, entire, very weakly bordered and plane at upper margins, not decurrent; **upper laminal cells** hexagonal-rhombic, thin-walled, c. 45–54 × 12–15 µm and c. 3–4:1, becoming more oblong in lower leaf, and laxly quadrate near alar corners; **marginal cells** linear and ± thicker-walled to form a very weak (1–3 cells wide), ill- or well-defined border in upper half of leaf; **basal cells** usually red in 1–2 rows across base. **Costa** stout at base but rapidly tapered, ± red, short-excurrent or percurrent. **Brood bodies** (including tubers) absent.

Diocious. Perichaetia terminal, usually overtopped by innovations. **Perigonia** terminal. **Setae** to 40 mm, red, cygneous just below capsule; **capsules** pendent, narrowly pyriform, 2.5–3 mm, with a well-defined neck c. 1/4 – 1/3 the total length and wrinkled when dry; **operculum** conic, weakly apiculate. **Exostome teeth** yellow-brown; **endostome** with perforate **segments** equal in length to the teeth, and appendiculate **cilia** in groups of 3. **Spores** 12–15 µm.

Illustrations: Plate 10. Nyholm 1958, fig. 136; Smith 2004, fig. 183, 9–10.

Distribution: SI: Otago (Pipsens Creek, White Creek, “West Wanaka”).

Bipolar. Reported from Europe and north and central Asia by Smith (2004).

Habitat: Known from only three Otago L.D. collections, two from streamside gravel with weedy species, including *Breutelia affinis*, *Campylopus clavatus*, *Ceratodon purpureus*, and *Dicranoweisia antarctica*, and the third from “dry rocks at lakeside”. All collections are from c. 350 m elevation.

Notes: A report of this species from Banks Peninsula (Macmillan 1996, p. 37) is based on a misdetermination of *B. argenteum*.

The N.Z. collections of this distinctive species were all made by J.T. Linzey and compare well to European material. There are no compelling reasons to doubt the original determinations of this material by E. Nyholm and A.C. Crundwell.

Smith (2004, p. 568) stated in relation to European collections: “whether the plants currently named *B. funkii* are the same as that described by Schwägrichen is obscure and likely to remain so”.

Recognition: The pale catkin-like plants are distinctive in a N.Z. context and could be confused only with *B. argenteum* or *B. harriottii*. The leaves of *B. funkii*, however, lack the hyaline apical cells of *B. argenteum* and the two species differ also by sporophytic characters, including capsule size and the nature of their endostomal cilia. *Bryum harriottii* has rounded leaf apices, less-developed endostomal cilia, and much larger spores.

Etymology: The species epithet honours the German botanist Heinrich C. Funck; Schwägrichen's original spelling of the epithet is followed here

***Bryum harriottii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 458 (1899)**

≡ *Anomobryum harriottii* (R.Br.bis) Dixon, *Bull. New Zealand Inst.* 3: 202 (1926)

Neotype: N.Z., Canterbury, Mt Torlesse, Jan. 1900, R. Brown s.n., WELT M012282!

Paratypes: BM-Dixon!, CHR 514980!

= *Anomobryum densum* Dixon, *Bull. Torrey Bot. Club* 42: 103 (1915)

Holotype: N.Z., South Island, Paparoa Range, 1888, R. Helms, BM-Dixon!

Plants yellow- or brown-green, forming loose turves. **Stems** julaceous, green or brown below, mostly c. 5–8(–10) mm, branching by subperichaetial innovation, simple or forked above, beset below with dark brown, strongly papillose rhizoids, in cross-section with firm-walled cortical cells and central strand weak or absent. **Leaves** evenly spaced and ± uniformly sized on stem, imbricate when moist, little altered when dry, broadly ovate (and then rounded at apex) to nearly cochleariform, c. 0.6–1.0 × 0.4–0.6 mm, strongly concave, pale- or brown-green, entire, lacking border, and plane at margins, not decurrent; **upper laminal cells** rhombic-hexagonal, incrassate, 21–30 × 10–12 µm and c. 2–3:1, smaller at apex and larger (to c. 60 µm) in lower leaf; **marginal cells** not differentiated; **basal cells** not pigmented. **Costa** rather broad at base, tapered, brown or red-brown at base, subpercurrent. **Brood bodies** (including tubers) absent.

Sexuality unknown (but frequently fruiting). **Perichaetia** near base of plant; **perichaetial leaves** ± lingulate, enlarged, c. 1.0–1.2 mm. **Perigonia** not seen. **Setae** 12–25 mm, red-brown; **capsules** inclined or horizontal, narrowly clavate or pyriform, (2.5–)3–4 × c. 1 mm, with a well-defined neck nearly ½ the total capsule length and wrinkled when dry; **operculum** lowly conic, not apiculate.

Exostome teeth yellow-brown, bordered; **endostome** with narrow, perforate segments ± equal the teeth in length, and **cilia** rudimentary or absent. **Spores** 22–30 µm, yellow-brown.

Illustrations: Plate 11. Brown 1899, pl. 41, fig. 30; Dixon 1915, pl. 9, fig. 9 (as *Anomobryum densum*); Ochi 1970, fig. 18; Seppelt 2004, fig. 39; Spence & Ramsay 2006, fig 38, G–K.

Distribution: NI: Gisborne (Mōkau Falls, Makaretu River, Te Waipuhake Stream), Hawke's Bay (Waikari Gorge), Wellington (Taihape, Ruahine Range); SI: Nelson (Mt Mytton, Mt Owen), Marlborough (Branch River), Canterbury (Mt Torlesse, Cass, Broad Stream, Rough Creek), Westland (Paparoa Range, Ōtira Gorge, Franz Josef), Otago (Pigroot Creek); A. Recorded from M by Seppelt (2004).

Australasian. Recorded from Tasmania by both Seppelt (2004) and Spence & Ramsay (2006).

Habitat: On irrigated rock (greywacke, limestone, papa), most commonly at stream margins and also in seepages on vertical rock faces. On South I. ranging from c. 500 to c. 1350 m. Most frequent associates are *Dicranella cardotii* and *Bryum laevigatum*, and occasionally *Blindia magellanica*, *Bryum clavatum*, *Cratoneuropsis relaxa*, and *Tridontium tasmanicum*.

Notes: The present species was placed by Dixon (1926) in the genus *Anomobryum* Schimp., which is recognised in some modern floras (e.g., Smith 2004). Ochi's (1992) placement of *Anomobryum* as a subgenus within *Bryum* is followed here. In overall gametophytic habit *B. harriottii* is not distinguishable from the widespread northern hemisphere *B. filiforme*, but it differs in a number of sporophytic features, including the nature of its endostomal cilia.

There is a problem with the typification of the name *B. harriottii* R.Br.bis. The Weka Pass specimen labelled as "*Bryum harriottii* sp. nov." by Brown (CHR 335144) contains the pottiaceous moss *Tetracoscinodon irroratus* (Hook.f.) R.H.Zander with a few fruiting plants of *B. clavatum*. Ochi (1984, p. 182) stated that CHR 335144 "cannot be accepted as the type" of *B. harriottii* and had previously noted that "no type material of *B. harriottii* was available from European herbaria" (Ochi 1970, p. 35). I concur with Ochi's conclusion that neither element in the Weka Pass specimen conforms to Brown's protologue and that it cannot be considered as the holotype of *B. harriottii*; it is likely that a labelling error has occurred, most likely by Brown himself. The citation of the Weka Pass (Canterbury L.D.)

collection as the holotype by Spence & Ramsay (2006, p. 285), who apparently did not see the specimen, is not correct.

However, both Brown's description and illustrations suggest that the plant used in preparing the protologue was consistent with the concepts of *B. harriottii* used by later authors (Dixon 1926, p. 202; Sainsbury 1955a, p. 269).

Thus, it is concluded that "no original material is extant" (International Code of Nomenclature, McNeill et al. 2012, Art. 9.7). Two courses of action are available: to declare a neotype for *B. harriottii* R.Br.bis or to consider *B. harriottii* a *nom. dub.* and to employ a later, validly published name for the taxon. The latter option would necessitate undesirable name changes, since a combination in *Bryum* based on the only other validly published name (*Anomobryum densum* Dixon) would create an illegitimate homonym. Selection of a neotype using a Brown collection from Canterbury L.D. is deemed the best option conforming to the ICN and this is done above.

Recognition: There are no other species of *Bryum* in N.Z. with which *B. harriottii* could be easily confused, given its julaceous stems and strongly concave, nearly cochleariform leaves. *Bryum funkii*, a rarer plant with likewise small and imbricate leaves, is a paler plant with acute leaf apices and mostly excurrent costae. *Ochiobryum blandum* has leaves of similar shape but is a much larger plant with \pm bordered, larger leaves. *Ochiobryum blandum* is usually strongly pigmented (red or black), lustrous, and grows in more aquatic situations than the present species.

Etymology: The significance of the specific epithet is not known.

***Bryum laevigatum* Hook.f. & Wilson, *London J. Bot.* 3: 546 (1844)**

\equiv *Gemmabryum laevigatum* (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 67 (2005)

\equiv *Imbribryum laevigatum* (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay, *Telopea* 15: 146 (2013)

Lectotype: Tasmania, s. loc., 1831, *Lawrence* 261 ("Hooker 2856"), BM-Wilson 730494!

= *Bryum incurvifolium* Müll.Hal., *Bot. Zeitung (Berlin)* 9: 549 (1851)

Type: N.Z., soft sandstone rock, N. head, Kaipara, *S. Mossman* 63, 1850, E2442 (Viewed online, JSTOR Global Plants, accessed 15 Jan. 2015)

= *Bryum crassinerve* Hook.f. & Wilson in Wilson, *Bot. Antarct. Voy. II (Fl. Nov.-Zel.) Part II* 83 (1854)

Lectotype: N.Z., Auckland, *Sinclair (a)*, BM-Wilson! Isolectotype: BM-Hooker!

= *Bryum eximium* Mitt. in Hooker, *Handb. New Zealand Fl.*, 440 (1867)

Type: N.Z. Not seen. (Discussed below.)

= *Bryum megamorphum* Müll.Hal., *Hedwigia* 37: 99 (1898)

\equiv *Webera megamorpha* (Müll.Hal.) Paris, *Index Bryol. Suppl.*, 328 (1900)

Lectotype: N.Z., Otago, Dunedin, Pelichet Bay, Oct. 1890, *W. Bell*, (herb. T.W.N. Beckett 358), CHR 514101! The collector given (as Beckett) in Müller's protologue is incorrect.

= *Bryum huttonii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 460 (1899)

Lectotype: N.Z., South Island, Styx Marsh, near Christchurch, Oct. 1895, *R. Brown*, CHR 335589! Isolectotype: BM 1086517 (Viewed online at JSTOR Global Plants, accessed 15 Jan. 2015.) Paratype: CHR 516715! (CHR 335589 is cited by Ochi 1984, p. 181.)

= *Bryum traillii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 460 (1899)

Lectotype: N.Z., Stewart I., Waterfall Run, *R. Brown*, CHR 335587! (Cited by Ochi 1984, p. 181.) Isolectotype: BM 1086473 (Viewed online at JSTOR Global Plants, accessed 15 Jan. 2015.)

Plants brown- or yellow-green, mostly robust but extremely variable in size, forming loose or compact turves. **Stems** branching by innovation, (5–)25–50 mm (but to c. 100 mm in aquatic situations), beset with dark brown, coarsely gemmate-insulate or baculate rhizoids below, in cross-section with firm-walled cortical cells and a distinct central strand, sometimes scalloped in outline. **Leaves** evenly spaced on stem, mostly erect-spreading when moist, variably contorted when dry, oblong-spathulate, oblong-elliptic, to broadly elliptic (broadest at or above mid leaf), tapered to a broadly acute or obtuse and sometimes cucullate apex, narrowed at insertion, highly variable in size, mostly 1.6–2.8 mm on vegetative stems, concave or occasionally subtubulose, usually red-brown at base, entire or serrulate near apex, variably bordered, recurved to shoulder or plane; **upper laminal cells** rhombic or \pm hexagonal-rhombic, very incrassate and slightly more so in corners, weakly porose, variable in dimensions, mostly 25–50 \times 12–25 μ m and 2–3:1, \pm obliquely oriented, usually becoming shorter in extreme apex, becoming longer, more hexagonal, and more porose below and often \pm oblong near the leaf base; **marginal cells** weakly to well-differentiated, forming an ill- or well-defined border 1–5 cells wide at mid leaf but not extending to leaf apex; **basal cells** mostly red-brown, sometimes with a large

but ill-defined area of \pm quadrate cells in alar angles. **Costa** stout, pale brown (mostly darker or \pm red below), subpercurrent, percurrent, or very short-excurrent, in cross-section strongly projecting abaxially, round, and with a single layer of guide cells abaxially, plane or weakly convex and with 1–2 rows of guide cells adaxially, with a very large central stereid group. **Brood bodies** (including tubers) absent.

Perichaetia scattered on main stem (and overtopped by subperichaetial innovations), with perichaetial leaves distinctly enlarged, \pm oblong-deltoid, c. 3.2–4.0 mm. **Perigonia** inconspicuous, terminal or becoming lateral by innovation, with outer bracts not distinguished from vegetative leaves, the inner bracts smaller, broadly ovate, brown below, enclosing numerous antheridia and brown, filiform, 7–8-celled paraphyses. **Setae** to c. 30 mm; **capsules** subpendent or pendent, obovoid-cylindric, 3.5–4.5 mm long, with an ill-defined neck less than $\frac{1}{3}$ the total capsule length, only weakly constricted below mouth when dry; **operculum** conic, apiculate in N.Z. material. **Exostome teeth** yellow-brown throughout, connate at base; **endostome** with perforate segments \pm equal the teeth in length and well-developed appendiculate **cilia** mostly in groups of 3. **Spores** (12–)16–18 μ m, nearly smooth.

Illustrations: Plate 12. Seppelt 2004, fig. 40; Spence & Ramsay 2006, fig. 40 P–W (as *Gemmabryum laevigatum*).

Distribution: NI: N Auckland (Kerikeri, Kaipara Harbour, Warkworth, Waitakere Ranges), S Auckland, Gisborne, Hawke's Bay (Hendley, Māhia Peninsula), Wellington; SI: Nelson, Marlborough (D'Urville I., Mt Alarm), Canterbury, Westland, Otago, Southland; St, A, M. Reported from C by Vitt (1974).

Austral. Tasmania*, mainland Australia*, Kerguelen*, Marion I.*, Falkland Is*, Argentina*, Chile*.

Habitat: A species of extremely wide habitat tolerance, best developed in damp situations such as stream margins, seepages, lake margins, but also common in drier situations on rock or thin soil. Occurring on mineral or humic soil over a variety of rock types (including limestone, gneiss, greywacke, and mortar), on alluvial sand, and eroding soil banks, in both insolated and \pm shaded situations. Ranging from near sea level to c. 2300 m. Commonly associated mosses include *Breutelia pendula*, *Bryum pseudotriquetrum*, *Cratoneuroopsis relaxa*, *Drepanocladus aduncus*, *Fissidens rigidulus*, *Ochiobryum blandum*, *Philonotis tenuis*, and *Tridontium tasmanicum*.

Notes: *Bryum laevigatum* is extremely variable in respect to stature, leaf shape, size, degree of contortion when dry, and degree of leaf margin recurvature. The most reliable diagnostic features of this non-comose but robust species are the very thick-walled laminal cells that are both porose and \pm obliquely oriented and the stout, \pm percurrent, brown costa that projects strongly abaxially from the dry lamina. Leaf dimension and shape can vary greatly even in single plants, especially when the plants are subject to periodic flooding (as in the type of *B. huttonii*). Shorter and broader leaves are often characteristic of plants from moister habitats. The occurrence of strongly recurved leaf margins does not seem correlated with moisture availability.

The degree of leaf contortion in dry material varies greatly, with most populations (including the type) having leaves turned to one side and the apices often \pm incurved when dry. Dry leaves may also be weakly twisted about their own longitudinal axes. In many populations, however, there is little or no leaf contortion on drying.

Some populations have leaf margins strongly reflexed when dry and this, together with abaxially protruding costa, give the plants a distinctive appearance. Reflexed margins are not a constant feature of this species, however, and the utility of this feature as a recognition aid is given too much emphasis by Scott & Stone (1976, p. 282). In the species type, the leaf margins are plane or even slightly incurved when dry. A curious feature of this commonly fruiting species is the apparent rarity of perigonia.

The type sheet of *B. laevigatum* (BM-Wilson) consists of five packets of the same collection attached to a single sheet, with several Wilson drawings dated between 1844 and 1854 and a single packet of *Gunn 1588*. The packet at extreme upper right corner of the sheet (BM 730494) bears the collection number *Lawrence 261* (in pencil, in the hand of neither J.D. Hooker nor W. Wilson). The selection of this material as lectotype conforms with the protologue and with Ochi's (1970, p. 42) designation of "Hooker 2856" as isotype of this name. The number 2856 is a Hooker herbarium number and not a collection number *per se* as indicated by Spence & Ramsay (2006). The several packets in the Wilson herbarium also preclude considering any of the packets as a holotype, as done by Spence & Ramsay.

Type material of *B. incurvifolium* Müll.Hal. has been seen only online (at JSTOR Global Plants, accessed 15 Jan. 2015), however the online photograph of E2442 in my opinion is sufficiently detailed to permit confident placement of this name in the synonymy of the widespread *B. laevigatum*. Material referred by Dixon to *B. incurvifolium* Müll.Hal. has also been examined and referred to *B. laevigatum*.

The lectotype of *B. crassinerve* is designated (by Wilson) by a symbol of two dots under a dash and bears Wilson's annotation "specimen drawn, March 10, 1852." The lectotype, collected by Sinclair, is mounted at the right hand margin of a sheet in Wilson's herbarium, immediately below Wilson's drawings of *Colenso 4785*. In the upper left hand corner of the relevant sheet are Wilson's drawings of March 10, 1852. Wilson's handwritten draft protologue is mounted on another sheet, with several duplicates of a Hooker collection.

No type material of *B. eximium* Mitt. has been available for study. However, material collected by D. Petrie at Dunedin (CHR 516747) and determined by Brotherus as *B. eximium*, is unquestionably the same aquatic form of *B. laevigatum* as the type of *B. megamorphum* Müll.Hal. On this basis, plus Dixon's (1926, p. 217) comment that "this remarkably fine plant [*B. eximium*] will ... have to be looked upon as a striking marsh form of *B. laevigatum*", *B. eximium* is considered here a synonym of *B. laevigatum*. Apparent syntype material of *B. eximium* (in the Mitten herbarium at NY) has been viewed at JSTOR Global Plants (accessed 15 Jan. 2015) but little morphological detail can be seen in the online photographs.

Plants of a submerged population of *B. laevigatum* were described by Müller under the name *B. megamorphum*. The type of this name is (compared to terrestrial forms of *B. laevigatum*) more lurid brown with elongate (to c. 130 mm) stems; its leaves are more distant, widely spreading, broader and more obtuse, less concave, much larger (to c. 6 × 3 mm), weakly and bluntly serrate above, and more weakly recurved. Also, its upper laminal cells are less incrassate, more porose, and decidedly less obliquely oriented and its costae are narrower and protrude abaxially less prominently when dry. In addition to the type, the best examples of the "*megamorphum* growth form" are from the Dunedin area, but similar material has been seen from other N.Z. regions. Transitional forms from subaquatic habitats, with distant leaves that are larger than the usual range for the species are not uncommon (e.g., CHR 464913 ex Mt Arthur, Nelson L.D.). The collector of the type, W. Bell, referred to *B. megamorphum* (in herb. Beckett) as "The Emperor of all the New Zealand *Bryum*".

Material (in CHR, WELT) cited as *B. muehlenbeckii* by Bartlett (1984) from the Ruahine and Mt Arthur Ranges, and accepted by Fife (1995), is here referred to *B. laevigatum*. It is probable that reports of *B. muehlenbeckii* from Australia (e.g., Crum & Anderson 1981, p. 564) are also based on other misdeterminations of *B. laevigatum*. Confusion sometimes occurs between *B. laevigatum* and *B. pseudotriquetrum*, q.v. Specimens that cannot be confidently assigned to either *B. laevigatum* or *Rosulabryum subtomentosum* rarely occur (e.g., CHR 467597 ex Ruahine Range). When sterile, plants of *Pleurophascum ovalifolium* can be strikingly similar to *B. laevigatum*, however the former differs in many ways including its obvious lack of costae, and its areolation and rhizoid colour.

Etymology: The epithet *laevigatum* means smooth and polished and probably refers to the leaves, which Hooker & Wilson (1844, p. 546) described as concave, shining, and subcoriaceous.

***Bryum mucronatum* Mitt. in Hooker, *Handb. New Zealand Fl.*, 442 (1867)**

Isolectotypes: N.Z., Otago, open ground, *Hector 17*, BM-Hooker!, WELT M012370! The lectotype in NY-Mitt., designated by Ochi (1973, p. 218), has not been seen.

Plants brown-green, forming compact turves or tufts. **Stems** red-brown, to c. 14 mm, branching by subperichaetial innovations, beset below with dark brown, coarsely papillose rhizoids, in cross-section with 1–2 layers of firm-walled cortical cells and a distinct and large central strand. **Leaves** moderately comose in fertile material, ± evenly spaced on sterile stems and innovations, erect-spreading when moist and ± spiralled around stem when dry, broadly ovate or oblong-ovate, acute, mostly 2.0–3.0 × c. 1.0 mm in comae, smaller (c. 1.0 mm) on lower stem and on innovations, weakly concave, not pigmented at base, entire, narrowly bordered, not decurrent, with margins plane or ± recurved below; **upper laminal cells** rhombic-hexagonal or oblong, rather thin-walled, 69–90 × 24–27 µm and 2.3–3.5:1, becoming longer and more oblong below; **marginal cells** forming a border of 2–3 rows of ± linear cells at mid leaf and extending ± to apex. **Costa** brown, rather stout, mostly percurrent, occasionally excurrent to form a short mucro. **Brood bodies** (including tubers) absent.

Synoicous. Perichaetia terminal, but usually overtopped by innovation, often several per plant. **Setae** to c. 30 mm, curved just below capsule, red-brown; **capsules** ± horizontal to weakly cernuous when moist, becoming suberect when dry, narrowly pyriform, 3–5 mm long, with a distinct neck c. half the capsule length, and a ± oblique and narrow mouth; **operculum** conic and apiculate. **Exostome teeth** yellow, hyaline and baculate near apex; **endostome segments** well developed, narrowly perforate; **cilia** mostly 3, often only short projections of basal membrane, sometimes longer (to c. ¼–⅓ the height of segments) and truncate. **Spores** 21–30 µm.

Illustrations: Plate 13. Ochi 1973, fig. 1; Seppelt 2004, fig. 41.

Distribution: NI: Wellington (Mt Ruapehu); SI: Nelson (Winter Peak, Mt Owen), Marlborough (Tapuaenuku), Canterbury (Temple Basin, Broken River, Porters Pass), Otago (Naseby). Reported from M by Seppelt (2004).

Apparently austral. Reported from South America by Ochi (1973).

Habitat: The habitat and elevation range are very poorly documented. The best documented collections come from humic soil on alpine rock outcrops, including greywacke and marble. Known from c. 1830 m at its single North I. locality and from c. 1070–1800 m on South I.

Notes: As noted by various authors (e.g., Hooker 1867; Ochi 1973), *B. mucronatum* is closely allied to the northern hemisphere *B. uliginosum* (Brid.) Bruch & Schimp. It differs from *B. uliginosum* in having consistently synoicous (rather than autoicous) inflorescences. The N.Z. species also has less acuminate leaves than *B. uliginosum*, as noted by Ochi (1973), who also cites a minor difference in the nature of the leaf marginal cells. Geographic isolation also lends support to the decision to recognise this austral species as distinct. However, an argument in favour of recognition at subspecies rank could be made. Reports of *B. uliginosum* in N.Z. (Bartlett 1984) are not accepted here.

The narrowly pyriform capsules, synoicous inflorescences, entire leaf margins, and percurrent or short mucronate costae make this rare species readily identifiable. Confusion sometimes occurs with *B. amblyodon*, but that species has decurrent and pigmented leaf bases and long-excurrent costae. The suberect, dry capsules are suggestive of those of *Meesia uliginosa* and *Entosthodon laxus*. The leaves in the *Meesia* are \pm lingulate and broader and more rounded at their apices, its setae much longer (c. 20–40 mm) and its exostome teeth are much shorter than its endostome segments. The laminal cells in *E. laxus* are much laxer, its costae are shorter, and its peristome also differs markedly from the present species.

Etymology: The species epithet refers to the short-excurrent or mucronate nature of the costa.

***Bryum pallescens* Schwägr., Sp. Musc. Frond. Suppl. 1(2), 107 (1816)**

\equiv *Ptychostomum pallescens* (Schwägr.) J.R.Spence, *Phytologia* 87: 21 (2005)
Type: Europe. Not seen.

= *Bryum thomasii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 447 (1899)
Type (probable holotype): N.Z., Canterbury, Styx Marsh, near Christchurch, R. Brown, CHR 335584! (Cited by Ochi 1984, p. 181.)

Plants brown- or yellow-green, forming rather thick cushions or turves. **Stems** red, to at least 15 mm, branching repeatedly by innovation, beset below with dark red- or chocolate-brown, papillose rhizoids, in cross-section with firm-walled cortical cells and a weak central strand. **Leaves** larger and crowded at stem apex, erect-spreading when moist, tightly erect and \pm twisted around stem with dry, oblong-ovate, widest at or near mid leaf, acute or short-acuminate, 1.4–2.4 \times c. 0.8 mm (some vegetative leaves shorter) and with lamina c. 0.9 the entire leaf length, concave, mostly red at base, entire or denticulate near apex, bordered (sometimes weakly) and recurved at margins, not decurrent; **upper laminal cells** hexagonal, firm-walled, 45–60 μ m long and c. 3:1, not altered near apex, longer and more oblong in lower leaf; **marginal cells** linear and firm-walled to form a weak to moderate border c. 2–3 cells wide at mid leaf and extending \pm to apex; **basal cells** pigmented but not otherwise differentiated. **Costa** red below, short- or long-excurrent (usually forming a short cusp). **Brood bodies** (including tubers) absent.

Synoicous. Perichaetia terminal (at the end of successive subperichaetial innovations). **Setae** c. 15–20 mm, cygneous just below capsule; **capsules** pendent, narrowly pyriform, constricted below the mouth when dry, (1.8–)2–2.5 mm long, with a well-defined neck c. $\frac{1}{3}$ the total length and wrinkled when dry. **Exostome teeth** pale yellow-brown; **endostome** free of exostome, the segments with oval perforations and paired, nodose to weakly appendiculate **cilia**. **Spores** 21–24, papillose.

Illustrations: Plate 14. Crum & Anderson 1981, fig. 257, A–H; Smith 2004, fig. 183, 1–4; Ochyra et al. 2008, fig. 225.

Distribution: SI: Canterbury (Styx Marsh, Cave Stream, Rough Creek), Otago (Naseby, Cardrona). Bipolar. Reported to be widespread in northern hemisphere (Smith 2004, p. 564). Ochyra et al. (2008) recorded it from the Antarctic Peninsula, Tierra del Fuego, Falkland Is, South Orkney Is, and South Sandwich Is. Spence & Ramsay (2013) recently recorded this species from Tasmania.

Habitat: The habitat preferences of this species are rather poorly known in N.Z. Known from widely disparate elevations ranging from sea level (Styx Marsh) to 1632 m (Cardrona). A collection by P. Beveridge from Cardrona came from semi-shaded, thin soil on a “small vegetated schist block in tussock grassland” at 1632 m. Smith (2004) indicates this species sometimes occurs on heavy-metal mine waste in Britain.

Notes: The capsules illustrated by Smith (2004) and by Crum & Anderson (1981) are longer and more cylindrical than those in N.Z. material of this species. The leaves illustrated by Ochyra et al. (2008) have longer and more excurrent costa than seen in N.Z. material.

Bryum pallescens and *B. creberrimum* s.l. (including what has been termed *B. affine*) share the characteristics of being monoicous (either autoicous or synoicous), with generally large spores, ovate-lanceolate, ± entire leaves that are weakly to strongly spiralled when dry, and firm-walled, non-porose laminal cells. Monoicy (variously expressed in the two species) is also relatively uncommon among N.Z. species and hence a useful recognition feature.

Bryum austro-pallescens Broth. is here considered as a synonym of *B. creberrimum*, in contrast to Ochi's (1970, p. 37) referral of it to *B. pallescens*. Ochi (1984) tentatively placed *B. thomasi* in synonymy with *B. pallescens*. Brown's immature type has been examined and its observable features (including synoicous sexuality) are consistent with Ochi's conclusion.

Recognition: The boundary between *B. pallescens* and *B. creberrimum* is not always clear in N.Z. *Bryum pallescens* appears to be distinguishable by the following features: shorter, more pyriform capsules; endostomal cilia mostly two and less appendiculate; and synoicous sexuality. Some intermediate material is discussed under *B. creberrimum*, q.v.

Confusion between *B. pallescens* and *B. algovicum* var. *rutheanum* is possible as both taxa are synoicous, have rather short pyriform capsules, and share some vegetative leaf characters. However, the free endostome and the more strongly developed cilia of *B. pallescens* normally preclude confusion with the latter taxon.

Bryum pallescens can be confused with *Rosulabryum capillare*, due to the spiralling of dry leaves around the stem and synoicy, but the former is distinguished by leaves that are oblong-ovate and widest near mid leaf (rather than ± spatulate), larger and more papillose spores, shorter capsules, less well-developed endostomal cilia, and an absence of rhizoidal tubers.

Etymology: The species epithet means becoming pale; the reference of this epithet is unclear.

Bryum preissianum* Hampe, *Icon. Musc. [Hampe], 25 (1844)

≡ *Brachymenium preissianum* (Hampe) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1873–1874: 113 (1875)

≡ *Gemmabryum preissianum* (Hampe) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 67 (2005)
Lectotype: Australia, Novae Hollandiae, prope Freemantle, ad saxa calcarea, *L. Preiss* 2453, BM-Hampe! (Designated by Ochi 1970, p. 13). Isolectotype: BM-Hampe!

=*Brachymenium coarctatum* Hook.f., *Handb. New Zealand Fl.*, 437 (1867) nom. illeg.

Plants yellow-green, very small, forming compact turves on calcareous rock. **Stems** pale brown and short, mostly <4 mm, branched by subperichaetial innovation, with sparse brown rhizoids, in cross-section with firm-walled cortical cells and a central strand. **Leaves** ± larger towards stem apex, erect when moist, scarcely altered when dry, oblong-lanceolate, acute, and aristate, 0.7–0.8 × c. 0.25 mm, with lamina c. ¾ or more of the total leaf length, concave, yellow-green throughout, entire, plane; **upper laminal cells** rhombic-hexagonal, firm-walled, (18–)27–39 × c. 6–9 µm and (3–)4–6:1; **marginal cells** slightly more oblong and elongate in 1–2 rows but not forming a distinct border; **basal cells** quadrate and firm-walled. **Costa** stout, yellowish, strongly excurrent to form an arista c. 20–25% of the total leaf length. **Brood bodies** (including tubers) absent.

Apparently dioicous (but often fruiting). **Perichaetia** near base of plant; **perichaetial leaves** lanceolate, to c. 1.4 mm. **Perigonia** terminal, conspicuous but uncommon. **Setae** to 10 mm, red-brown below, pale above, mostly strongly curved below capsule; **capsules** symmetric, horizontal to suberect, obovoid-cylindric, c. 1.5–2 × 0.8 mm, with an ill-defined neck ± equal to the urn in diameter, c. ¼ the total capsule length, and irregularly wrinkled when dry; **mouth** narrow; **operculum** high-conic.

Exostome teeth lanceolate, yellow-brown below, finely ornamented, with the abaxial divisural line ± straight; **endostome** with a basal membrane c. ⅓ the height of the teeth and linear segments reaching c. ⅔ the height of the teeth; **cilia** absent or very rudimentary. **Spores** (8–)9–12 µm, nearly smooth.

Illustrations: Plate 15. Ochi 1970, fig. 4 (as *Brachymenium preissianum*); Catcheside 1980, fig. 143 (as *Brachymenium preissianum*).

Distribution: NI: N Auckland (Auckland City), S Auckland (Te Akatea), Gisborne (Marumaru Caves), Hawke's Bay (Nūhaka, Wairoa, Māhia Peninsula, Maraetōtara, Pourērere, Tāhaenui), Wellington (Ruakōkoputuna); SI: Nelson (Nelson City), Canterbury (Arthur's Pass), Otago (Ōamaru).

Australasian. Mainland Australia* and recorded from Tasmania (Spence & Ramsay 2006).

Habitat: On limestone and other base-rich rock, including sandstone; rarely on clay banks. Predominantly at low elevations, but recorded from c. 350 m at Ruakōkoputuna and at subalpine elevations (near Arthur's Pass). *Gymnostomum calcareum* is a frequent associate.

Material collected in the "Bealey Basin" in Canterbury L.D. (Martin 1946) (*W. Martin*, 16 Jan. 1944, CHR 490357) is anomalous for its occurrence on clay soil in an area of greywacke bedrock at a higher elevation than any other N.Z. collections. It has longer stems (to c. 10 mm), but in other features is characteristic of the species. Material cited by Dixon (1926, p. 202) from Mauriceville (Wellington L.D.) has not been seen.

Notes: New Zealand material of *Bryum preissianum* has been treated in *Brachymenium* by Dixon (1926), Sainsbury (1955a), and Ochi (1970), in part because of the orientation of the capsules. The genus *Brachymenium* is lectotypified by *Brachymenium nepalense* Hook. (*vide* Ochi 1992; see also Spence & Ramsay 2006, p. 277), which is a far more robust and epiphytic plant of autoicous sexuality that has narrowly spatulate leaves strongly spiralled around the stem when dry, long-excurrent costae, long-necked and erect capsules in excess of 3 mm, and larger spores. The horizontal to suberect capsules found in *Bryum preissianum* are admittedly infrequent in *Bryum*, but in all other respects, including its sexuality, laminal areolation, costal development, capsule form, and peristome morphology, this species is well-placed in *Bryum*.

Recognition: Dixon (1926, p. 202) discussed the differences between N.Z. material and *Brachymenium coarctatum* Bosch & Sande Lac. from Java, which Mitten (*in herb.*) apparently considered to be conspecific. No material of *B. coarctatum* has been available for study, but the description and illustrations provided by Eddy (1996, p. 169) contrast sharply with N.Z. material. The problem of this Javan species is outside the scope of this Flora.

Etymology: The species epithet commemorates J.A.L. Preiss, an early collector of Western Australian plants.

***Bryum pseudotriquetrum* (Hedw.) P.Gaertn., E. Meyer & Scherb., Oekon. Fl. Wetterau 3(2), 102 (1802)**

≡ *Mnium pseudotriquetrum* Hedw., *Sp. Musc. Frond.*, 190 (1801)

≡ *Ptychostomum pseudotriquetrum* (Hedw.) J.R.Spence & H.P.Ramsay in Spence, *Phytologia* 87: 23 (2005)

Type: Europe. Not seen.

= *Bryum maudii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 460 (1899)

Lectotype: N.Z., Southland, near Lake Manapōuri, *R. Brown*, CHR 335588! (Cited by Ochi 1984, p. 181 and by Ochi 1970, p. 44.)

= *Bryum obesothecium* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 459 (1899)

Type (probable holotype): N.Z., Canterbury, Mt Torlesse, *R. Brown*, CHR 335242! (Cited by Ochi 1984, p. 181.)

Plants bright or dark-green, usually strongly tinged with red, robust or medium-sized. **Stems** dark red to nearly black in lower portions, to at least 55 mm, often forked, beset below with coarsely papillose, red-brown rhizoids, in cross-section with several layers of firm-walled cortical cells and a strong central strand. **Leaves** evenly spaced on stem, erect-spreading or wide-spreading when moist, much altered and incurved or ± twisted around stem when dry, broadly ovate-lanceolate to broadly elliptic, narrowed at insertion, acute and ± cuspidate at apex, variable in size, mostly 1.5–2.7(–3.0) mm (excluding perichaetial) on well-developed stems and with lamina ± 100% of the total leaf length, weakly concave to nearly plane, red below, entire or denticulate near apex, bordered, recurved at margins in lower two-thirds or nearly to apex, narrowly but distinctly decurrent (and often with a "tail" remaining attached to the costa when removed); **upper laminal cells** oblong-hexagonal, firm-walled, not or weakly porose, (30–)36–54 μm long (rarely shorter in compact forms) and mostly 2.5–4:1, shorter at apex, and larger and ± oblong in lower leaf; **marginal cells** linear and forming a distinct border (mostly c. 5 cells wide at mid leaf) extending to apex; **basal cells** strongly pigmented but not otherwise differentiated. **Costa** stout, red at base or throughout, shortly excurrent or percurrent. **Brood bodies** (including tubers) absent.

Synoicous in N.Z. material. **Perichaetia** terminal or appearing lateral due to overtopping innovation; **perichaetial leaves** larger (to c. 3 mm) than vegetation but not otherwise differentiated. **Setae** very long, to c. 50 mm, red below, pale brown above, cygneous just below capsule; **capsules** pendent, oblong-cylindric, 3.5–4.5 mm, with a well-defined neck $\frac{1}{3}$ – $\frac{1}{2}$ its total length; **operculum** mammillate, apiculate. **Exostome teeth** yellow-brown, finely papillose below, baculate near apex; **endostome segments** fenestrate; **cilia** (2–)3, well-developed and appendiculate. **Spores** 15–18 μm .

Illustrations: Plate 16. Crum & Anderson 1981, figs 258, 259 A–G; Seppelt 2004, fig. 42; Spence & Ramsay 2006, fig. 44 S–Y (as *Ptychostomum pseudotriquetrum*); Ochyra et al. 2008, figs 218, 219.

Distribution: NI: N Auckland (Tokerau Beach), S Auckland (Ātiamuri, Tāhunaatara Stream), Wellington (Ohakune); SI: Nelson (Mt Mytton, Culliford Hill); Marlborough (Rai River), Canterbury, Westland (Kelly Range, Grey Valley, Lake Matheson), Otago, Southland (Eyre Range). Reported from A by Vitt (1979) and from M by Seppelt (2004).

Bipolar. Reported from Tasmania and mainland Australia by Spence & Ramsay (2006); also recorded by them from Europe, Asia, North America, South America, West Africa, and Antarctica. Ochyra et al. (2008) recorded the Antarctica distribution in detail.

Habitat: Occurring on damp or waterlogged soil, usually in nutrient rich situations and most commonly in swamps (e.g., raupo swamps, lake margins) or fens, or at stream margins in areas of limestone. Occurring less frequently in crevices of alpine limestone/marble outcrops or on rocks in cascading forest streams (as at Arthur's Pass) or in alpine grasslands. Commonly associated moss species include *Breutelia pendula*, *Campylium stellatum*, *Drepanocladus aduncus*, and *Fissidens adianthoides*. From near sea level to c. 2000 m.

Notes: In Europe, synoicous material of *B. pseudotriquetrum* is often segregated as the var. *bimum* (Schreb.) Lilj. (or at the species level *B. bimum* (Schreb.) Turner) All the examined N.Z. material is synoicous (including the types of the synonymous R. Brown names) and hence could be referred to that variety. Ochi (1970, 1984) does not recognize this variety, noting instead that at least some N.Z. material is referable to “the so-called 'bimum' form”. Crum & Anderson (1981, p. 558), dealing with synoicous material from eastern North America, also concluded that the variety was not worthy of recognition. Under the influence of these authors, a broad view of *B. pseudotriquetrum* is taken here. Curiously Spence & Ramsay (2006, p. 328) described this species as “dioicous in Australia”. The discussion of Spence & Ramsay (2013) does little to clarify the status of *B. pseudotriquetrum* or its dubious segregates in Australia.

Pohlia elatior Sainsbury, placed incorrectly in the synonymy of *B. pseudotriquetrum* by Fife (1995), is a sterile, elongate form of *P. nutans*.

Recognition: A robust habit, spreading, non-comose, distinctly decurrent, entire and bordered leaves with weakly excurrent or percurrent, red costae characterise this species of wet soils. The synoicous inflorescence is a particularly useful feature. In sterile material the leaves are widely spaced, which makes the decurrent leaf base obvious; in fertile material the leaves are usually more crowded. The most common form in N.Z. has vegetative leaves >2 mm; however, compact forms occur in which the leaves do not exceed c. 1.3 mm, particularly on the South I. (e.g., *A.J. Fife 9177* from Culliford Hill, Nelson L.D., CHR 476994). In some populations the leaves of innovative branches are much smaller (even <1 mm) than leaves occurring on the lower stems (e.g., *B.H. Macmillan 75/13* from Mt Olympus, Canterbury L.D., CHR 162832). Generally, there is a strong decrease in leaf size at higher elevations. An unusual form with broadly elliptic, widely obtuse leaves has been collected from wet soil over magnesite at the margin of a cascade in southern beech forest in the Cobb Valley, Nelson L.D. (*A.J. Fife 8665*, CHR 460781).

Confusion often occurs with *B. laevigatum*. That species, which more often grows in dry habitats, has a generally coarser appearance, and costae that have little red pigmentation. When dry the leaves of *B. laevigatum* usually have abaxially strongly protruding costae; when moist its strongly concave leaves contrast with the nearly flat leaves of *B. pseudotriquetrum*. The upper laminal cells of *B. laevigatum* are shorter (c. 2:1) than those of *B. pseudotriquetrum* (mostly 2.5–4:1).

The features that distinguish *B. pseudotriquetrum* from *B. caespiticium* are detailed under the latter species.

Etymology: According to Crum & Anderson (1981, p. 561) “the name, meaning falsely triangular, 3-sided, or possibly 3-ranked can be traced to a pre-Hedwigian association with an early name for *Meesia triquetrum*.”

***Bryum radiculosum* Brid., *Muscol. Recent. Suppl.* 3, 18 (1817)**

≡ *Gemmabryum radiculosum* (Brid.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 68 (2005)

Type: Europe. Not seen.

Stems to c. 5 mm, beset below with red-brown rhizoids. **Leaves** evenly spaced on stem, erect-spreading when moist, becoming more erect and narrowed when dry, ovate- or elliptic-lanceolate, acute, entire or weakly denticulate above, very weakly bordered and ± recurved at margins, not decurrent, c. 1.0 × 0.3 mm, with lamina forming c. 0.8–0.9 of entire length; **mid laminal cells** firm-walled, c. (30–)45 × 8–10 µm; **marginal cells** elongate in 1–2 rows, forming a weak and ill-defined border. **Costa** stout and excurrent. **Tubers** sparse, spherical to oblong, (100–)120–150(–180) µm diam., red-brown, c. 6–8 cells across, cells not protruding.

Dioicous. Perichaetial leaves deltoid, c. 1.5 mm. **Perigonia** not seen. **Setae** c. 12–20 mm, red; **capsules** weakly constricted below the mouth when dry, 1.5–2.5 × c. 1 mm long. **Endostome** with 2 or 3 appendiculate **cilia**. **Operculum** blunt, non-apiculate, glossy, large in relation to the capsule. **Spores** 9–12 µm.

Illustrations: Plate 9. Crundwell & Nyholm 1964, fig. 1 a–k; Smith 2004, fig. 189, 1–5; Porley 2008, p. 64.

Distribution: NI: N Auckland (Waipoua, New Lynn, Kaiaua and sterile material from Manukau), S Auckland (Miranda); SI: Otago (sterile material from Benhar and Dunedin). Localities given are for fertile material unless specified.

Apparently bipolar but possibly adventive. Recorded from mainland Australia, Macaronesia, and the Caribbean by Spence & Ramsay (2006) and from additional northern hemisphere localities by Smith (2004).

Habitat: On mortar and calcareous soils at low elevation; three collections were made from shell fragments close to high tide mark on beaches.

Notes: *Bryum radiculosum* is treated here as one of six N.Z. members of the “*B. erythrocarpum* complex” *sensu* Crundwell & Nyholm (1964). The complex is discussed in more detail under *B. duriusculum*.

The name *B. radiculosum* Brid. was applied by Linzey to a small number of geographically scattered collections, and accepted by Fife (1995). The species remains poorly documented in N.Z. The occurrence of plants on mortar and calcareous soils is similar to that recorded in other parts of its range by Crundwell & Nyholm (1964). It is distinguished from *B. ruderale* by tuber and rhizoid colour, and from *B. rubens* by the non-protruding nature of its tuber cells and narrower, firm-walled laminal cells. *B. radiculosum* has been found fruiting in N.Z., while *B. ruderale* has not.

The relatively short, broad capsules and the large, glossy opercula are suggestive of *B. coronatum* but the present species lacks a swollen capsule neck. Indeed, Crundwell & Nyholm suggest that *B. radiculosum* “forms a connecting link between *B. bicolor* (to which *B. coronatum* is allied, or synonymous) and the other *erythrocarpa*”.

Etymology: The epithet means bearing radicles or roots.

***Bryum rubens* Mitt., *Hooker's J. Bot. Kew Gard. Misc.* 8: 232 (1856)**

≡ *Gemmabryum rubens* (Mitt.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 68 (2005)

≡ *Rosulabryum rubens* (Mitt.) J.R.Spence, *Novon* 19: 399 (2009)

Type: Europe. Not seen.

Stems to c. 12 mm, beset with pale brown rhizoids (some arising in leaf axils of lower stem). **Leaves** evenly spaced on stem, erect-spreading moist, becoming more erect and narrowed when dry, ovate- or elliptic-lanceolate, acute, entire or weakly denticulate above, narrowly bordered and ± recurved at margins, not decurrent, c. 1.5–2.4 × 0.5 mm, with lamina forming c. 0.9 of entire length; **mid laminal cells** thin-walled, 69–105 × 14–18 µm; **marginal cells** elongate in 2–4 rows, forming a distinct border. **Costa** rather thin, excurrent. **Tubers** numerous, at least some on axillary rhizoids, spherical, 165–225(–285) µm diam., red-brown, c. 8–10 cells across, with cells moderately protruding.

Dioicous. Perichaetial leaves larger than vegetative, oblong-lanceolate, to c. 3 mm. **Perigonia** and **sporophytes** not seen.

Illustrations: Plate 17. Crundwell & Nyholm 1964, fig. 9 a–m; Smith 2004, fig. 192; Porley 2008, p. 62 & 64.

Distribution: K (Raoul I., between Low Flat & Fishing Rock); NI: N Auckland (Point England Domain); SI: Nelson (“Neudorf”). All verified material is sterile.

Probably adventive. Spence & Ramsay (2006) recorded this species from mainland Australia; and scattered northern and southern hemisphere localities. According to Porley (2008), in Britain this species is characteristic of pH neutral soils.

Habitat: The Raoul I. material grew in an open place among herbs at a roadside; the Point England material with *Funaria hygrometrica* on soil over a concrete foundation; and the “Neudorf” material on moist soil shaded by exotic weeds in a paddock. Ranging from 7 to 60 m elevation.

Notes: *Bryum rubens* is one of six N.Z. members of the “*B. erythrocarpum* complex” in the sense of Crundwell & Nyholm (1964). The complex is discussed in more detail under *B. duriusculum*.

The wider (relative to other species of the “*B. erythrocarpum* complex”) and thinner-walled mid laminal cells together with the numerous red-brown tubers (with some on short, axillary rhizoids) are distinctive. The costae are also more delicate than in any other N.Z. member of the complex. The only other N.Z. species of the complex with leaves as wide as *B. rubens* is *B. sauteri*, which has very different tubers and hence is unlikely to be confused.

The Point England material accords very closely to the leaf and cell dimensions given by Crundwell & Nyholm (1964), who described the tubers of this species as “usually abundant, many of them often on very short rhizoids, clustered at the base of the stem or solitary in the leaf axils, bright crimson, sometimes darker on basic soils.” N.Z. material has red-brown rather than crimson tubers.

Crundwell & Nyholm (1964, p. 633) recorded *B. rubens* from Napier and Dunedin. The former locality record was based on material segregated from *Pottia zealandiae* collected by Berggren in 1874. Two duplicates of the Berggren Napier collection have been examined but no material referable to the “*B. erythrocarpum* complex” is present in either. The Dunedin material that they cited is also a Berggren collection and has not been available for study.

Etymology: The epithet *rubens* means reddish and presumably refers to the colours of the tubers.

***Bryum ruderale* Crundw. & Nyholm, Bot. Not. 116: 95 (1963)**

≡ *Gemmabryum ruderale* (Crundw. & Nyholm) J.R.Spence, *Phytologia* 89: 111 (2007)

Type: Sweden. Not seen.

Stems c. 5 mm, beset below with purple rhizoids. **Leaves** evenly spaced on stem, erect-spreading when moist, becoming more erect and narrowed when dry, ovate- or elliptic-lanceolate, acute, denticulate above, weakly bordered and ± recurved at margins, not decurrent, 0.7–1.3 × 0.2–0.3 mm, with lamina forming c. 0.9 of entire length; **mid laminal cells** firm-walled, c. 39–66 × 10 µm; **marginal cells** elongate in 2–3 rows, forming a weak border. **Costa** stout and excurrent. **Tubers** ± spherical, (75–)120–195(–250) µm diam., bright orange, c. 10–12 cells across, with cells not protruding.

Reportedly dioicous. **Perichaetial leaves** to 1.5 × 0.5 mm. **Perigonia** terminal, with bracts to 1.6 mm. **Setae** c. 28 mm, red-brown; **capsules** pendent, pyriform, red-brown, c. 2.3 mm; **operculum** mammillate. **Exostome teeth** yellow-brown, **endostome segments** fenestrate; **cilia** well-developed, in groups of 3, appendiculate, ± the height of the teeth. **Spores** c. 10 µm, nearly smooth.

Illustrations: Plate 17. Crundwell & Nyholm 1964, fig. 2 a–k; Smith 2004, fig. 189, 10–13; Porley 2008, p. 64.

Distribution: SI: Nelson (Onekākā), Otago (sterile material from Abbotsford, Waipori River). The Onekākā material is fertile.

Probably adventive. Smith (2004) provided a summary of the scattered, primarily northern hemisphere distribution of this species.

Habitat: Known only from one Nelson L.D. and two Otago L.D. sites. Although the Onekākā collection by J. Tisdall (WELT M036076) is ample and fertile, male plants could not be demonstrated. It came from a “road verge at base of concrete bridge”. Both sterile Otago collections were from the margins of railway lines and one was growing with *Funaria hygrometrica* on “ash & clay”.

Notes: *Bryum ruderale* is treated here as one of six N.Z. members of the “*B. erythrocarpum* complex” *sensu* Crundwell & Nyholm (1964). The complex is discussed in more detail under *B. duriusculum*.

All three N.Z. collections are distinctive by their tuber and rhizoid morphology and colour.

Etymology: The species epithet refers to occurrence in rubbish dumps.

***Bryum sauteri* Bruch & Schimp., *Bryol. Eur.* 4, 162, 377 (1846)**

≡ *Gemmabryum sauteri* (Bruch & Schimp.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 68 (2005)
Syntypes: Europe. Not seen

= *Bryum gibsonii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 448 (1899)

Lectotype: N.Z., South Island, near Kaikōura, Jan. 1898, R. Brown, CHR 335155! (Cited by Ochi 1984, p. 181.)

Stems to 15 mm, beset below with red-brown rhizoids. **Leaves** evenly spaced on stem, erect-spreading when moist, becoming more erect and narrowed when dry, ovate- or elliptic-lanceolate, acute, denticulate above, weakly bordered and ± recurved at margins, not decurrent, c. 1.0–1.8 × 0.5–0.7 mm, with lamina forming 0.85 to ± entire leaf length; **mid laminal cells** firm-walled (rarely ± thin-walled), (24–)30–48(–75) × 10–12 μm, and c. 3–4:1; **marginal cells** elongate in 2–4(–5) rows, forming a weak or rarely distinct border; **basal cells** usually not pigmented. **Costa** stout, short-excurrent. **Tubers** pyriform or ellipsoid, (45–)60–105(–140) × 45–60 μm, red-brown, mostly 2 cells wide, with cell walls not protruding.

Dioicous. Perichaetia sometimes 2–3 on one plant, appearing to be in branch axils due to innovation, with narrowly lanceolate leaves, c. 2.2 mm. **Perigonia** terminal or on short lateral branches. **Setae** to c. 20 mm, red; **capsules** distinctly constricted below mouth when dry, 1.5–2.0(–3.0) mm long; **operculum** low-conic, not apiculate. **Exostome** as per *B. erythrocarpum* complex; **endostome** with single appendiculate **cilia** (rarely 2–3). **Spores** 14–18(–20) μm.

Illustrations: Plate 18. Crundwell & Nyholm 1964, fig. 5 a–l; Smith 2004, fig. 190, 1–3; Porley 2008, p. 64. Seppelt 2004, fig. 43.

Distribution: K (sterile material); NI: N Auckland, including offshore islands (Bay of Islands, Ōkaihou, Manukau, and sterile material from Kaipara Harbour, Kawerua, TK), S Auckland (Tuakau and sterile material from Whale I.), Gisborne (sterile material from Te Waipuhake Stream), Wellington (Tiritea River, Mana I., Hutt Valley, Wiltons Bush, and sterile material from Mt Ruapehu, Somes I.); SI: Nelson (Nine Mile Beach, and sterile material from Stephens I., Kōhahai Bluff, Perpendicular Point), Marlborough (D'Urville I., and sterile material from Puhi Puhi River, Kaikōura), Canterbury (Port Hills, summit of Arthur's Pass, and sterile material from Banks Peninsula, Broad Stream, Erewhon, Hooker Valley), Otago (Signal Hill, Berwick, Sandymount); St (sterile material only); Ch (sterile material only); C (sterile material only); M (sterile material only). Localities given are for fertile material unless specified.

Apparently bipolar. Reported from Tasmania and mainland Australia by Spence & Ramsay (2006), from Britain and scattered European localities by Crundwell & Nyholm (1964), as well as North America, south-east Asia, New Guinea, Lord Howe I., and Norfolk I. by Spence & Ramsay (2006).

Habitat: Coastal or inland, mostly on vertical soil banks and often associated with weak seepage. Occasionally on bare soil, or over rock (pumice, papa, conglomerate, etc) and nearly always occurring in ± basic (nutrient rich?) situations. Frequently associated species include *Bryum dichotomum*, *Calyptrochaeta apiculata*, *Hennediella macrophylla*, *Philonotis tenuis*, *Pseudocrossidium crinitum*, *Tridontium tasmanicum*, *Weissia austrocrispa*, and *W. controversa*. Where influenced by coastal spray, occurring from sea level to c. 325 m, but extending to c. 900 m (and rarely to c. 1300 m at Broad Stream, Canterbury L.D.) in inland situations.

Notes: *Bryum sauteri* is one of six N.Z. members of the “*B. erythrocarpum* complex” *sensu* Crundwell & Nyholm (1964). The complex is discussed in more detail under *B. duriusculum*. With the exception of *B. duriusculum*, it is the most commonly collected member of the complex in N.Z.

While the ellipsoid to pyriform tubers appear to be constantly present, they can sometimes be sparse. The highly characteristic tubers make this species unmistakable; the capsules when present are characteristically constricted below the mouth. In a small fraction of populations the laminal cells are relatively thin-walled; such variation appears to be developmental, with thinner cell walls restricted to younger plants.

Some material from Chatham I. (*A.J. Fife* 11282, CHR 514610) and Perpendicular Point, Nelson L.D. (*A.J. Fife* 5018, CHR 103708) is unusual in having a very strong leaf borders (4–5 cell rows wide at mid leaf) and plane, denticulate leaf margins.

Recognition: The red costal base cited by Crundwell & Nyholm (1964) for members of the “*B. erythrocarpum* complex” in Europe is not a constant feature of N.Z. *B. sauteri*. In most populations leaves on older stem portions have some degree of secondary pigmentation, while those on younger stems have pale or brown lower costae. Crundwell & Nyholm (1964) suggest that both monoicous and dioicous races of *B. sauteri* occur in Europe, while Smith (2004) stated that in Europe/Britain it is

“possible that there are two taxa, one oceanic and dioicous and the other continental and synoicous”. N.Z. material appears to be consistently dioicous.

Some sterile populations can be difficult to distinguish from other species, especially *Bryum dichotomum*, which also has uniformly distributed and weakly bordered leaves, stout, ± excurrent costae, and firm-walled laminal cells. In *B. dichotomum* the leaves are widest at or near the leaf base and the margins plane while in *B. sauteri* the leaves are widest at or above the middle and the margins usually ± recurved. Axillary bulbils are usually present in *B. dichotomum*, but not in *B. sauteri*.

Distinctions between *B. sauteri* (and other members of the “*B. erythrocarpum* complex”) and *B. clavatum* are discussed under the latter species.

Etymology: The epithet honours the Salzburg botanist and physician Anton Sauter (1800–1881).

***Bryum tenuidens* Dixon & Sainsbury in Sainsbury, *Trans. & Proc. Roy. Soc. New Zealand* 75: 180 (1945)**

Holotype: N.Z., Nelson, Mt Arthur, Feb. 1930, G.O.K. Sainsbury 689, BM! Isotypes: CHR 506174!, WELT M005687!

Plants small and catkin-like, ± golden above, pink-green below. **Stems** red, to c. 7 mm, branching by subperichaetial innovation, densely beset below by brown, very finely papillose rhizoids, in cross-section with an indistinct central strand. **Leaves** ± crowded and larger at stem apices (moderately comose), erect when moist, scarcely altered when dry, elliptic-lanceolate, tapered to a narrowly acuminate apex, (1.5–)2–2.3 × 0.8–1 mm in coma (smaller on innovative branches, c. 1–1.3 mm) and with lamina c. 0.6–0.8 the total leaf length, pale green above and red below, serrulate in acumen, nearly entire below, moderately bordered, plane or weakly recurved at margins, not decurrent; **upper laminal cells** rhombic-hexagonal, thin- to firm-walled, mostly 54–65(–75) µm long and c. 2.5–3.5:1, not altered near apex, becoming more oblong towards base; **marginal cells** linear and firmer-walled to form a border c. 2–4 cells wide at mid leaf and extending to apex; **basal cells** pigmented in 1–2 rows but not otherwise differentiated. **Costa** long-excurrent. **Gemmae** sparsely present in axils of upper leaves, ± ellipsoid, with numerous primordial leaves occupying their full body length; **tubers** not seen.

Synoicous. Perichaetia single and near plant base or sometimes >1 per plant. **Setae** (6–)12–15 mm, red-brown, cygneous just below capsule; **capsules** pendent, pyriform, c. 2 × 1 mm, with a narrow mouth and a well-defined neck c. ⅓ the total length; **operculum** mammillate from a low conic base. **Exostome teeth** pale brown, c. 250–300 µm, narrowly lanceolate, bordered, with c. 12–14 adaxial lamellae; **endostome** ± adherent to the exostome, with **segments** nearly the height of the teeth and perforate, and **cilia** rudimentary. **Spores** 21–27 µm.

Illustrations: Plate 19. Ochi 1970, fig. 24.

Distribution: SI: Nelson (Mt Arthur), Canterbury (Porters Pass).

Endemic.

Habitat: The type specimen was collected at 1220 m on Mt Arthur (a marble massif), while the Porters Pass collection was from c. 610 m.

Notes: The species is retained here due to the distinctive features of its peristome, the pyriform capsule with a narrowed mouth, large spores, and catkin-like gametophytes.

Material in the Dixon herbarium is considered the holotype, despite the fact that material in herb. Sainsbury is more ample. The material in herb. Sainsbury (WELT M005687) is labelled as “*Bryum tenuidens* Dix.” in Sainsbury’s hand, thus making clear his reliance on Dixon’s opinion concerning the status of this material. The protologue makes comparison to *Bryum crateris* Dixon and *B. imperfectum* Cardot, from Antarctica and southern South America, respectively. Ochyra et al. (2008, p. 482) treated both *B. crateris* Dixon and *B. imperfectum* Cardot as synonyms of *B. archangelicum* Bruch & Schimp. No material of these species has been available for comparison.

Bryum tenuidens was reported from the Waipakihi (“Waipakaki”) River, Wellington L.D. by Bartlett (1985), based on a sparse collection (WELT M008374). While similar in overall habit, stature, capsule form, sexuality, and spore dimensions to the type of *Bryum tenuidens*, Bartlett’s collection differs in significant ways, including exostome teeth with c. 20 lamellae, paired, appendiculate cilia, firmer-walled laminal cells, and considerably longer (to c. 25 mm) setae. Bartlett’s record is not accepted here, but the specimen is too poor to permit confident determination.

Ochi (1970) provisionally recognised this species but subsequently (Ochi 1992) considered *Bryum tenuidens* an “uncertain species.”

Recognition: The most striking feature of the *B. tenuidens* peristome is the relatively short, lanceolate exostome teeth with few (c. 12–14) adaxial lamellae. The difficulty of observing both the exostomal lamellae and endostomal features is compounded by endostome adherence to the teeth. Some endostomal features appear to vary, even within a single capsule. Single, non-nodose cilia c. half the height of the teeth were observed, as were very rudimentary cilia scarcely projecting from the basal membrane. No nodose or appendiculate cilia were seen. Sainsbury (1945) made very similar observations.

In some respects, the type of *B. tenuidens* resembles a diminutive *Bryum amblyodon*. However, in addition to being smaller in virtually all respects (stem, leaf, seta, and capsule dimensions), the lack of leaf decurrencies, the tendency for the endostome to adhere to the exostome teeth, and fewer exostome tooth lamellae preclude placing *B. tenuidens* in synonymy with that species. The short, pyriform capsules are suggestive of some *Pohlia* spp., e.g. *P. wahlenbergii*. However, the presence of a well-developed leaf border prevents confusion with *Pohlia*.

Etymology: The species epithet *tenuidens* means thin-teeth.

***Bryum tenuisetum* Limpr., Jahresber. Schles. Ges. Vaterl. Cult. 74: 4 (1897)**

≡ *Gemmabryum tenuisetum* (Limpr.) J.R.Spence & H.P.Ramsay, *Phytologia* 87: 68 (2005)
Type: Austria. Not seen.

Stems to c. 6 mm, beset below with pale brown rhizoids. **Leaves** evenly spaced on stem, erect-spreading moist, becoming more erect and narrowed when dry, ovate- or elliptic-lanceolate, acute, denticulate above, very weakly bordered, ± recurved at margins, not decurrent, c. 1.2–1.5 × 0.3–0.4 mm, with lamina forming c. 0.85–0.9 of entire length; **mid laminal cells** thin-walled, c. 45–54 × 10 µm; **marginal cells** elongate in 1–2 rows, forming a very weak border. **Costa** stout and excurrent. **Tubers** numerous, yellow-brown, ± spherical, 210–250(–300) µm, c. 6–8 cells across, with cells ± protruding.

Dioicous. Perichaetial leaves linear-lanceolate, c. 2.5 mm. **Perigonia** terminal. **Sporophytes** not seen.

Illustrations: Plate 18. Crundwell & Nyholm 1964, fig. 6 a–m; Smith 2004, fig. 190, 9–13.

Distribution: NI: N Auckland (sterile material only from Waimauku).

Adventive and known only from an artificial habitat. Reported from mainland Australia, Eurasia, and North America by Spence & Ramsay (2006). The northern hemisphere distribution outlined by Smith (2004) is very wide.

Habitat: The single collection recorded here was collected by Noel Turner from an artificial habitat: well-drained, sterilised potting soil between pepino (*Solanum muricatum*) bushes, growing under shade.

Notes: *Bryum tenuisetum* is one of six N.Z. members of the “*B. erythrocarpum* complex” *sensu* Crundwell & Nyholm (1964). The complex is discussed in more detail under *B. duriusculum*.

Bryum tenuisetum is known from only a single N.Z. collection and is reservedly accepted here. The N.Z. material is anomalous in having thinner-walled laminal cells than European material. The thin-walled laminal cells set it apart from all N.Z. members of the *B. erythrocarpum* complex except *B. rubens*. The laminal cells in *B. tenuisetum* are much narrower and its tuber colour different from those in *B. rubens*.

Collections recorded by Bartlett (1984) from Kawarau Gorge, central Otago have not been examined. There is only one poorly documented J.K. Bartlett collection from central Otago in AK (Jessica Beever and Dhahara Ranatunga, pers. comm., Jan. 2015); Jessica Beever informed me that it (AK 186449) differs in many significant features from the Waimauku collection and it is not considered further.

Etymology: The species epithet refers to a thin or delicate seta.

***Plagiobryum* Lindb., Öfvers. Kongl. Vetensk.-Akad. Förh. 19: 606 (1863)**

Type taxon: *Plagiobryum zieri* (Hedw.) Lindb.

Plants small and delicate, mostly whitish or silvery and suffused below with pink. **Stems** short, much branched. **Leaves** mostly imbricate, broadly ovate to cochleariform, variable at apex, thin-walled and

delicate, strongly concave, mostly entire, plane or recurved, unbordered, not decurrent, little altered when dry; **upper laminal cells** rhombic-hexagonal, mostly thin-walled, more oblong and usually shorter below; **marginal cells** not differentiated. **Costa** percurrent or ending below the leaf apex, rarely excurrent.

Dioicous. **Setae** short and cygneous; **capsules** horizontal to ± pendulous, elongate with a narrow neck, asymmetric and curved, often ± gibbous; **annulus** revoluble. **Exostome teeth** yellow-brown, lanceolate, nearly smooth, mostly ± shorter than endostome; **endostome** ± adherent, with a high membrane and rudimentary **cilia**. **Spores** persisting in tetrads until maturity, often with trilete scars, large.

Taxonomy: *Plagiobryum* is a small genus of scattered, predominantly temperate distribution. Ochi (1992) recognised six spp. One endemic species occurs in N.Z. The genus is characterised by very long-necked, slightly gibbous and horizontal to pendulous capsules with endostomal segments usually exceeding the teeth.

Spence & Ramsay (2006) treated one Australian species, *P. cellulare*, in *Plagiobryum*.

Etymology: The generic name refers to the curved capsule and to a relationship with *Bryum*.

***Plagiobryum novae-seelandiae* Broth., Proc. Linn. Soc. New South Wales 41: 586 (1916)**

Holotype: N.Z., Canterbury, Broken River, 1000 m, 3 Feb. 1902, *L. Diels s.n.*, H-Brotherus!

Plants whitish or pale brown-green, often tinged with pink below. **Stems** 3–6 mm, often broken at tips, beset at base with papillose, brown rhizoids, in cross-section with both cortical cells and central strand ill-defined. **Leaves** ± evenly spaced on stem, imbricate, cochleariform and broadly rounded at apex, c. 0.5–0.7 mm long, often ± pink below, entire, concave, plane at margins, not bordered; **upper laminal cells** thin-walled, often lacking chlorophyll, 45–75 × 21–30 µm and 1.5–2:1, somewhat smaller at extreme apex, more oblong and slightly firmer-walled in lower leaf; **basal cells** green or suffused with pink. **Costa** rather thin, ± pink below, ending far below leaf apex.

Apparently dioicous. **Perichaetia** in stem axils or near base of plant; **perichaetial leaves** oblong-lanceolate, 1.3–1.5 mm, recurved at margins. **Perigonia** terminal, with broadly ovate and acute bracts to 1.4 × 0.8 mm. **Setae** c. 10–17 mm, pale brown; **capsules** horizontal or nearly so (but sometimes pendulous when dry), with an oblong, ± gibbous urn and a very long, narrow neck c. ½ the capsule length (poorly illustrated here and best seen in dry material), c. 5–6 mm; **operculum** mammillate.

Exostome teeth nearly smooth, equal or shorter than endostome; **endostome** with narrow, perforate, lanceolate segments and rudimentary **cilia**. **Spores** ± reniform, 27–33 µm diam., brown, papillose, often with trilete scars.

Illustrations: Plate 20.

Distribution: NI: Wellington (NW Ruahine Range); SI: Nelson (Mt Arthur, Mt Owen), Canterbury (Broken River, Bealey River, Godley River), Southland (Takahē Valley).

Endemic.

Habitat: On humic soil over limestone and marble, in either forest or grassland habitats. Collections from the Bealey River and the Godley River suggest occurrence on greywacke; these collections are probably from base-rich sites. Documented from 790–1650 m. *Bryoerythrophyllum recurvirostrum*, *Distichium capillaceum*, and *Pohlia cruda* are frequently associated.

Notes: The vegetative leaves of *P. novae-seelandiae* are consistently cochleariform and broadly rounded at apices, in contrast to the ± ovate and acute leaves of the widespread northern hemisphere *P. zierii* (Hedw.) Lindb., which it resembles in capsule form. The differences in leaf form, together with phytogeographic considerations, justify the specific status accorded the N.Z. taxon by Ochi (1970, p.14). Sainsbury's (1955a, p. 265) suggestion that *P. novae-seelandiae* be reduced to a variety of *P. zierii* is not followed here. The limited fruiting material available suggests that the capsules may be more pendulous in *P. novae-seelandiae*.

Poorly documented collections from the Bealey and Godley Rivers have leaves more ovate and more acute than other populations, including the type. Such atypical populations (presumably from areas of greywacke bedrock) deserve closer investigation. Unfortunately, the scant herbarium material lacks capsules. A collection from Bealey River by *S. Berggren* (WELT M 010129) is the only material in which perigonia have been observed.

Recognition: *Plagiobryum novae-seelandiae* could be confused with *Bryum harriottii*, although the thinner-walled and larger upper laminal cells, the more delicate leaves, and the very elongate capsules (c. 5–6 mm) of the former provide distinction. Confusion might also occur with sterile *B. argenteum*, but the features in the key to species, including capsule form and dimensions, clearly differentiate *P. novae-seelandiae*. *Plagiobryum novae-seelandiae* is documented only from relatively high elevations, in comparison to the weedy and more widely distributed *B. argenteum*.

Etymology: The species epithet refers to the N.Z. provenance of this endemic species.

***Rosulabryum* J.R.Spence, *Bryologist* 99: 222 (1996)**

Type taxon: *Rosulabryum albolimbatum* (Hampe) J.R.Spence

Plants medium-sized to robust, bright, yellow-, or brown-green, weakly lustrous, usually comose (“rosulate”), often serially. **Stems** red-brown, often branched by innovations arising within or below perichaetia, beset with red-brown, densely papillose rhizoids, in cross-section with firm-walled cortical cells and a distinct central strand. **Leaves** mostly enlarged and comose at stem apices, sometimes evenly spaced on sterile stems, wide- or erect-spreading when moist, twisted around the stem or less often spiralled around their own axis when dry, widest above the middle, obovate or spatulate, ± narrowed at base, abruptly tapered to a cuspidate, awned, or piliferous apex, sometimes reflexed apically, weakly or strongly bordered and ± recurved at margins, sharply serrate, denticulate or rarely entire, not decurrent; **upper laminal cells** hexagonal to ± short rhombic, firm- or less often thin-walled, strongly or weakly porose, becoming more oblong, and usually more porose towards leaf base; **marginal cells** differentiated, linear, and mostly pale, forming a distinct border that fuses with cells of the leaf apex or fades near the leaf apex; **basal cells** usually brown. **Costa** mostly brown, strong, either fusing with the cells of the apical cusp or excurrent to form an awn. **Brood bodies** (tubers or filamentous axillary gemmae) often present.

Dioicous or less often synoicous or polygamous. **Perichaetia** terminal and comose or rarely at the plant base. **Perigonia** terminal. **Setae** single or multiple (to 4 per perichaetium), red, cygneous and sometimes strongly hooked just below the capsule; **capsules** cernuous or pendent, narrowly cylindrical or oblong-cylindrical, with a well-defined or ill-defined and usually curved neck; **operculum** mammillate, with or without an apiculus. **Peristome** double and often perfect; **exostome teeth** yellow-brown or pale; **endostome** with a high basal membrane, narrowly perforate or sometimes fenestrate segments ± equal in height to the teeth; **cilia** well-developed, 2–4, appendiculate or occasionally nodose. **Calyptra** cucullate and smooth. **Spores** spherical, c. 11–21 µm in N.Z. species.

Taxonomy: The genus *Rosulabryum* was erected by Spence (1996) to accommodate the rosulate species placed by Ochi (1992) in his sect. *Capillaria*, subsections *Capillaria* and *Rosulata*. According to Spence, those species “share several features that in combination distinguish them from other groups in the broadly conceived genus [*Bryum*]. These include obovate, twisted or contorted leaves; usually distinct leaf border with marginal teeth; rhizoidal tubers; filiform gemmae in leaf axils; and inclined to nutant capsules with unreduced peristomes.”

Spence’s concept of *Rosulabryum* is followed here, despite the consequent equivocal placement of *R. capillare* (Hedw.) J.R. Spence, which is accepted here with reservation; this species is anomalous in the genus in respect to several characters, including sexuality, perichaetial position, capsule shape, and operculum shape.

Etymology: The generic name is a combination of the word *Rosula* (rosette) with *Bryum*.

- 1 **Comal leaves** with a very strong, pale, and conspicuous border that is commonly of 10–12 cells at widest part of leaf; with; **setae** short, <15 mm *R. perlimbatum*
- 1' **Comal leaves** with a narrower border of ≤8 cells at widest part of leaf; **setae** longer, 17–55 mm 2
- 2 **Well-developed comal leaves** with apices strongly reflexed; **setae** strongly hooked below the capsule; **capsules** mostly 3–6 mm long; **fertile plants** plurisetose (at least some with multiple setae) *R. subtomentosum*
- 2' **Well-developed comal leaves** lacking strongly reflexed apices; **setae** not obviously hooked below the capsule; **capsules** shorter (except in *R. capillare*); **fertile plants** with one seta per perichaetium 3
- 3 **Border** of 4–5 cells at widest part of comal leaf; **leaf apex** short-cuspidate and weakly reflexed *R. billardierei*
- 3' **Border** narrower, of 2–4 cells at widest part of comal leaf; **leaf apex** with an elongate awn (or if merely cuspidate, not reflexed) 4
- 4 **Plants** bright green or rarely pink, usually not serially comose, synoicous or polygamous; **upper laminal cells** mostly thin-walled and not or weakly porose; **setae** 20–55 mm; **endostome** with fenestrate segments and appendiculate **cilia**; **axillary gemmae** sometimes present and filamentous; **tubers** often present, mostly 180–260(–360) µm in greater diam. *R. capillare*
- 4' **Plants** gold or brown-green, strongly and often serially comose, dioicous; **upper laminal cells** firm-walled and mostly porose; **setae** 17–20 mm; **endostome** with narrowly perforate segments and nodose **cilia**; neither **axillary gemmae** nor **tubers** seen in N.Z. material *R. campylothecium*

***Rosulabryum billardierei* (Schwägr.) J.R.Spence, *Bryologist* 99: 223 (1996)**

≡ *Bryum billardierei* Schwägr., *Sp. Musc. Frond. Suppl.* 1(2), 115 (1816) — as *billardierii*
Holotype: “Novo Belgio”: *Billardièrè*, no date, G-Hedwig-Schwägrichen!

Plants bright- or yellow-green, weakly lustrous, not or weakly comose, forming turves. **Stems** red-brown, to c. 45 mm, in cross-section as per genus. **Leaves** ± uniformly distributed, erect-spreading or spreading when moist, much altered and often twisted around the leaf axis when dry, obovate, recurved below, abruptly tapered to narrowly-triangular and weakly reflexed cusp, 2.5–3.5 mm (including cusp), c. 2–4:1, moderately concave, lacking secondary pigmentation, sharply serrate in upper 1/3 or more by projecting cells ends, weakly bordered, not decurrent; **upper laminal cells** hexagonal to ± rhombic, firm-walled and porose, c. 45–75 × c. 25 µm and 3–4:1, in lower leaf becoming longer and more oblong, **marginal cells** linear, thicker-walled, and paler to form a weak border (commonly of 4–5 cells at widest part of leaf, fading to 1–2 cells at base of apical cusp); **basal cells** not differentiated. **Costa** pale brown throughout, excurrent to form a short (usually c. 120–200 µm) cusp. **Tubers** not seen in N.Z. material.

Dioicous. Perichaetia terminal, enclosing a single fruit. **Perigonia** terminal. **Setae** c. 20–35 mm, red, cygneous just below capsule, not hooked; **capsules** pendent, oblong-cylindric, curved in the neck and slightly curved or nearly straight above, (2–)3–3.5 mm; **operculum** mammillate, scarcely apiculate.

Exostome teeth yellow-brown; **endostome** detail poorly seen in N.Z. material, with weakly appendiculate **cilia**. **Spores** 11–18 µm diam., finely papillose.

Illustrations: Plate 21. Schwägrichen 1816, pl. 76 (as *Bryum billardierii*); Spence & Ramsay 2006 fig. 46, j–s (as *R. billardieri*).

Distribution: SI: Nelson (Travers R.), Otago, Southland; St; Sol.

Anomalous? Tasmania*, mainland Australia*. The wider distribution of this species is very unclear and depends on taxonomic interpretation. Spence & Ramsay (2006) considered it to be “a circum-temperate to subtropical species of the Southern Hemisphere, in Africa, Australasia, Malesia, Oceania, New Zealand, and Macquarie Is.” and to be widely distributed in all Australian states and territories, except the Northern Territory. Ochi (1994) presented a very different distribution that included many northern hemisphere localities.

Habitat: On rock or soil; often on sand in coastal situations. Ranging from near sea level to c. 400 m.

Notes: This species remains poorly understood in N.Z. and its status here is admittedly uncertain. Most of the N.Z. material referred here to *R. billardierei* is sterile, and from Otago L.D. southwards. A small number of additional sterile collections from Westland L.D. and various North I. localities approach *R. billardierei* but in my opinion cannot be placed here with confidence. The distinction between this species and the variable and much more common *R. subtomentosum* is not clear-cut. It is possible that some material tentatively referred here may be depauperate material of the latter species. It is best to continue to recognise this species as part of the N.Z. flora until its relationship to *R. subtomentosum* is better understood. However, since conflicting opinions concerning the status of *B. billardierei* and its allies have been published, clarity will be difficult to achieve.

Material collected at Horseshoe Bay, Stewart I. (*W. Bell s.n.*, CHR 517730) agrees with Schwägrichen's type in all significant morphological features. Material collected at Flagstaff, Otago L.D. (*D. Martin*, 1879, CHR 517403) also agrees well with the type (albeit with capsule length at the shorter end of the range observed in the type).

Spence & Ramsay's (2006) placement of *Bryum leptothecium* Taylor in the synonymy of *B. billardierei* is rejected here. They did not examine the type and may simply be following Mohamed's (1979) earlier treatment of this Norfolk I. taxon. Taylor's type is referable to *R. subtomentosum*.

Neither Ochi (1970, p. 55–59), Mohamed (1979, p. 401–412), Spence (1996, p. 223), nor Spence & Ramsay (2006, p. 333) saw type material of *Bryum billardierei* Schwägr. Schwägrichen's protologue states that the type was "Legit in Novo Belgio Billardiè, australium terrarium investigator celeberrimus." The interpretation that "Novo Belgio" refers to Tasmania (Ochi 1970, p. 59), which is often repeated in the Australasian literature (e.g., Sainsbury 1955a, p. 279), seems to have originated with J.H. Willis. Willis' interpretation was unfounded. The geographic identity of "Novo Belgio" is unknown to me and to several Australasian colleagues (J. Beever, L. Cave, and P. Milne, all pers. comm., Oct. 2014) and its identification is crucial for the correct application of the name *B. billardierei* Schwägr.

Recognition: There is type material of *Bryum billardierei* in the Hedwig-Schwägrichen herbarium. Its examination confirms the concept of *R. billardierei* as having single, pendent and relatively short (c. 2–3.5 mm) capsules, moderately developed comae, short (2.5–3.5 mm, including the cusp) obovate leaves with ill-defined borders that narrow to only 1–2 cells wide at the leaf apex, and a narrowly-triangular and weakly reflexed cusp. Schwägrichen's (1816, pl. 76) illustration of *Bryum billardierei* is accurate in regard to leaf form and distribution and capsule form and number. The five plants comprising the holotype are comose, and one of the plants has subperichaetial innovations that overtop the coma.

The list of localities given by Bruch & Schimper for *Bryum billardierei* in *Bryologia Europaea* (Bruch et al. 1836–1846, p. 58) indicates *B. billardierei* has a southern European distribution, but beyond this gives no hint as to the provenance of the type collection. Prior to his collections in Tasmania and mainland Australia, de Labillardière travelled and collected extensively in Cyprus, Syria, and Lebanon in the years 1787–1788 (Duyker 2003). It is likely that the type of *B. billardierei* was collected there. In an appendix, however, Duyker (2003, p. 320) lists *Bryum billardierei* (as "*billardieri*") among several mostly Australasian plant species named in homage to de Labillardière. Ochi (1994), in his treatment of *Bryum* for the Moss Flora of Mexico, did not discuss the location of "Novo Belgio". Ochi's (1994, fig. 366) illustration shows a plant somewhat more comose than N.Z. material and with abundant filiform axillary gemmae. In other respects, plants he described accord well with N.Z. material. The provenance of Schwägrichen's type specimen, collected by de Labillardière, is an intriguing problem, but its resolution is beyond the scope of this Flora.

Etymology: The epithet honours the French botanist J.J.H. de Labillardière, the collector of the type. The species epithet and the collector's name have been spelt in various ways in the literature. Scott & Stone (1976, p. 278) employed the spelling "*billardieri*", while Ochi (1994, p. 478) argued that Schwägrichen's original spelling ("*billardieri*") should be retained. The ICN, Article 60.7 (McNeill et al., 2012, viewed on line on 27 Jan. 2015) stated that epithets based on de Labillardière's name should be spelt "*billardierei*", as done here.

***Rosulabryum campylothecium* (Taylor) J.R.Spence, *Bryologist* 99: 223 (1996)**

≡ *Bryum campylothecium* Taylor, *London J. Bot.* 5: 52 (1846)

Holotype: Australia, Swan River, 1843, *J. Drummond*, FH-Taylor! Isotypes: BM-Hooker!, FH-Taylor!

Plants gold or brown-green, strongly comose (often serially). **Stems** red-brown, c. 15–25 mm, branching by one or several innovations arising from within or below the perichaetium, in cross-section as per genus. **Leaves** larger and crowded at stem apex, erect-spreading when moist, ± erect and little altered or twisted around the stem when dry, oblong-ovate or ± obovate, widest at or slightly above mid leaf, tapered to an acute and strongly awned apex, c. 2–3.2 mm, with lamina c. 0.8 the total leaf length, concave, golden throughout (lacking secondary pigmentation at base), sharply denticulate near apex, weakly bordered and narrowly recurved (seen clearly only by cross-section) at margins, denticulate above; **upper laminal cells** hexagonal or oblong-hexagonal, firm-walled, porose or not, 30–45 × 12–15 µm and c. 3:1, somewhat smaller near apex, more oblong and thinner-walled near leaf base, not obliquely oriented; **marginal cells** very weakly differentiated in c. 2 rows of elongate cells at mid leaf, not extending to apex and often obscured at mid leaf by recurved margins; **basal cells** not differentiated or pigmented. **Costa** rather stout, yellow-brown throughout, long-excurrent and forming an elongate, denticulate awn commonly 275–600 µm long. **Brood bodies** absent.

Dioicous. **Perichaetia** terminal, with leaves more oblong-lanceolate than vegetative leaves.

Perigonia terminal, superficially indistinguishable from perichaetia and rarely seen. **Setae** single, 17–20 mm, strongly curved (but not hooked) just below capsule; **capsules** pendent, elongate oblong-cylindric, weakly curved, narrowed to (but not constricted below) the mouth, (2.8–)3.0–3.5 mm, with a narrow and well-defined neck c. 1/3 the total capsule length; **operculum** mammillate, not apiculate, red-brown. **Exostome teeth** yellow-brown; **endostome** with narrowly perforate segments and paired, nodose, and elongate **cilia**. **Spores** 15–21 µm, ± insulate.

Illustrations: Plate 22. Ochi 1970, fig. 32 (as *Bryum campylothecium*); Catcheside 1980, fig. 153 (as *B. campylothecium*); Spence & Ramsay 2006, fig. 46, t–aa.

Distribution: NI: N Auckland including offshore islands (TK, PK, HC, LB, GB, RT), S Auckland, Gisborne, Hawke's Bay, Wellington; SI: Marlborough, Canterbury (Port Hills, Birdlings Flat), Westland (near Greymouth, Jackson Bay), Otago; Ch.

Australasian. Tasmania*, mainland Australia*. Reported from Lord Howe I. by Scott & Stone (1976, p. 284).

Habitat: Usually on thin soil (sometimes humic) over rock, including basalt, breccia, and limestone; often on sand in dune hollows or on stable dunes, and occasionally on rock faces; usually in exposed, highly insolated sites but occasionally partially shaded in *Kunzea* and/or *Leptospermum* scrub. Sometimes occurring among introduced grasses. This is a characteristic species of coastal situations throughout most of the main islands, but it can also be well-developed in suitable sites well away from the sea (as at Ātiamuri, S Auckland L.D.). From sea level to c. 350 m on North I. and to at least 400 m on South I. Commonly occurring with other *Rosulabrya*, *Leptodontium interruptum*, *Pseudocrossidium crinitum*, *Syntrichia princeps*, and *Triquetrella papillata*.

Notes: The shape of the capsule is distinctive and, given its gradual narrowing to the mouth and slight curve, was aptly described as banana-shaped by Scott & Stone (1976).

Recognition: Not all sterile material can be confidently distinguished from *R. capillare*, particularly when that species grows in coastal situations. Generally, *R. campylothecium* can be distinguished from *R. capillare* by the more strongly comose set of its leaves, golden-brown colouration, stouter awns, and more thick-walled, ± porose laminal cells. When fruiting, the two species are distinguishable by several features, including the nature of their endostomal cilia and spore size.

Confusion also occurs with *R. subtomentosum* but the more erect stance of the leaves with their straight awns and lack of a conspicuous border, larger spores, non-appendiculate endostomal cilia, and absence of tubers are among numerous features that distinguish *R. campylothecium* from that variable species.

Rosulabryum campylothecium could be confused with the similarly-coloured and serially comose *Bryum crassum*. *Rosulabryum campylothecium* has strongly awned comal leaves in which the awn is up to c. 0.2 the total leaf length and non-obliquely oriented juxtacostal cells, while *B. crassum* has short excurrent costae forming a small cusp (rather than an awn) and strongly obliquely oriented juxtacostal cells in the upper leaf. *Bryum crassum* also differs by having strongly recurved leaf margins and by sporophyte characters.

Etymology: The species epithet *campylothecium* refers to the bent or curved form of the capsules.

***Rosulabryum capillare* (Hedw.) J.R.Spence, *Bryologist* 99: 223 (1996)**

≡ *Bryum capillare* Hedw., *Sp. Musc. Frond.*, 182 (1801)

Type: Europe (*s.loc.*). (Cited by Syed 1973, p. 274.) Not seen.

= *Bryum searllii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 459 (1899)

Lectotype: N.Z., South Island, near Kaikōura, Jan. 1898, R. Brown, CHR 335243!

Plants medium-sized, bright green or rarely pink, lustrous, moderately comose, forming loose turves. **Stems** red-brown, c. 7–12 mm, branching by subperichaetial innovation in fertile material (sterile plants unbranched), beset below with pale red-brown, moderately papillose rhizoids, in cross-section as per genus. **Leaves** evenly spaced on sterile stems, ± comose and with lower stems often ± leafless in sexual plants, erect-spreading when moist, weakly to strongly twisted around the stem when dry, obovate-spathulate, widest above the middle, and ± narrowed at base, rather abruptly tapered to an elongate awn (less often a cusp), not reflexed apically, to 3.5 × 1.5 mm and with lamina 0.8–0.9 the total leaf length, bordered throughout, recurved on both sides, weakly concave, denticulate above or entire, not decurrent; **upper laminal cells** hexagonal-rhombic, thin- or rarely ± firm-walled, not or weakly porose, c. 50–60 × 18 μm and mostly 2–4:1, little altered near apex, and more oblong towards leaf base; **marginal cells** linear and firm-walled to form a distinct border of c. 2–4 cells at widest part of leaf and extending ± to apex; **basal cells** mostly not pigmented. **Costa** concolourous with lamina or red-brown, variably excurrent, mostly to form a long, ± denticulate awn. **Brood bodies** (axillary gemmae and/or tubers) sometimes present; **axillary gemmae** rare in N.Z. material, filamentous, chocolate-brown; **tubers** often present in N.Z. material, globose or ± irregular, mostly 180–260(–360) μm in greater diam., pale brown, with cells not protruding.

Synoicous or polygamous. **Perichaetia** near plant base; **perichaetial leaves** smaller than vegetative, ± lanceolate and entire with a long-excurrent costa. **Perigonia** terminal and ± comal, the bracts not differentiated, enclosing numerous antheridia and 7–9-celled filiform paraphyses. **Setae** single, c. 20–40(–55) mm, ± red, cygneous just below capsule; **capsules** pendent, clavate-cylindric, 3–5 mm long, with an ill-defined neck that is c. 1/3 the total length and weakly wrinkled when dry; **operculum** low-conic, apiculate. **Exostome teeth** pale; **endostome** with very broad, fenestrate segments that taper abruptly to a filiform apex and 3–4 appendiculate **cilia**. **Spores** 11–14 μm, smooth.

Illustrations: Plate 23. Syed 1973, figs. 1–4 (as *Bryum capillare* var. *capillare*); Eddy 1996, fig. 415 (as *B. capillare*); Spence & Ramsay 2006, fig. 47, a–h.

Distribution: NI: N Auckland (Waipū, Tī Point, Woodhill), S Auckland (Waitomo), Gisborne (Panikau), Hawkes Bay (Wairoa, Māhia Peninsula, Puketīri, Pētane, Havelock North), Wellington (Mt Ruapehu, Wanganui, Ruahine Range, Carterton); SI: Nelson (Mt Owen), Marlborough (Kenepuru, Kaikōura, Wairere Stream, Haldon Hills), Canterbury (Waipara, Akaroa), Otago (Ōamaru, Taieri River, Alexandra, Remarkable Range, Tautuku Beach); St; Ch.

Nearly cosmopolitan. The world distribution is summarised by Syed (1973) to include Europe, eastern and western North America including Mexico, South America, Hawai'i, Japan, Australia, New Zealand, South Africa, central Africa, Morocco, and Canary Islands.

Habitat: On soil (often humic) over a variety of substrates, including concrete, limestone, and logs. Mostly terrestrial in base-rich situations but occasionally epiphytic. Recorded from sand hills on the Māhia Peninsula. Ranging from sea level to at least 1220 m. Associated species include *Bryum caespiticium*, *B. dichotomum*, *Camptochaete pulvinata*, *Ceratodon purpureus*, *Fabronia australis*, and *Tortella knightii*.

Notes: The spathulate, weakly comose, and bordered leaves, which are strongly spiralled around the stem when dry, are usually sufficient for recognition. The thin-walled laminal cells and strongly excurrent costa provide further distinction.

Syed (1973) considered the segregate *Bryum torquescens* Bruch to occur in N.Z. He differentiated *B. torquescens* from *R. capillare* s.s. on the basis of synoicous sexuality and orange to red tubers in the former. Spence & Ramsay (2006) recorded this species (as a *Rosulabryum*) as widespread in Australia, but did not record it from N.Z. There is no clear boundary in N.Z. between dioicous and synoicous material. Syed's (and Spence & Ramsay's) narrowly defined segregates from *R. capillare* cannot easily be applied here. The great majority of N.Z. collections are synoicous (i.e., with some antheridia in seta-bearing perichaetia) but antheridial plants can also be found in some collections. Although some collections appear dioicous, perichaetia can usually be found with at least a few

antheridia present. A collection from Rangitoto I., North Auckland L.D. (*L.H. Millener 39*, WELT M012001) provides a good example of polygamous, fruiting material. Tubers are observable in most, but not all, collections; none have been seen that are orange or red. The most tenable taxonomic position is to apply the name *R. capillare* to all N.Z. material, while noting its variable sexuality.

The name *Bryum obconicum* Hornsch. is applied to numerous collections in N.Z. herbaria; these specimens are referred here to *R. capillare*. The former name is discussed very briefly above in the “Excluded Taxa” of *Bryum*.

Distinctive material allied to *R. capillare* occurs on the Port Hills of Canterbury L.D. This compact plant is apparently dioicous, with linear-lanceolate and entire inner perichaetial leaves and has firm-textured, short (c. 2 mm) elliptic to obovate, acute and non-decurrent leaves with stout, percurrent costae, and very weakly bordered, denticulate margins. Rhizoids of this population bear numerous, ± globose, red-brown tubers and the leaf axils bear abundant chocolate brown, filamentous, unbranched, and coarsely baculate-papillose gemmae. The presence of axillary filamentous gemmae is used by Syed (1973) to partially define several segregate species allied to *R. capillare*, but the Port Hills population does not agree with any of his segregates.

Recognition: Collections of *R. capillare* with only weakly excurrent costae are best distinguished from *R. subtomentosum* by the non-reflexed leaf apices, the thinner-walled and non-porose nature of the laminal cells, and the smaller tubers of the former. The dry leaves of *R. capillare* are spiralled around the stem, whereas those of *R. subtomentosum* tend to twist around their own axis when dry.

Rosulabryum capillare is best distinguished from *R. campylothecium* by features discussed under the latter species. The potential for confusion between *R. capillare* and *Bryum creberrimum* is discussed under the latter species.

Etymology: According to Crum & Anderson (1981) the epithet “refers to a hairy appearance, perhaps to mats of radicles, as also indicated by the vernacular designations provided by Bridel in the *Bryologia Universa*”.

***Rosulabryum perlimbatum* (Cardot) Ochyra, *Biodivers. Poland* 3, 162 (2003)**

≡ *Bryum perlimbatum* Cardot, *Bull. Herb. Boissier sér. 2*, 5: 1007 (1905)

≡ *Rosulabryum perlimbatum* J.R.Spence & H.P.Ramsay, *Telopea* 8: 333 (1999) nom. inval.

Type: Falkland Islands. Not seen.

Plants medium-sized to large, yellow-green, comose (sometimes serially), forming compact turves. **Stems** red-brown, mostly c. 15–20 mm, not or moderately branched by innovations arising within the perichaetia, beset below with red-brown, densely papillose rhizoids, in cross-section as per genus. **Leaves** enlarged and comose at stem apices, wide-spreading when moist, more erect and ± spiralled around the stem when dry, widest above mid leaf, obovate to spatulate, and ± narrowed to base, abruptly tapered to an acute, narrowly triangular-cuspidate and reflexed apex, (2.5–)3–4.5 × 1–1.3 mm (in comae, those on lower stem smaller) and with lamina ≥0.9 the total leaf length, concave, not pigmented at base, denticulate (occasionally nearly entire) in upper third, with a very strong, pale, and conspicuous border, recurved below, not decurrent; **upper laminal cells** hexagonal-rhombic, firm-walled and porose, mostly 40–63 × 12–16 μm and c. 3:1, becoming longer and more oblong below; **marginal cells** forming a very wide (commonly of 10–12 cells at widest part of leaf) but poorly defined border that extends to apex and fuses with cells of the costa. **Costa** excurrent or merging with the elongate cells of the triangular and sharply pointed cusp. **Brood bodies** (tubers) usually present on rhizoids, dark red-brown, oval or round, with cell walls not protruding, 150–300 μm diam.

Dioicous. **Perichaetia** terminal or overtopped by innovations, the inner leaves much smaller than those of the comae, lanceolate. **Perigonia** not seen. **Setae** single, short, 7–14 mm; **capsules** pendent, clavate-cylindric, c. 3 mm, details not seen in N.Z. material. **Spores** not seen.

Illustrations: Plate 24. Ochi 1970, fig. 33 (as *Bryum perlimbatum*); Mohamed 1979, figs. 25–26 (as *B. perlimbatum*).

Distribution: NI: S Auckland (Tauranga); SI: Nelson (Mt Euclid), Canterbury (Porters Pass, Port Hills, Mt Berard), Westland (Mt Priestly), Otago (Signal Hill, Taieri Gorge, Lee Stream, Paradise). According to Spence & Ramsay (2006, p. 331), this species also occurs on “subantarctic islands”, but they do not specify particular islands.

Austral. Reported from southern Chile, Argentina, and the Falkland Is., and tentatively from South Africa by Mohamed (1979); Magill (1987, p. 384) also recorded it from South Africa. The single NI

collection cited consists of one sterile stem and lacks the characteristic tubers of the species; confirmation of additional NI collections is needed. The Nelson and Westland L.D. localities are both in the Paparoa Range. Reported from Marlborough L.D. (Kaikōura) by Mohamed (1979).

Habitat: On soil, usually in proximity to streams or seepages; three collections from the Paparoa Range were from granite-derived soils. Ranging from c. 300–1020 m on SI.

Notes: *Rosulabryum perlimbatum* is easily confused with both *R. capillare* and *R. subtomentosum*. From *R. capillare* it is best distinguished by its wider leaf border, reflexed leaf apex, and its strongly and often serially comose habit. From *R. subtomentosum* it is distinguished by having smaller and more abundant tubers, wider leaf borders, less distinctly toothed leaf margins, and shorter setae.

Etymology: The epithet *perlimbatum* means completely bordered.

***Rosulabryum subtomentosum* (Hampe) J.R.Spence, *Bryologist* 99: 99 (1996)**

≡ *Rhodobryum subtomentosum* Hampe, *Linnaea* 36: 516 (1870) — as *Rhodo-Bryum subtomentosum*

≡ *Bryum subtomentosum* (Hampe) Mitt., *Trans. Roy. Soc. Victoria* 19: 73 (1882)

Isotype: “Australia felix”, F. Mueller, MEL 31031! Holotype: BM 1086480 (viewed online at JSTOR Global Plants, accessed 15 Jan. 2015).

= *Bryum leptothecium* Taylor, *Phytologist* 1: 1094 (1844)

Holotype: Norfolk I., A. Cunningham s.n., FH!

= *Bryum gracilicarpum* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 462 (1899)

Holotype: N.Z., Mt. Torlesse, R. Brown s.n., CHR 335586!

= *Bryum billardierei* var. *platyloma* Mohamed, *J. Bryol.* 10: 412 (1979) — as *Bryum billardieri* var. *platyloma*

Isotype: N.Z., Southland, Cascade Ck., Eglinton, May 1971, J. Child 2713, BM 1086485!

Holotype: E 348819 (viewed online at JSTOR Global Plants, accessed 15 Jan. 2015).

Misapplications: *Non Bryum platyloma* Schwägr., *Sp. Musc. Frond. Suppl.* 1(2): 116 (1816); *nec Bryum capillare* var. *platyloma* (Schwägr.) Schimp., *Coroll. Bryol. Eur.* 75 (1856); *nec Rosulabryum platyloma* (Schwägr.) Ochyra, *Biodivers. Poland* 3: 162 (2003).

Bryum truncorum sensu Sainsbury 1955a.

Plants large to robust, bright or yellow-green, weakly lustrous, variable in stature, comose, forming turves. **Stems** red-brown, c. 10 to at least 35 mm, with innovations arising from within the perichaetia, in cross-section as per genus. **Leaves** distinctly enlarged and more crowded at stem apices, often serially comose, wide-spreading when moist, much altered, more erect, and often twisted around the leaf axis when dry, obovate to spatulate, widest well above mid leaf, abruptly tapered to an acute, stoutly triangular-cuspidate and variably reflexed apex, c. 3–7 × 1.2–1.5(–1.7) mm (including cusp), sharply serrate or rarely denticulate in upper 1/3 or more, strongly bordered, recurved below, not decurrent; **upper laminal cells** hexagonal to ± rhombic, firm-walled and porose (often strongly so), c. 45–75 µm long and 3–4:1, in lower leaf becoming longer (to c. 100 µm), more oblong, and usually more porose; **marginal cells** linear, thicker-walled, and paler to form a wide (commonly 3–8 cells at widest part of leaf) but often poorly defined border, extending to apex and fusing with cells of the cusp; **basal cells** usually darker brown than adjacent cells. **Costa** pale brown throughout, excurrent into the triangular, sharply pointed, and ± reflexed cusp. **Tubers** often present, c. 500–900 µm in greater diam., orange-brown, oval, round, or irregular in outline.

Dioicous. **Perichaetia** terminal, the inner leaves much smaller than those of the coma, lanceolate or oblong-lanceolate, slenderly acuminate, with a long-excurrent costa. **Perigonia** terminal and scarcely distinguishable from perichaetia, with broadly ovate-lanceolate inner bracts and red-brown filiform paraphyses. **Setae** usually multiple (2–4 per perichaetium, less often 1), c. 20–50 mm, red, usually strongly hooked just below capsule; **capsules** cernuous or pendent, narrowly cylindrical, curved, 3–6 mm, with a narrow, scarcely wrinkled, and ± curved neck c. 1/4 the capsule length; **operculum** mammillate, scarcely apiculate. **Exostome teeth** yellow-brown; **endostome** with perforate segments nearly the length of the teeth and **cilia** in groups of 3, mostly appendiculate, but sometimes (variable in single capsule) reduced and nodose. **Spores** variable in single capsule, 11–18 µm diam., finely papillose.

Illustrations: Plates 25, 26. Mohamed 1979, fig 2, b; fig. 3, b; fig. 5 a–h (as *Bryum billardieri* var. *platyloma*); Spence & Ramsay 2006, fig. 49 i–q.

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

Probably Australasian. Tasmania*, mainland Australia*. The wider distribution of *R. subtomentosum* cannot be determined with confidence. Spence & Ramsay (2006) recorded this taxon from all states of Australia (excluding the Northern Territory). Ochi's (1970) concept of *Bryum billardierei* apparently corresponds to *R. subtomentosum* as interpreted here and he recorded it also from New Caledonia and Fiji.

Habitat: On duff, humus, or mineral soil (especially sand), rotten logs, and shaded rock in forest or scrub, including both coastal and inland situations. *R. subtomentosum* is well-developed in a wide range of forest types. In the far north it occurs commonly under *Leptospermum/Kunzea* and *Metrosideros* forest, often in coastal situations, as well as mixed podocarp-broadleaved forest (as in the Waitakere Ranges). In the central North I. and South I. it is widespread in montane southern beech (especially *Fuscospora cliffortioides* and *F. solandri*) forest. It also occurs in exotic (e.g. eucalypt and pine) plantations and rarely in grasslands (and then usually appearing lax in habit). It does not normally extend above tree line. Occurring from sea level to c. 1200 m elevation on both North I. and South I.

Notes: When well-developed, *R. subtomentosum* is easily recognised. Among the most constant features that facilitate its recognition are the hooked setae, the elongate, slender, curved, and usually multiple capsules, and the \pm reflexed nature of the leaf apices. The very large tubers, while not always present, are also distinctive. The usually markedly comose habit, especially in plants from drier and more insolated sites, is correlated with the above features, as is the weakly defined, but wide leaf border. Plants growing in very moist habitats sometimes have leaves more evenly spaced along the stem. The features noted in the key will allow placement of nearly all fruiting specimens.

Many of the features of this species, including the degree of differentiation of the comal leaves, the degree of reflexion of the leaf apices, and the breadth of the leaf border, seem to vary independently and a moderate number of collections, particularly sterile ones, cannot be placed confidently as either *R. subtomentosum* or *R. billardierei*.

The range of intermediate material involves many permutations of character states, including plants with gametophytes characteristic of *R. subtomentosum* that bear sporophytes characteristic of *R. billardierei* (single relatively short, pendent, and nearly symmetric capsules), as in *K.W. Allison 919* ex Flagstaff Hill, Otago (CHR 548195).

Mohamed's (1979, p. 414) suggestion that a progressive reduction in size, border width, and acuminate nature of [the leaf] apex occurs as one proceeds northwards (i.e., from Southland L.D. northwards) in *R. subtomentosum* (cited as *Bryum billardieri* var. *platyloma*) cannot be confirmed. However, plants from N Auckland L.D. generally have more weakly developed comae and leaves less spreading than those from other regions. Also, shorter and broader leaves are correlated with narrower leaf borders throughout both main islands.

Despite the difficulty associated with distinguishing *R. subtomentosum* and *R. billardierei*, the recognition of both taxa here is a pragmatic solution to an intractable taxonomic problem. Study using molecular techniques might yield an improved understanding of the population variability in *Rosulabryum*. Continued study of morphology alone is unlikely to improve our understanding.

The taxonomic confusion surrounding *R. subtomentosum* and its allies has been greatly compounded by nomenclatural confusion. In particular, the confusion has centred on the names *Bryum platyloma* Schwägr., *Bryum billardierei* Schwägr., and, much more recently, *Bryum billardierei* var. *platyloma* Mohamed. *Bryum platyloma* Schwägr. is based on a specimen from Madeira with an unspecified collector. *Bryum billardierei* Schwägr. is based on a de Labillardière collection of unknown (but probably Mediterranean) provenance; it is discussed elsewhere in this work. Confusingly, the names *Bryum platyloma* Schwägr. and *Bryum billardierei* Schwägr. were published on consecutive pages of Sp. Musc. Frond. Suppl. and both taxa were illustrated in the same plate. The name *Bryum platyloma* Schwägr. was not, to my knowledge, applied in print to Australasian material prior to its inclusion in the synonymy of *R. subtomentosum* (Hampe) J.R. Spence by Spence & Ramsay (2006). Their statement (p. 344) that *Bryum platyloma* Schwägr. and *Bryum billardierei* var. *platyloma* Mohamed are homotypic (nomenclatural) synonyms is incorrect.

Much of the reason for this nomenclatural confusion can be traced to Mohamed's choice of an epithet for a plant he considered to be a variety of *Bryum billardierei* Schwägr. The name *B. billardierei* var. *platyloma* Mohamed has been widely applied to a common and widespread N.Z. (and Australian) taxon since its publication in 1979. Mohamed's name is validly published. He clearly and correctly specified *John Child 2713* as the type of the var. *platyloma*. The salient features of Mohamed's type

include the length and number of the capsules, the hooked nature of the upper setae, and the capsule form and length. Spence & Ramsay's (2006) designation of *J. Child 2713* as a neotype is superfluous. In a N.Z. context, recognition of this taxon at the species, rather than variety level, is advocated here. At the species level, the name *R. subtomentosum* (Hampe) J.R.Spence is preferred since, as determined by Spence & Ramsay (2006), its Victorian basionym is the earliest valid name at species rank. Recognition at species level using this name obviates taxonomic and nomenclatural confusion with *R. billardierei* (Schwägr.) J.R.Spence. The last taxon has (as discussed elsewhere in this work) particular problems surrounding the provenance of its type.

Rosulabryum subtomentosum resists neat taxonomic treatment; a specialised study using non-morphological characters is probably the only way to improve our understanding of this species and its congeners.

Recognition: The distinction between *R. subtomentosum* and *R. capillare* can be difficult, particularly when lax growth forms of the former are involved. When dry, the leaves of *R. subtomentosum* tend to spiral around their own axes, while those of *R. capillare* spiral around the stem. The leaves of *R. subtomentosum* are mostly sharply serrate rather than entire or denticulate as in *R. capillare*. Additionally, in *R. subtomentosum* the leaf border tends to be wider, upper laminal cells more thick-walled and porose, and the apical cusp shorter and stouter than the corresponding structures in *R. capillare*. Sexuality also distinguishes these taxa in N.Z., as does rhizoidal tuber morphology, when these are present.

Rosulabryum subtomentosum is best distinguished from *R. perlimbatum* by having narrower leaf borders, stronger and sharper marginal teeth, and larger tubers. *Rosulabryum subtomentosum* is best distinguished from *R. campylothecium* by having more spreading leaves with wider borders and reflexed apices, smaller spores, and appendiculate cilia.

Etymology: The meaning of the species epithet, beyond the obvious reference to tomentum, is not clear. It may refer to the Indian species *Bryum tomentosum* (Brid.) Sw.

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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)
subsp.	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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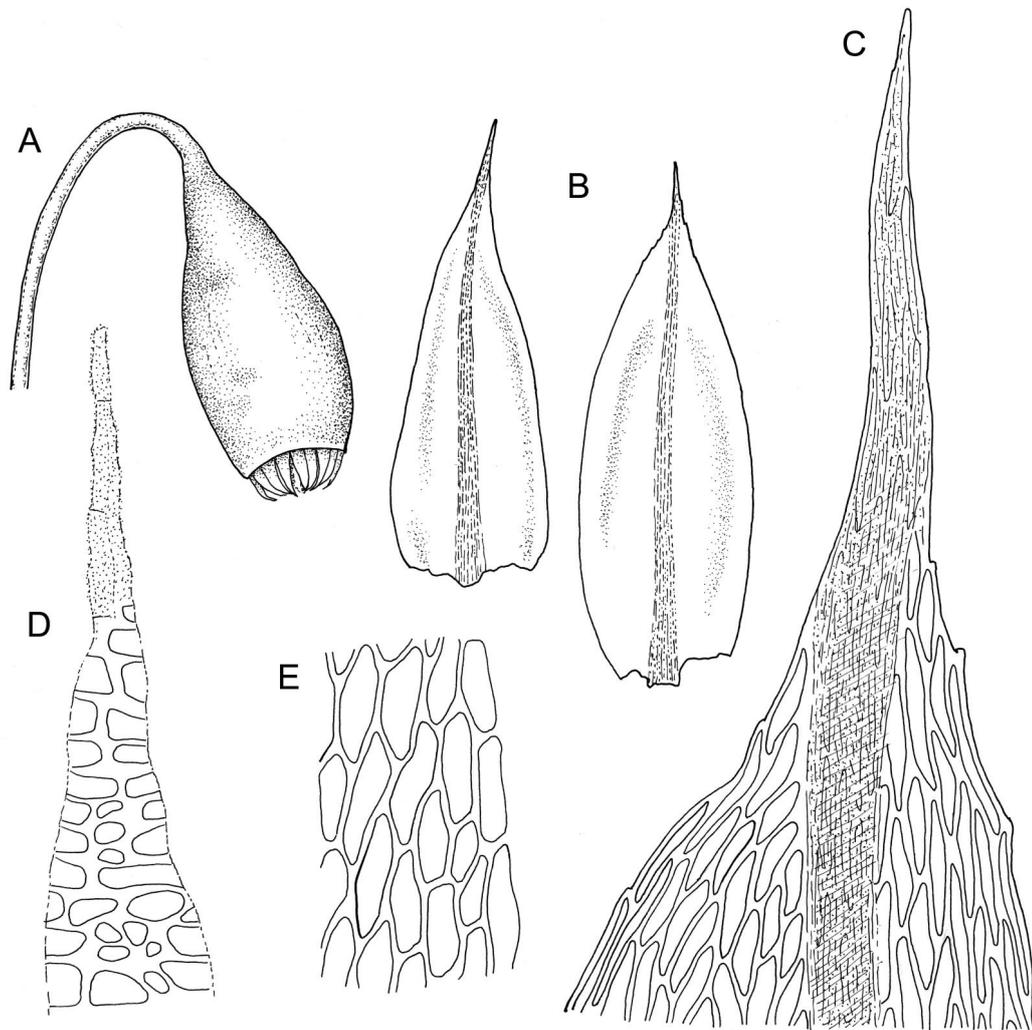


Plate 1: *Bryum*. A–E: *B. algovicum* var. *rutheanum*. A, capsule, dry. B, leaves. C, leaf apex. D, exostome tooth, inner surface. E, upper laminal cells. Drawn from *J.T. Linzey* 3124, CHR 516508, and *J.T. Linzey* 3363, CHR 516505.

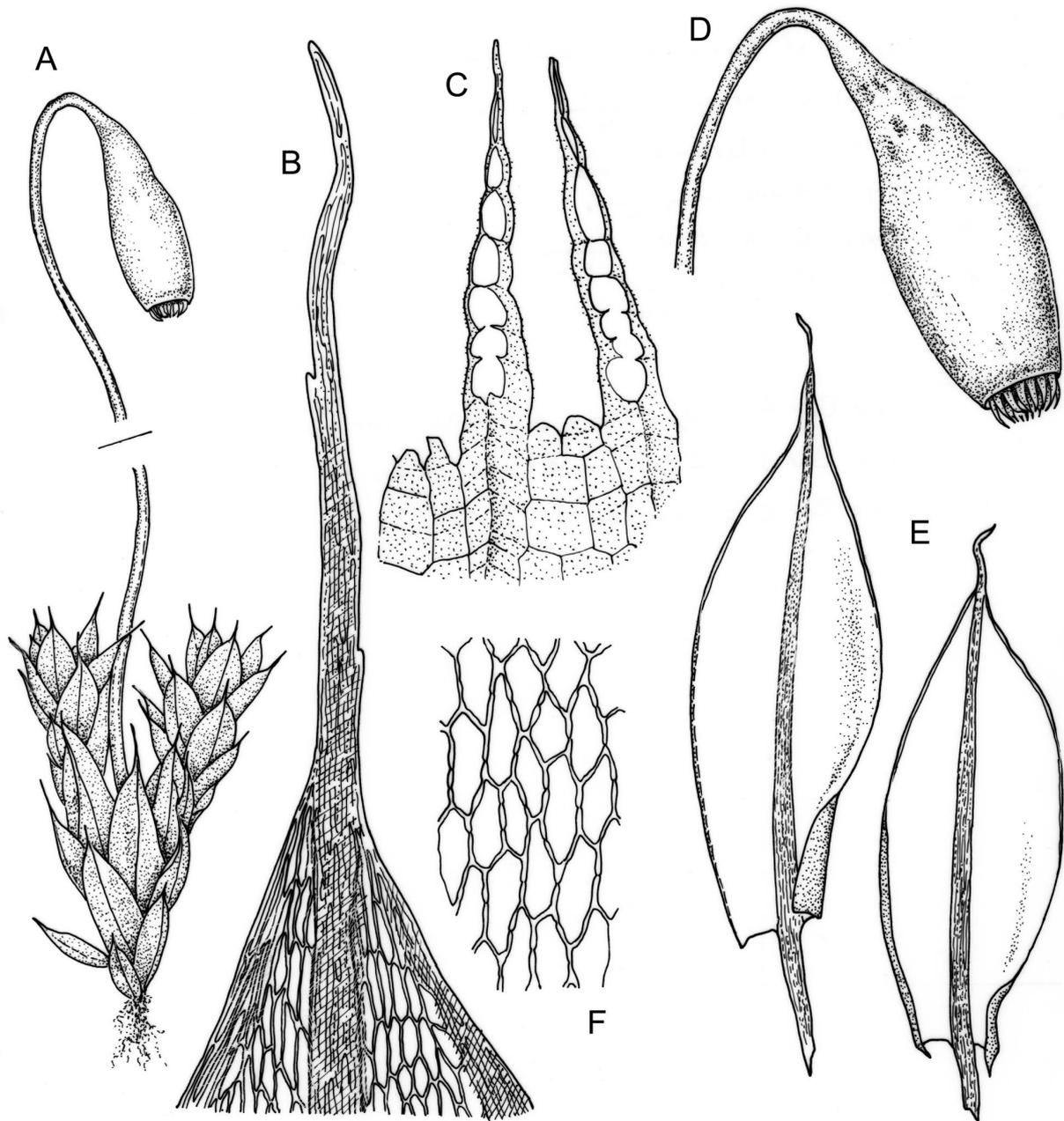


Plate 2: Bryum. A-F: *B. amblyodon*. A, habit with capsule. B, leaf apex with awn. C, endostome detail. D, capsule, dry. E, leaves. F, upper laminal cells. Drawn from A.J. Fife 5102, CHR 185995.

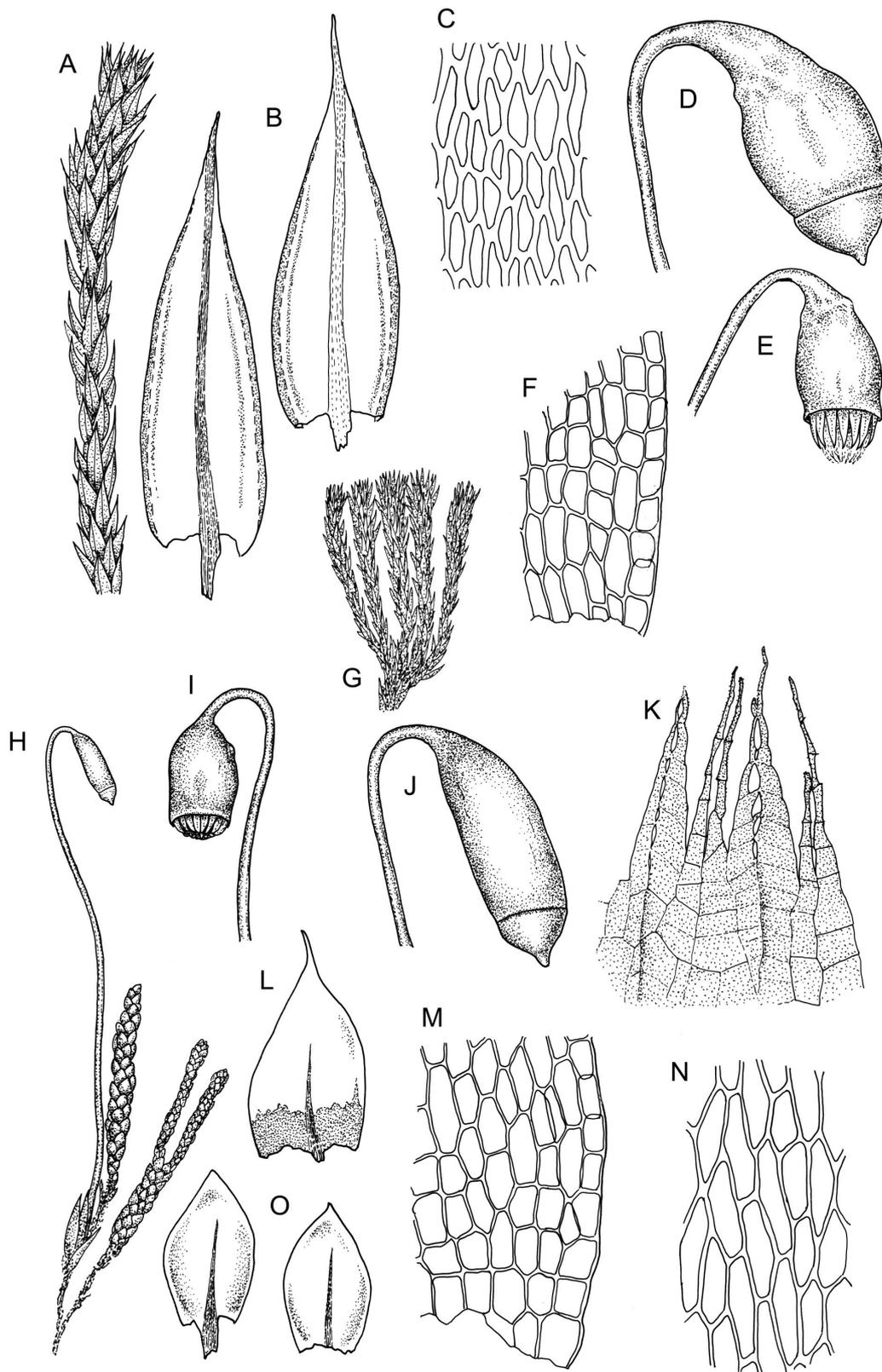


Plate 3: *Bryum*. A–G: *B. appressifolium*. A, shoot. B, leaves. C, upper laminal cells. D, capsule with operculum. E, capsule, dry. F, alar cells. G, habit. **H–O: *B. argenteum*.** H, habit with capsule. I, capsule, dry. J, capsule with operculum. K, endostome detail. L, leaf. M, alar cells. N, upper laminal cells. O, leaves. *B. appressifolium* drawn from A.J. Fife 4972, CHR 104083, and G.O.K. Sainsbury 916, CHR 490272. *B. argenteum* drawn from W. Martin 57.10, CHR 515790, K.W. Allison 2455, CHR 577448, and B.P.J. Molloy s.n., 7 Mar. 1972, CHR 164170.

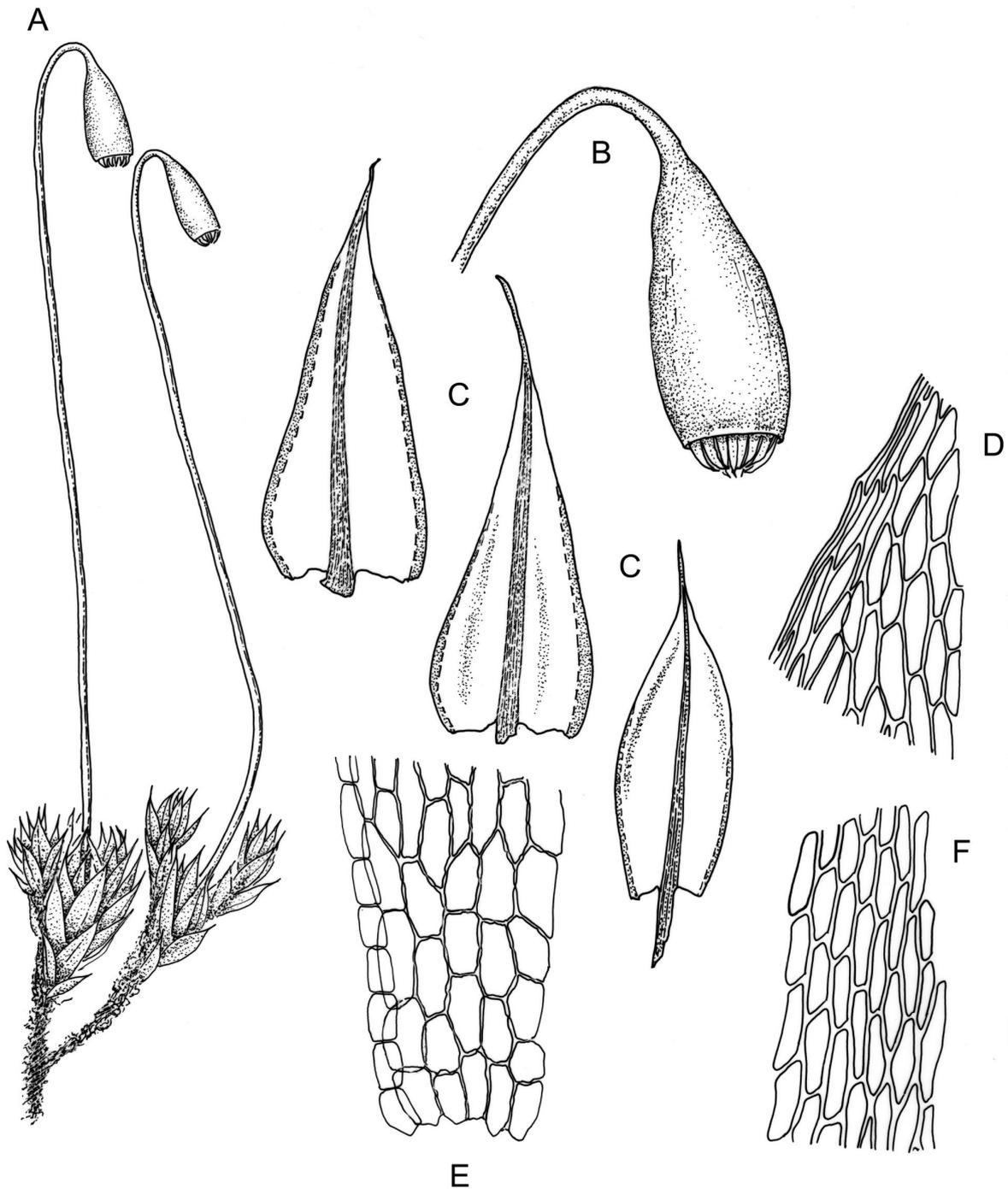


Plate 4: *Bryum*. A-F: *B. caespiticium*. A, habit with capsules. B, capsule. C, three leaves. D, border at base of acumen. E, basal laminal cells. F, upper laminal cells. Drawn from *J.T. Linzey s.n.*, 21 Feb. 1966, CHR 555446.

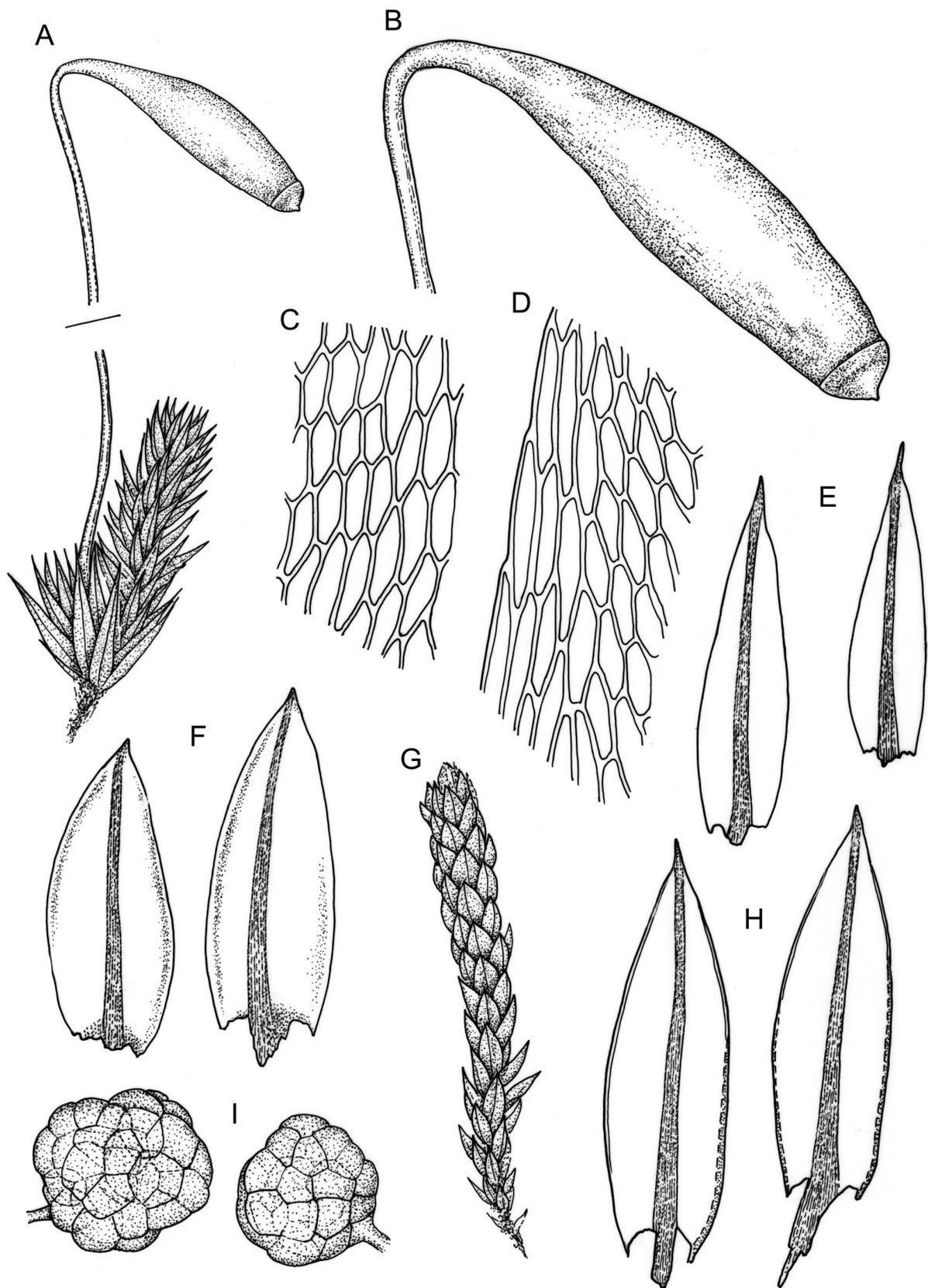


Plate 5: *Bryum*. A-I: *B. clavatum*. A, habit with capsule. B, capsule. C, upper laminal cells. D, border of upper leaf. E-F, leaves. G, habit of sterile shoot. H, leaves. I, tubers. A-E drawn from G.O.K. Sainsbury 6142, WELT M12154; F-G; H drawn from K.W. Allison 6449, CHR 604673; I drawn from A.J. Fife 7971b, CHR 106594.

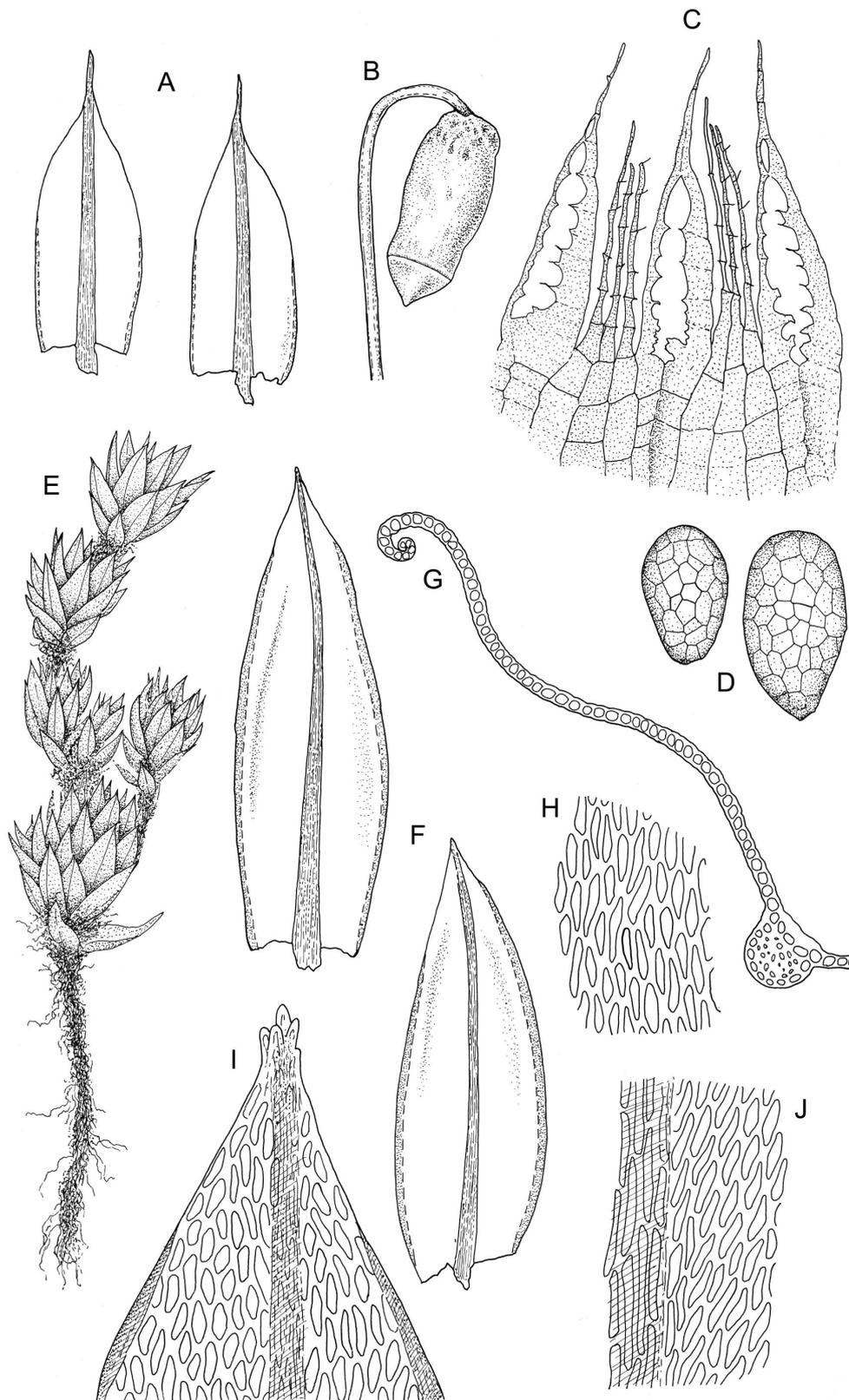


Plate 6: *Bryum*. A–D: *B. coronatum*. A, leaves. B, capsule with operculum, dry. C, endostome detail. D, gemmae. **E–J: *B. crassum*.** E, habit of sterile plant. F, leaves. G, cross-section of laminal cells including costa. H, upper laminal cells. I, leaf apex. J, mid laminal cells adjacent to costa. *B. coronatum* drawn from Auckland Domain (collector unknown), WELT 12375. *B. crassum* drawn from G.O.K. Sainsbury 1633, CHR 490286, and K.W. Allison 117, CHR 490278.

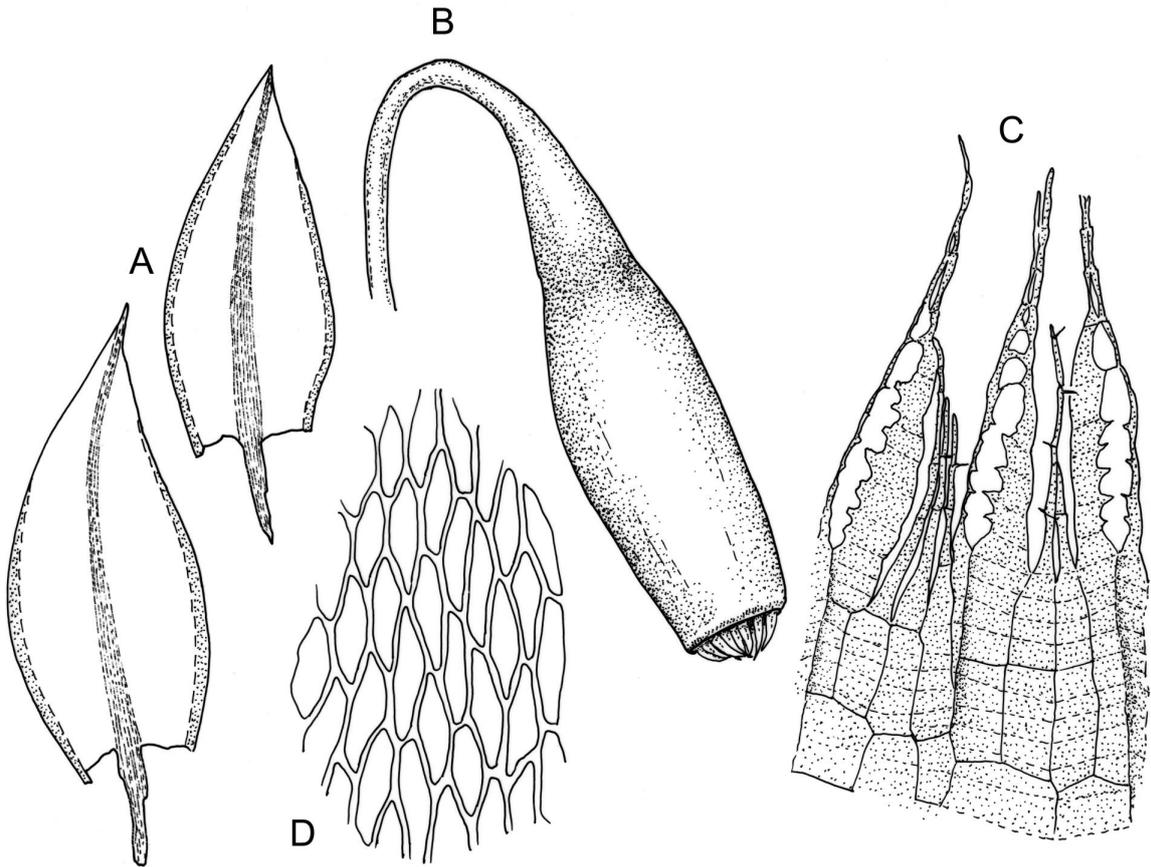


Plate 7: *Bryum*. A–D: *B. creberrimum*. A, leaves of innovation. B, capsule. C, endostome detail. D, upper laminal cells. Drawn from lectotype of *B. austropallescens*, *W. Bell*, Nov. 1889, H-Brotherus 608009.

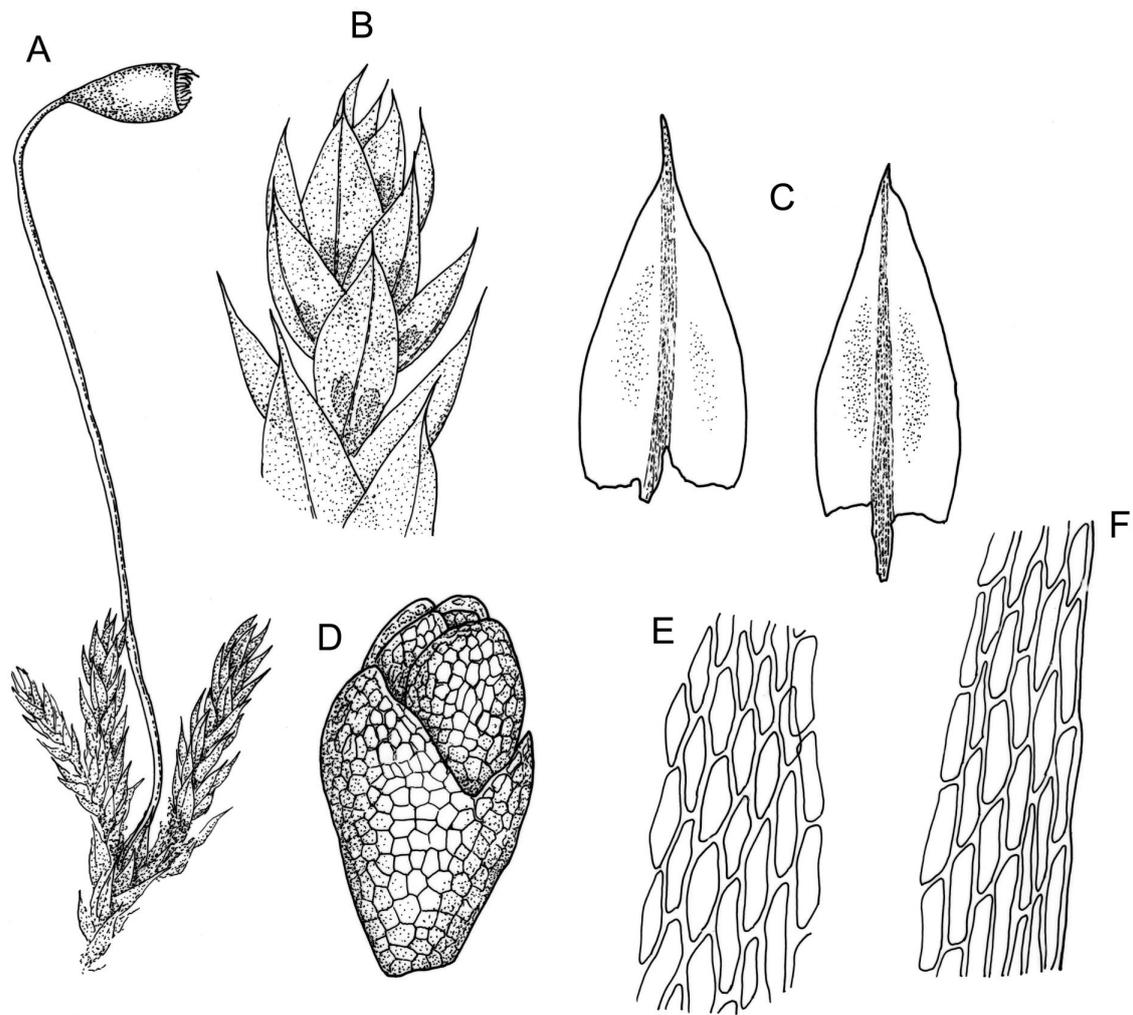


Plate 8: *Bryum*. A–F: *B. dichotomum*. A, habit with capsule. B, portion of shoot with gemmae. C, leaves. D, gemma. E, upper laminal cells. F, mid laminal cells at margin. Drawn from *K.W. Allison 1115*, CHR 577449, *K.W. Allison 1116*, CHR 578250, and *M.J.A. Simpson 4690*, CHR 161567.

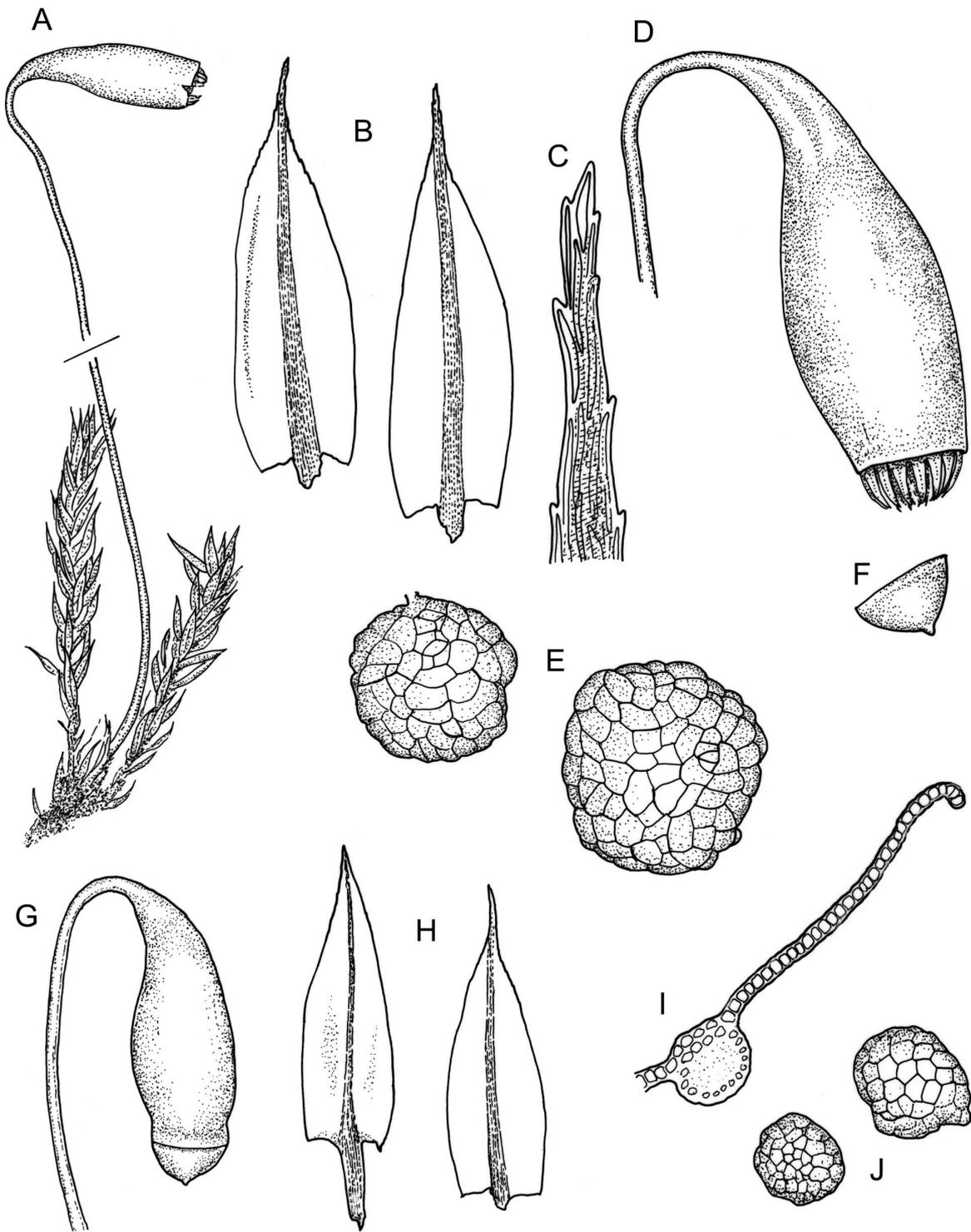


Plate 9: *Bryum*. A-F: *B. duriusculum*. A, habit with capsule. B, leaves. C, awn. D, capsule. E, tubers. F, operculum. G-J: *B. radiculosum*. G, capsule. H, leaves. I, cross-section of laminal cells including costa. J, tubers. *B. duriusculum* drawn from W. Bell 699, CHR 515291. *B. radiculosum* drawn from K.W. Allison 703, CHR 515482.

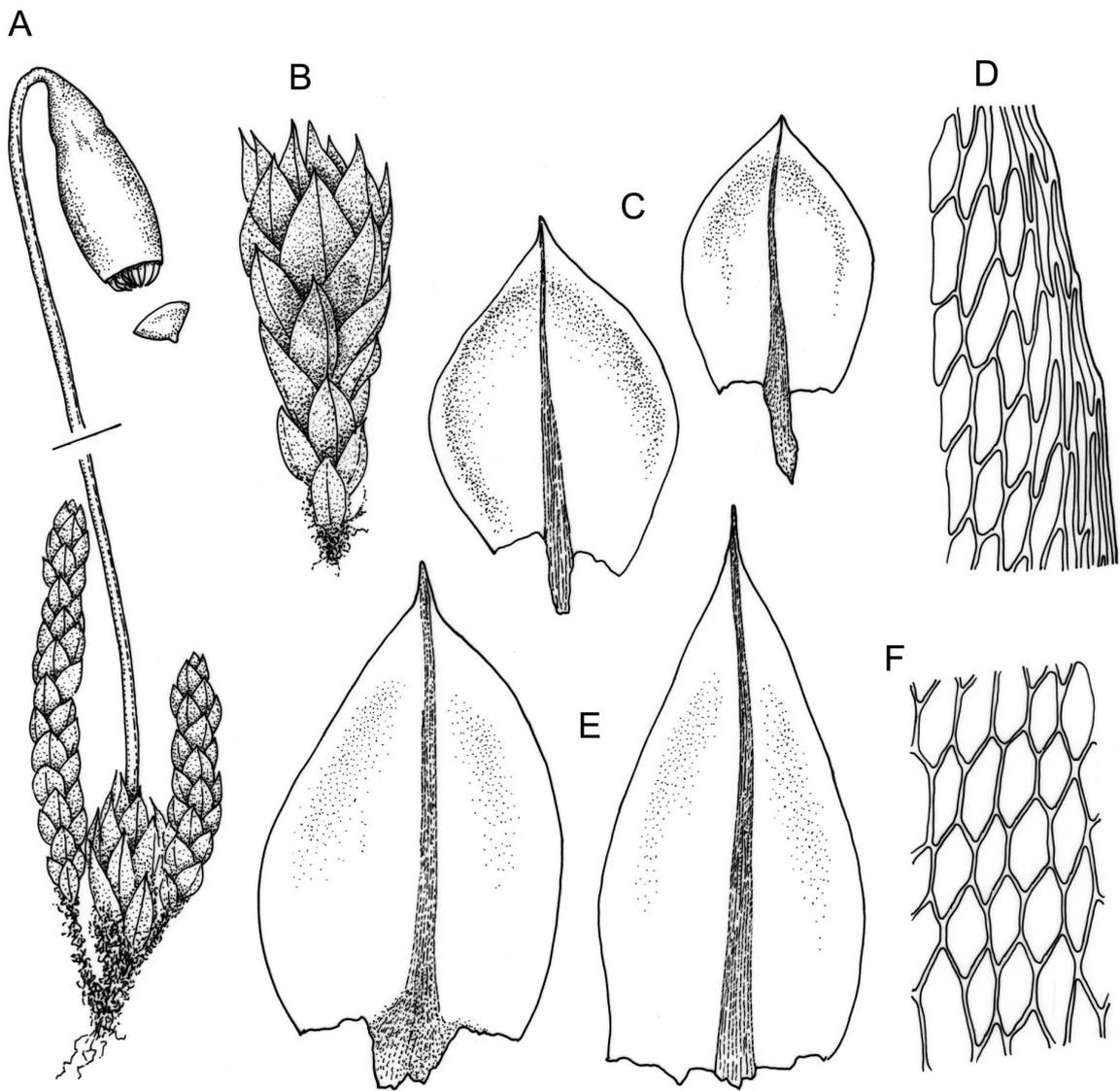


Plate 10: *Bryum*. A–F: *B. funkii*. A, habit with capsule. B, ♂ shoot. C, leaves of innovation. D, border of upper leaf. E, perichaetial leaves. F, upper laminal cells. Drawn from *J.T. Linzey 3247*, CHR 490350, and *J.T. Linzey 3248B*, CHR 227591.

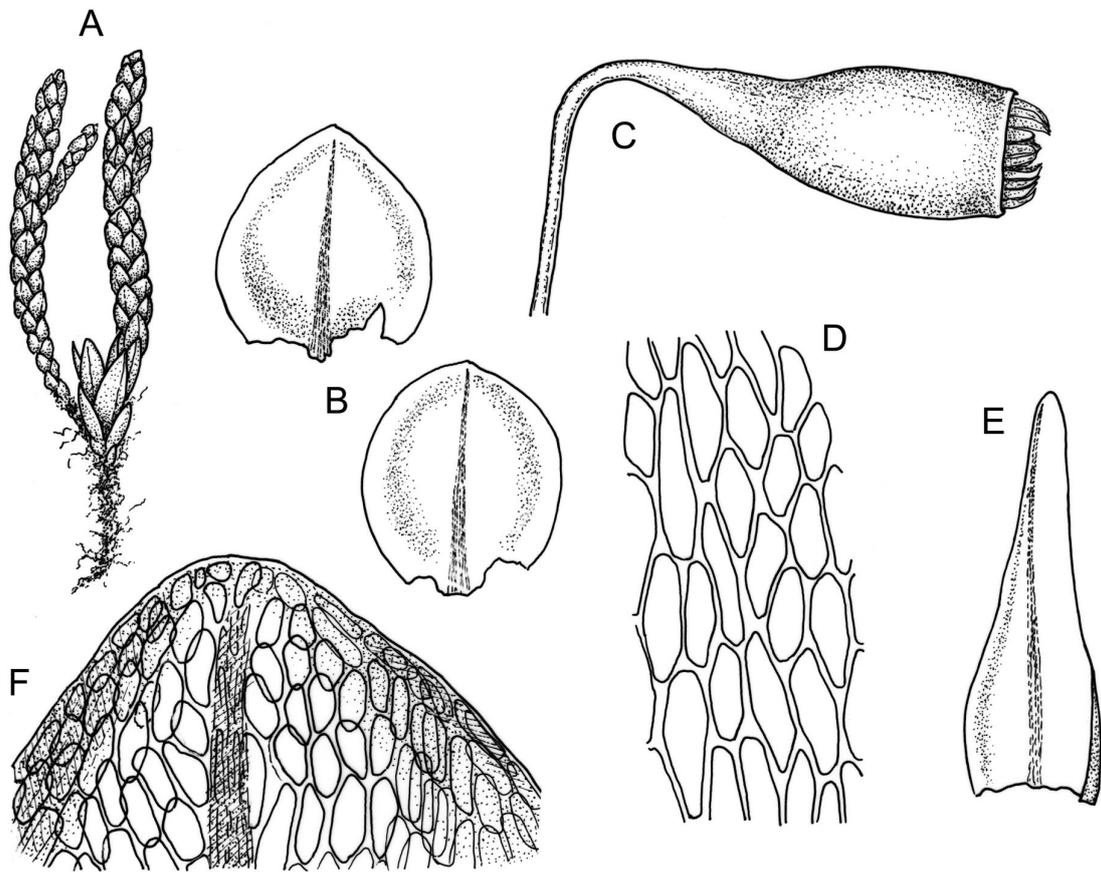


Plate 11: *Bryum*. A–F: *B. harriottii*. A, habit. B, leaves. C, capsule. D, mid laminal cells. E, perichaetial leaf. F, leaf apex. Drawn from *W. Martin 857*, 14 Apr. 1950, CHR 491662.

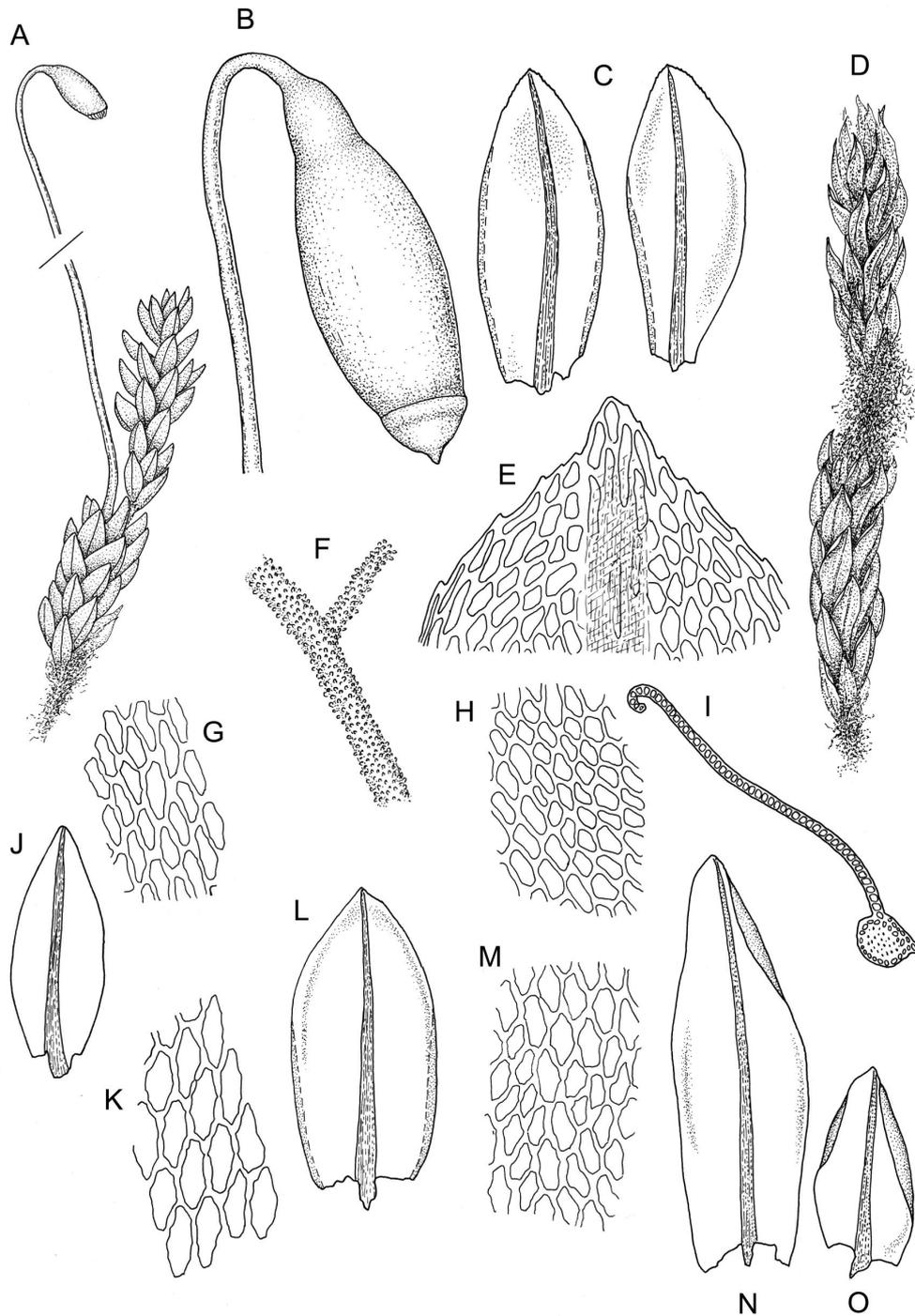


Plate 12: *Bryum*. A–O: *B. laevigatum*. A, habit with capsule. B, capsule. C, leaves. D, shoot, dry. E, leaf apex. F, rhizoid detail. G–H, upper laminal cells. I, cross-section of laminal cells including costa. J, leaf. K, upper laminal cells. L, leaf. M, upper laminal cells. N, perichaetial leaf. O, leaf. A–F, H–I drawn from *D. Petrie s.n.*, Nov. 1893, CHR 516751; G, J drawn from *A.J. Fife 8492*, CHR 464732; K–L drawn from *A.J. Fife 8058*, CHR 436794; M–O drawn from lectotype, *Lawrence 261*, BM-Wilson.

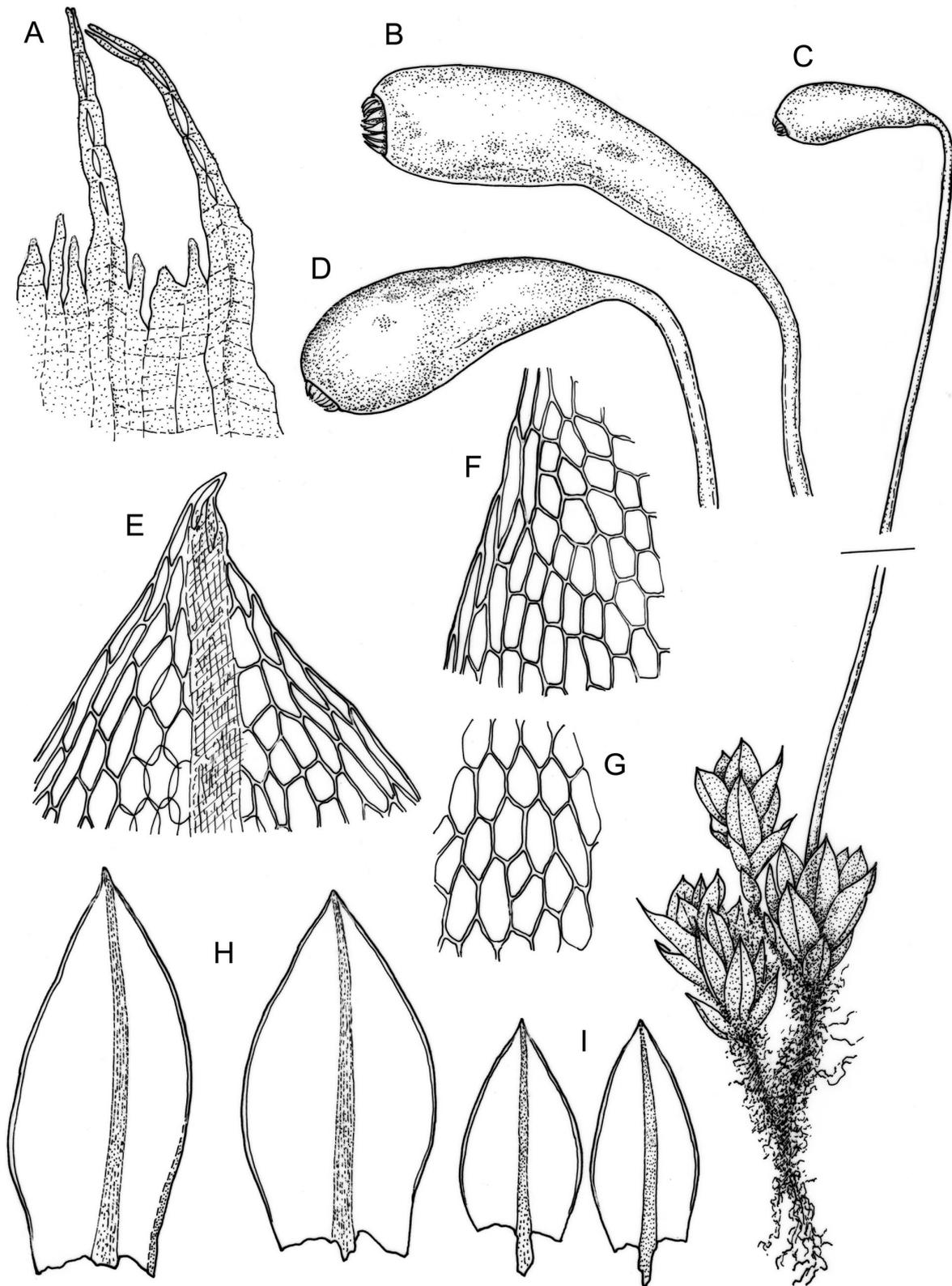


Plate 13: *Bryum*. A-I: *B. mucronatum*. A, endostome detail. B, capsule, dry. C, habit. D, capsule. E, apex of comal leaf. F, border at widest part of comal leaf. G, upper laminal cells. H, comal leaves. I, leaves of innovation. Drawn from A.J. Fife 7402, CHR 406610.

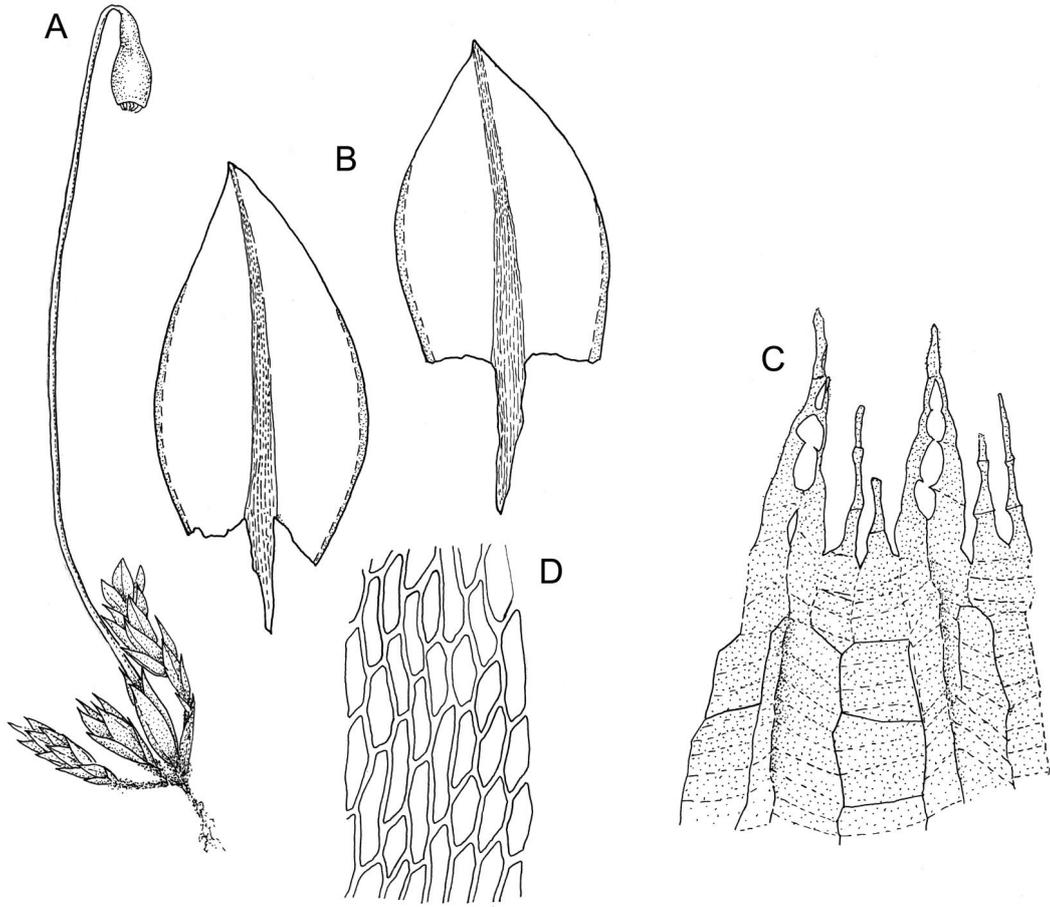


Plate 14: *Bryum*. A–D: *B. pallescens*. A, habit with capsule. B, comal leaves. C, endostome detail. D, upper laminal cells.
Drawn from K.W. Allison 8379, CHR 516752.

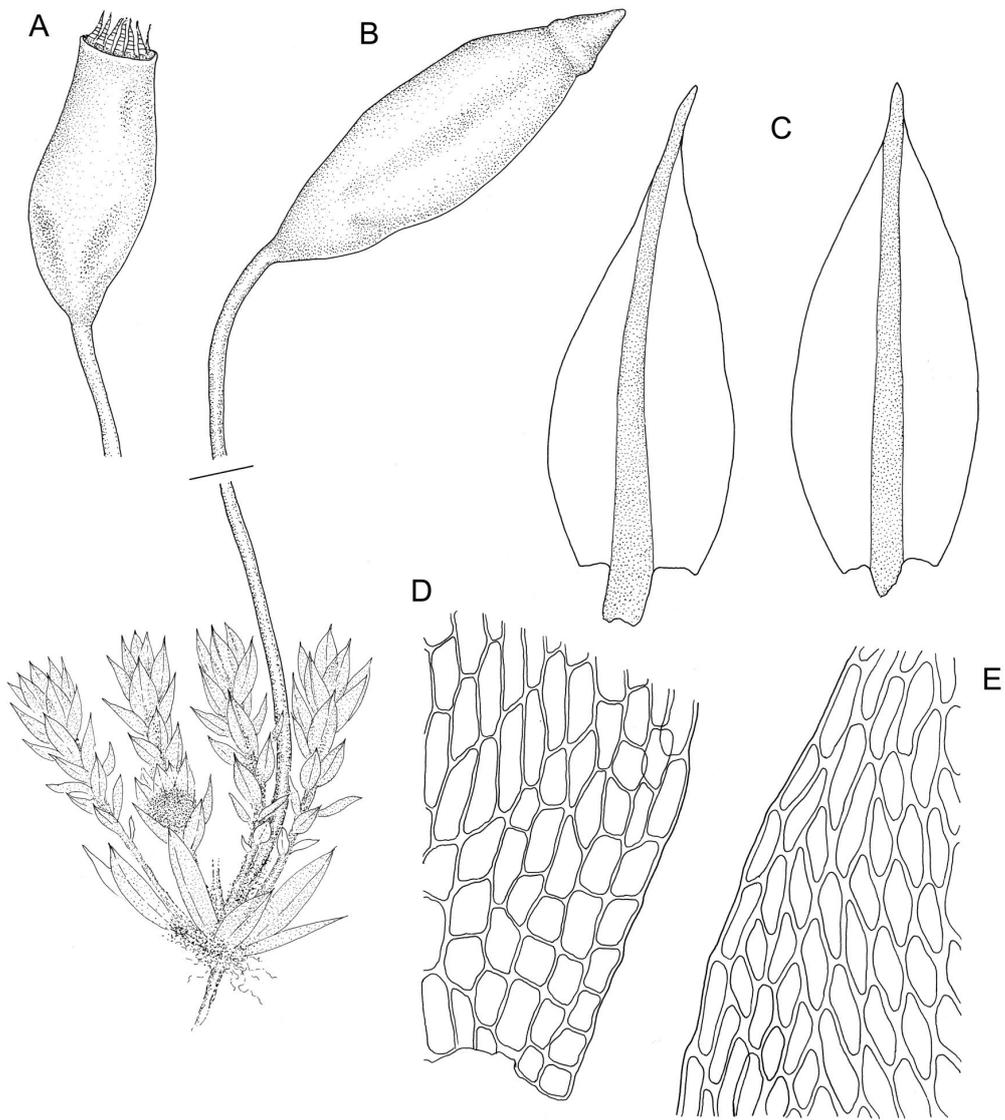


Plate 15: *Bryum*. A–E: *B. preissianum*. A, capsule. B, habit with capsule. C, leaves. D, alar cells. E, upper laminal cells at margin. Drawn from *D. Petrie s.n.*, Aug. 1918, CHR 490351, and *E.A. Hodgson 162*, CHR 490353.

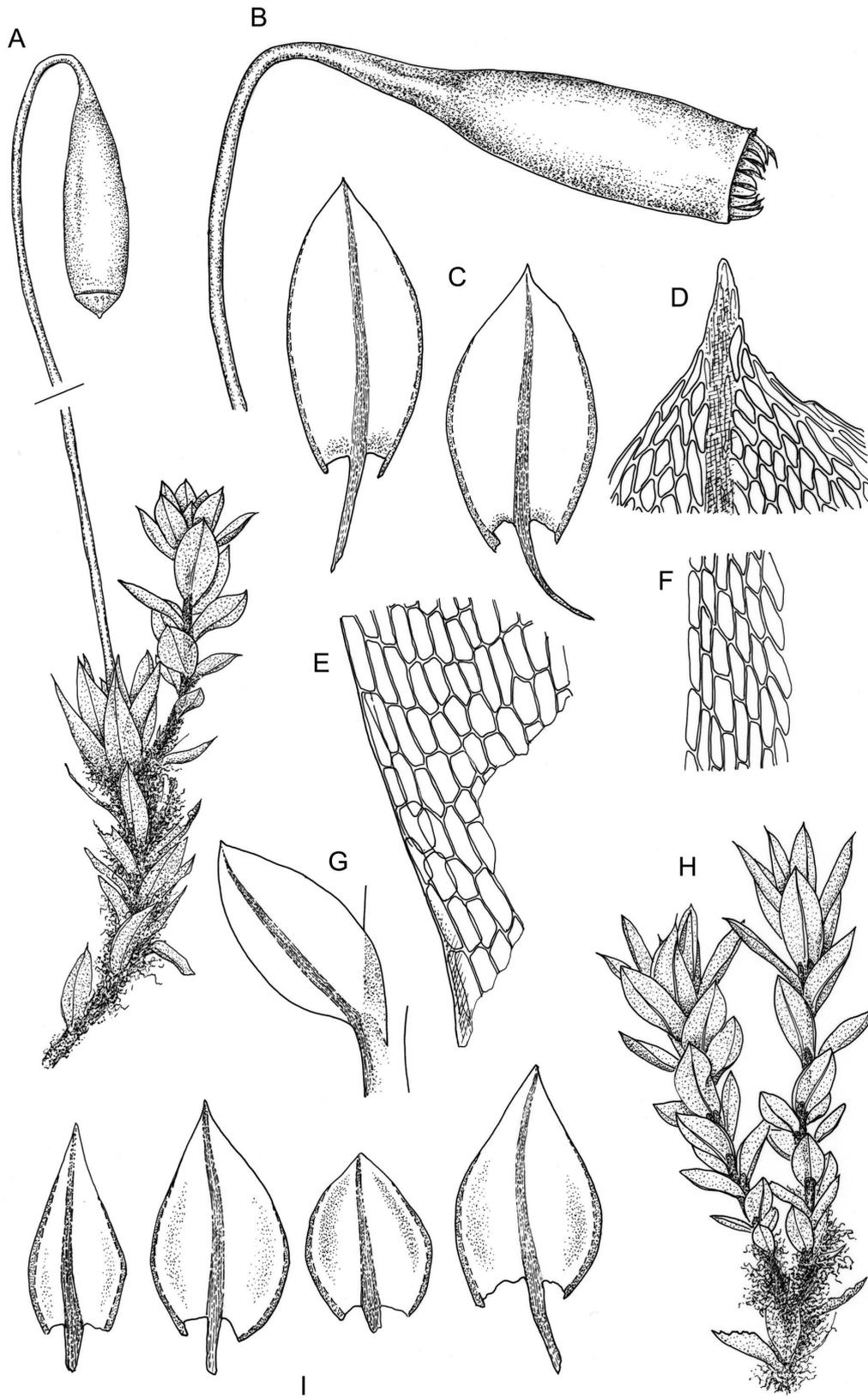


Plate 16: *Bryum*. A–I: *B. pseudotriquetrum*. A, habit with capsule. B, capsule. C, leaves. D, leaf apex. E, alar cells. F, upper laminal cells. G, leaf base showing decurrent cells. H, habit of sterile plant. I, four leaves. A, C–H drawn from G. Brownlie 282, CHR 426089; B drawn from K.W. Allison 491, CHR 604676A; I drawn from B.H. Macmillan 75/13, CHR 162832.

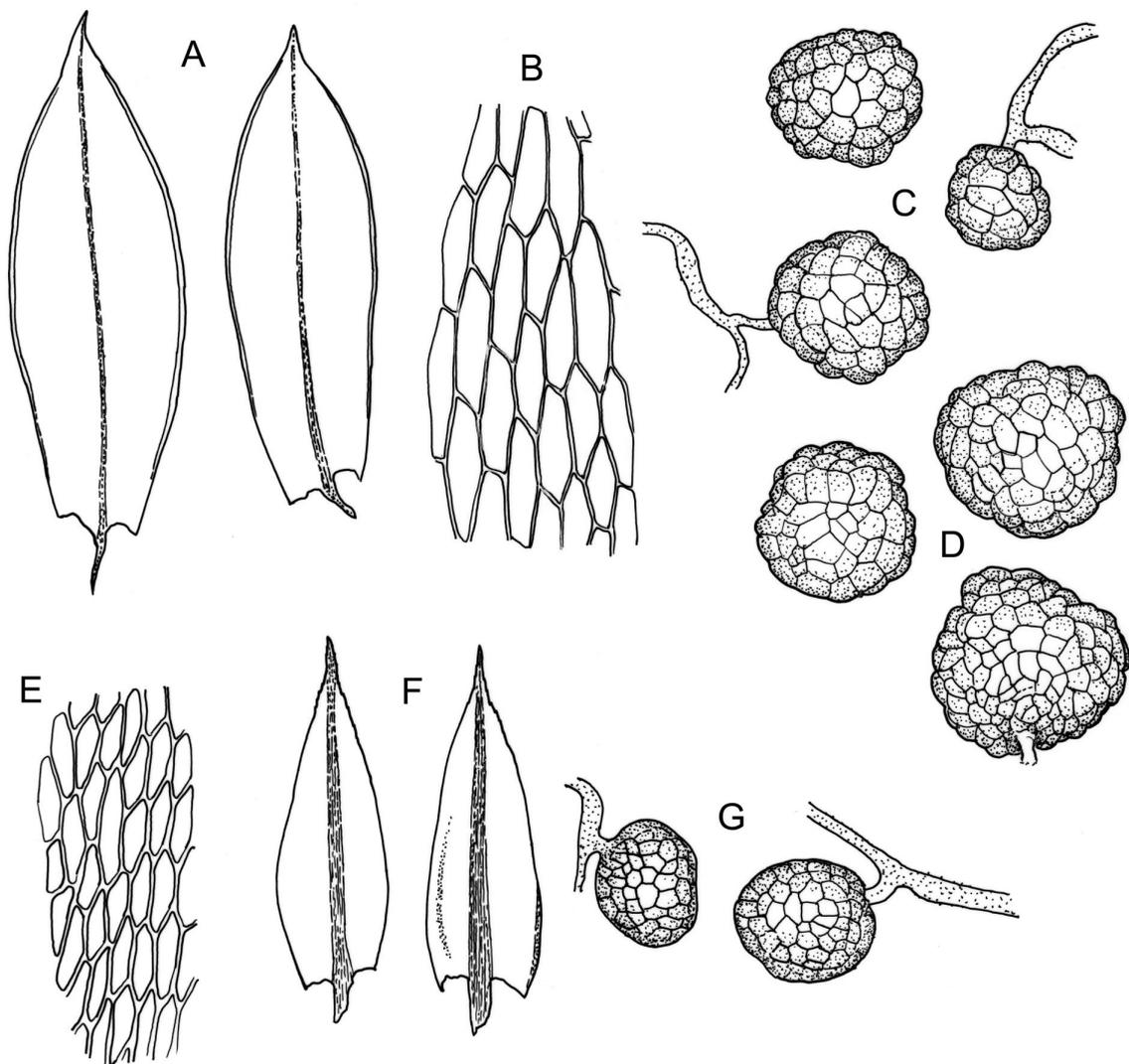


Plate 17: *Bryum*. A–D: *B. rubens*. A, leaves. B, mid laminal cells. C–D tubers. **E–G: *B. ruderale*.** E, mid laminal cells. F, leaves. G, tubers. *B. rubens*: A–C drawn from J.T. Linzey 3416, herb. Beaver; D drawn from W.R. Sykes 767/K, CHR 499361. *B. ruderale* drawn from J.T. Linzey 774, CHR 515484.

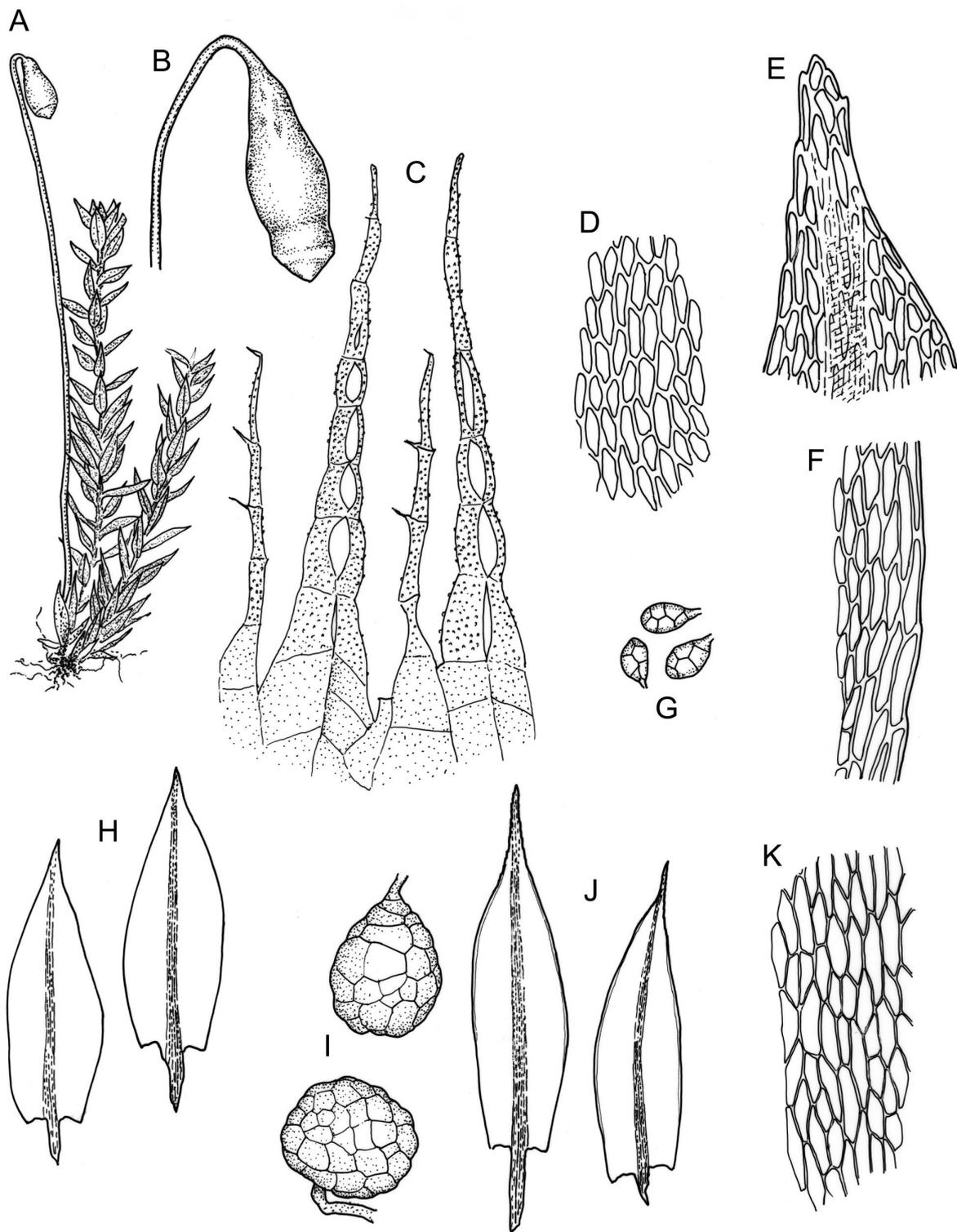


Plate 18: *Bryum*. A–H: *B. sauteri*. A, habit with capsule. B, capsule, dry. C, endostome detail. D, upper laminal cells. E, leaf apex. F, mid laminal cells at margin. G, tubers. H, leaves. **I–K: *B. tenuisetum*.** I, tubers. J, leaves. K, mid laminal cells. *B. sauteri* drawn from J. T. Linzey s.n., Aug. 1972, CHR 413356. *B. tenuisetum* drawn from N. Turner s.n., 1986, herb. Beever.

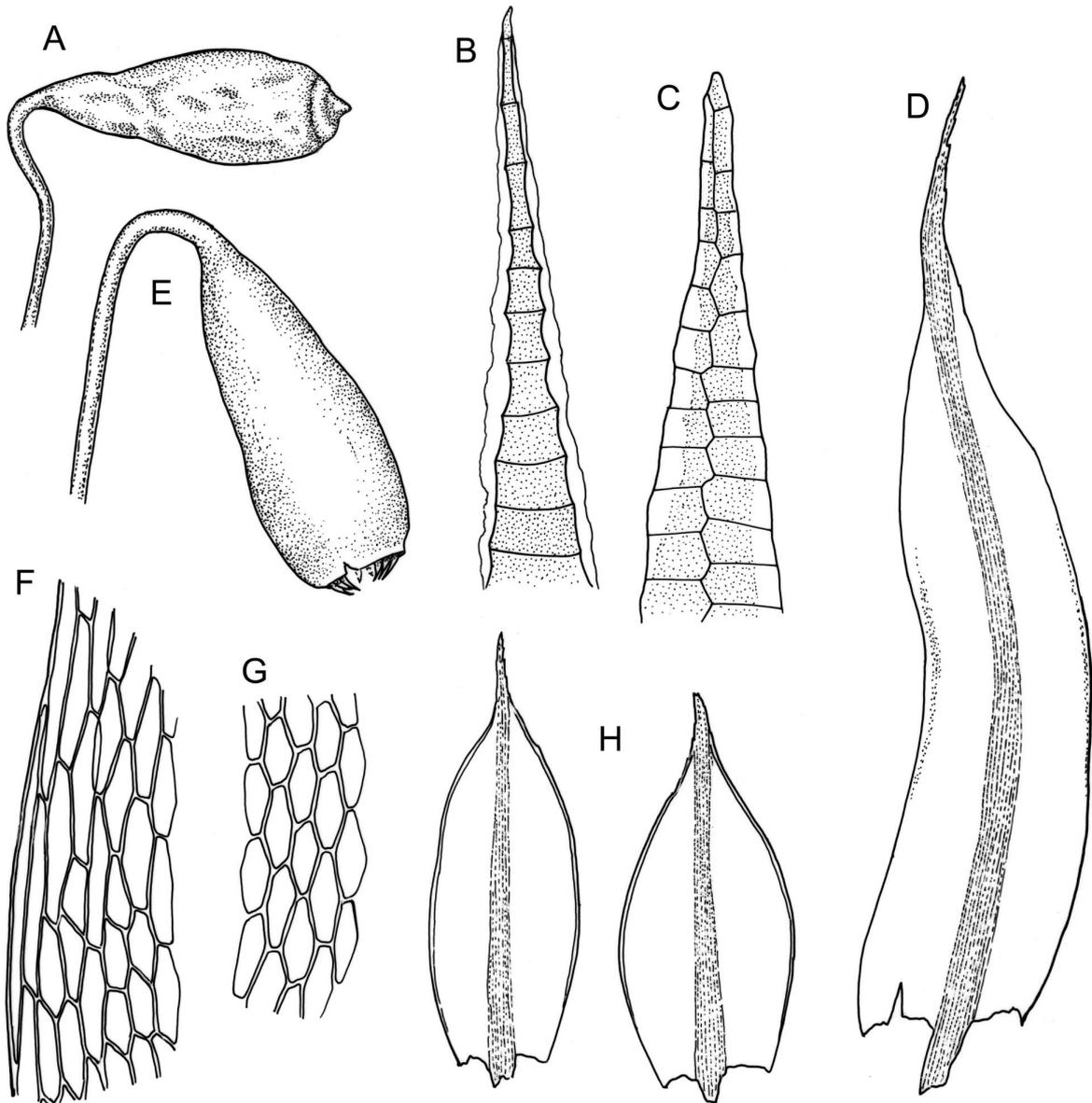


Plate 19: *Bryum*. A–H: *B. tenuidens*. A, capsule, dry. B, peristome tooth, inner surface. C, peristome tooth, outer surface. D, comal leaf. E, capsule. F, border of leaf of innovation. G, upper laminal cells of leaf of innovation. H, leaves of innovation. Drawn from isotype, G.O.K. Sainsbury 689, CHR 506174.

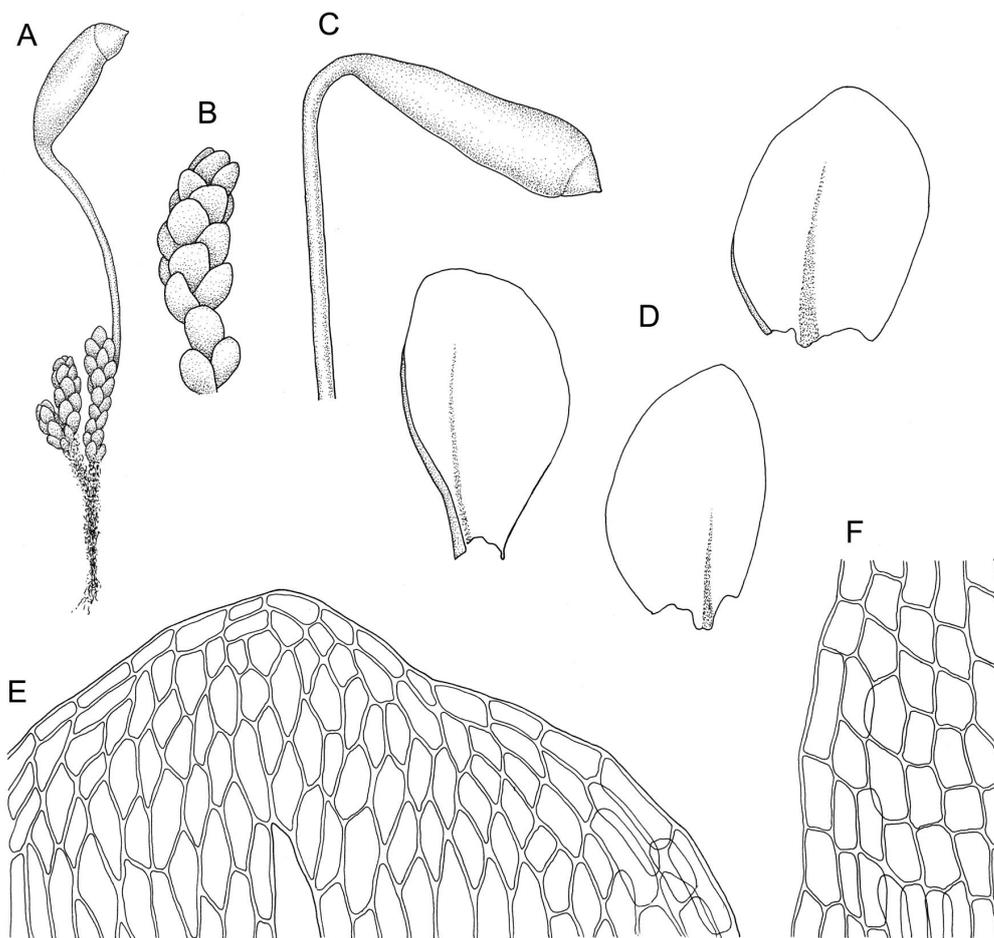


Plate 20: *Plagiobryum*. A–F: *P. novae-seelandiae*. A. habit with capsule. B. portion of shoot. C. capsule. D. three leaves. E. leaf apex. F. mid laminal cells at margin. Drawn from A.J. Fife 5075, CHR 104220.

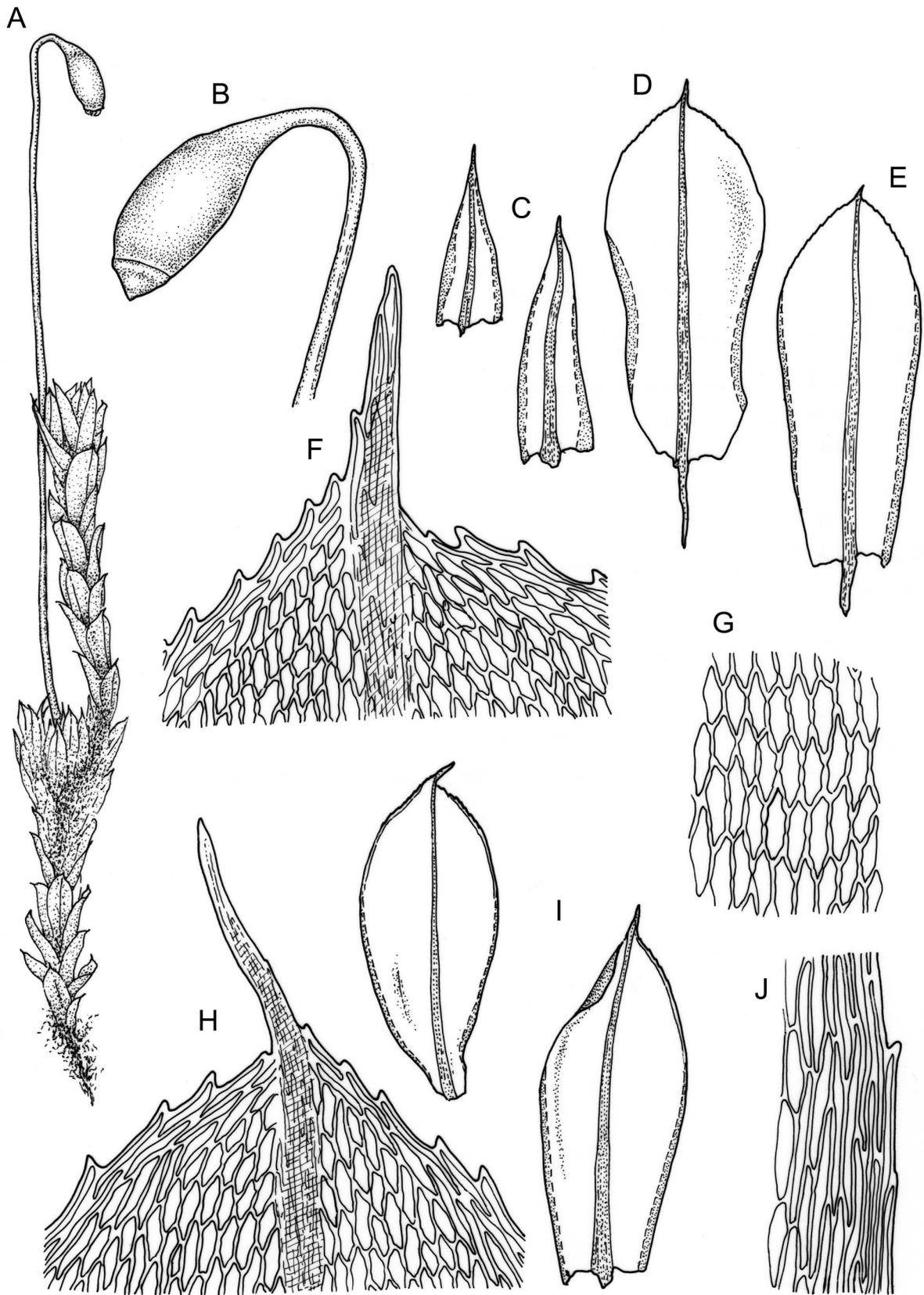


Plate 21: *Rosulabryum*. A–J: *B. billardieri*. A, habit with capsule. B, capsule with operculum. C, inner perichaetial leaves. D, leaf of innovation. E, comal leaf. F, leaf apex. G, upper laminal cells. H, leaf apex. I, comal leaves. J, border at widest part of leaf. A–G drawn from *W. Bell s.n.*, Jan. 1889, CHR 517730; H–J drawn from holotype, *Billardière*, G-Hedwig-Schwägrichen.

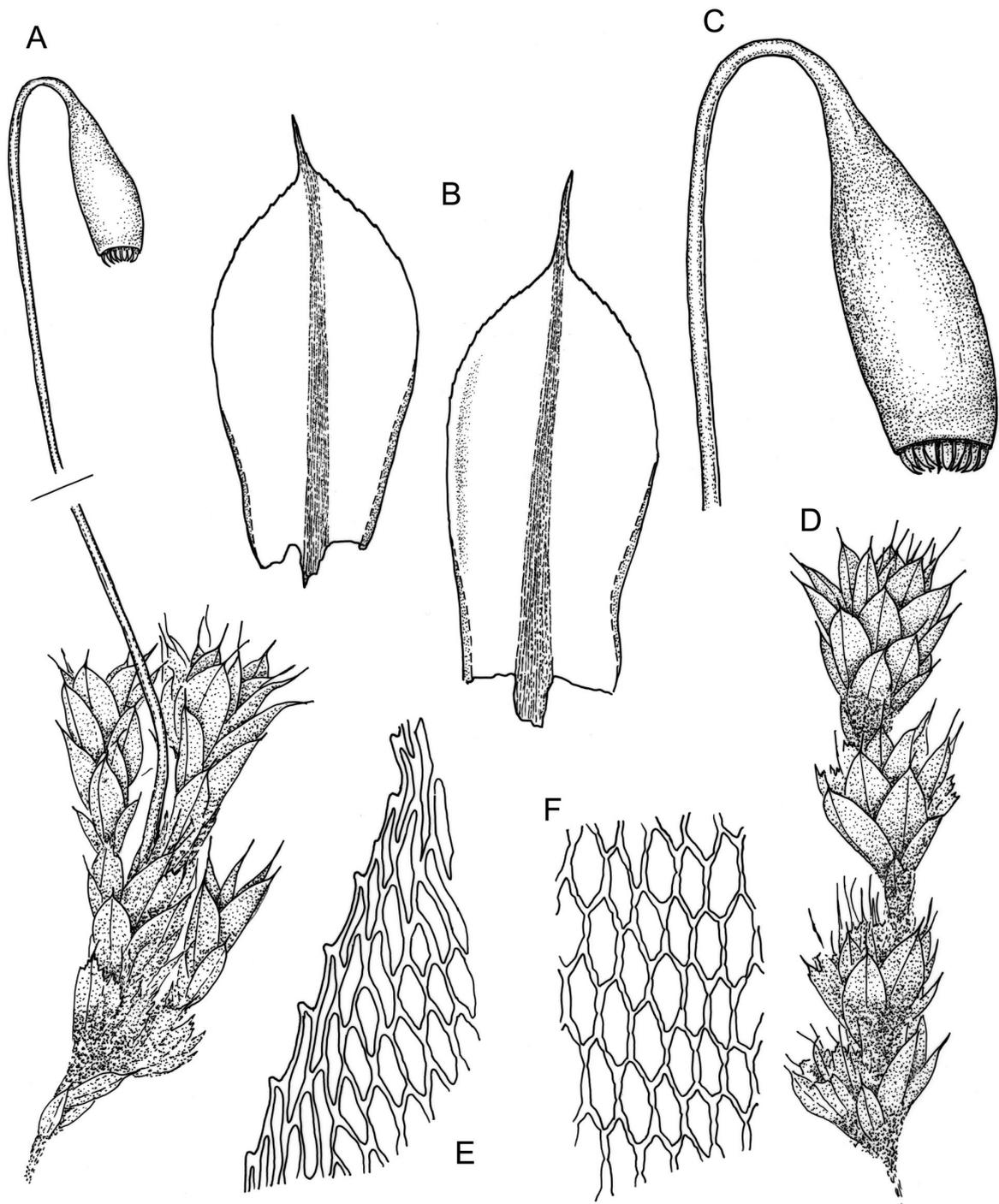


Plate 22: *Rosulabryum*. A–F: *R. campylothecium*. A, habit with capsule. B, leaves. C, capsule. D, habit of sterile plant. E, marginal cells below awn base. F, upper laminal cells. Drawn from *K.W. Allison 135, CHR 567440A*.

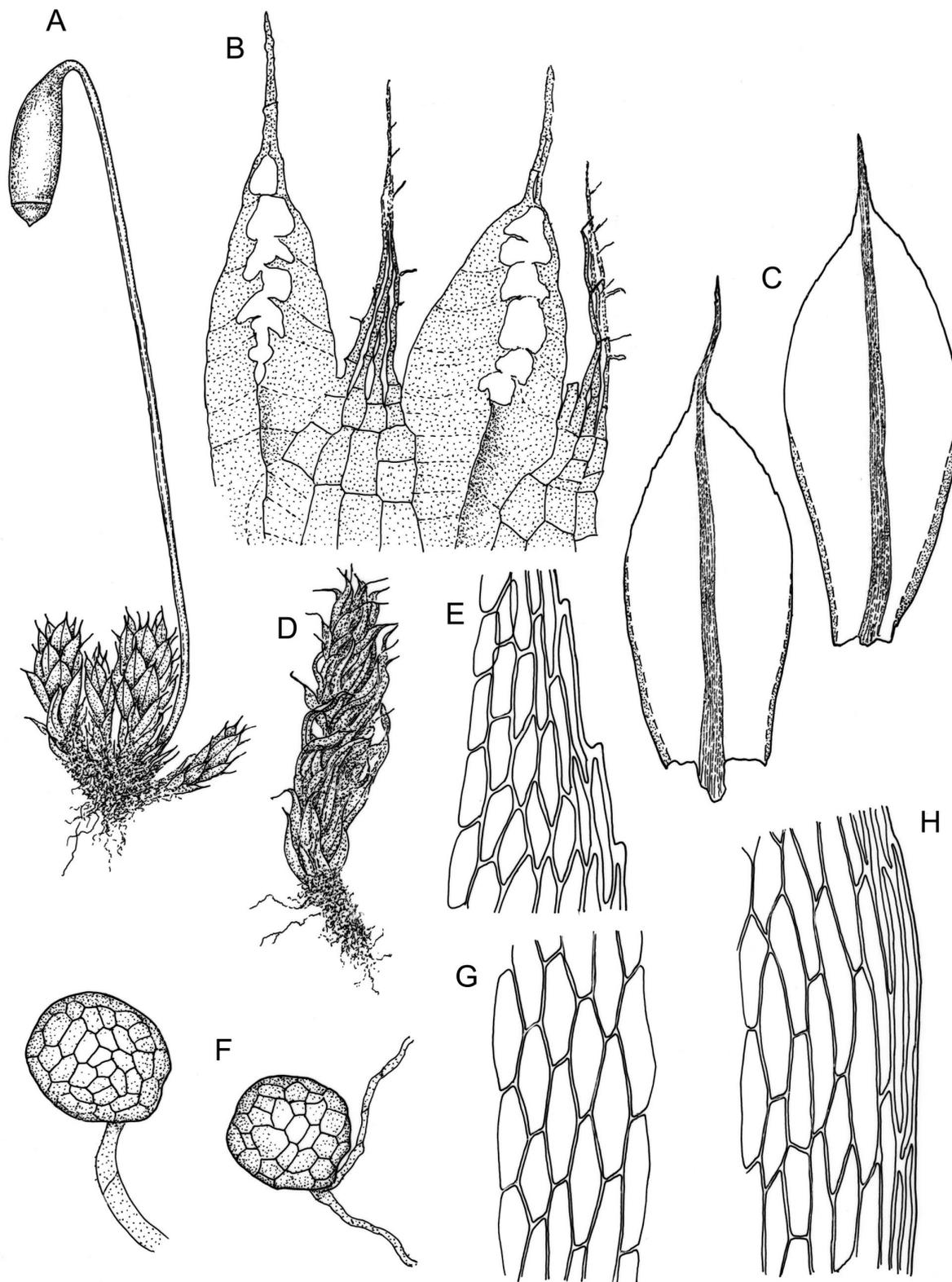


Plate 23: *Rosulabryum*. A–H: *R. capillare*. A, habit with capsule. B, endostome detail. C, leaves. D, habit of sterile plant, dry. E, border of upper leaf. F, tubers. G, upper laminal cells. H, border at widest part of leaf. Drawn from *L.H. Millener* 39, WELT M012001, *G.O.K. Sainsbury* 1715, WELT M01202, and *A.J. Fife* 7941, CHR 106613.

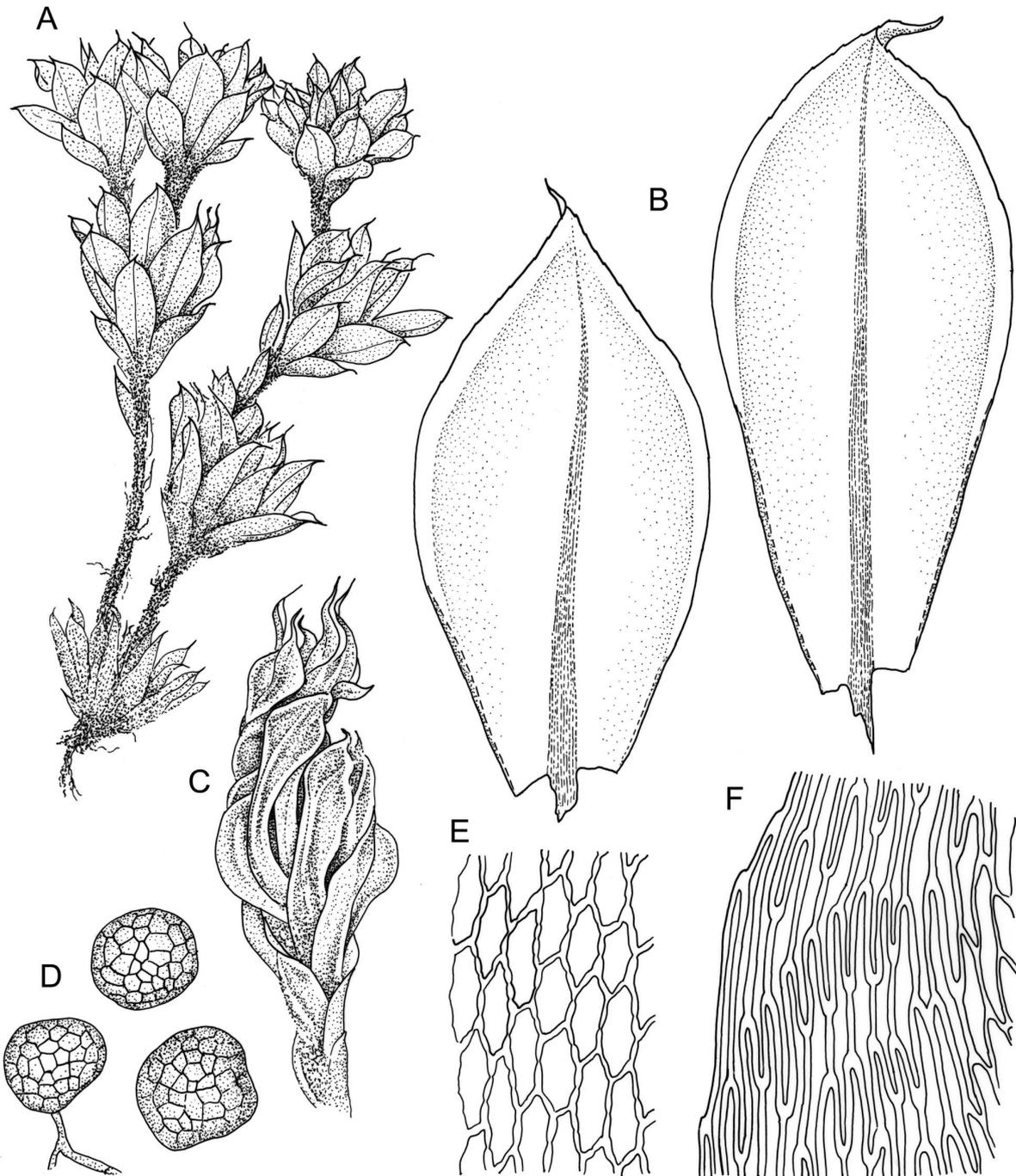


Plate 24: *Rosulabryum*. A–F: *R. perlimbatum*. A, habit. B, comal leaves. C, shoot, dry. D, tubers. E, upper laminal cells. F, border at widest part of leaf. Drawn from A.J. Fife 5562, CHR 405597.

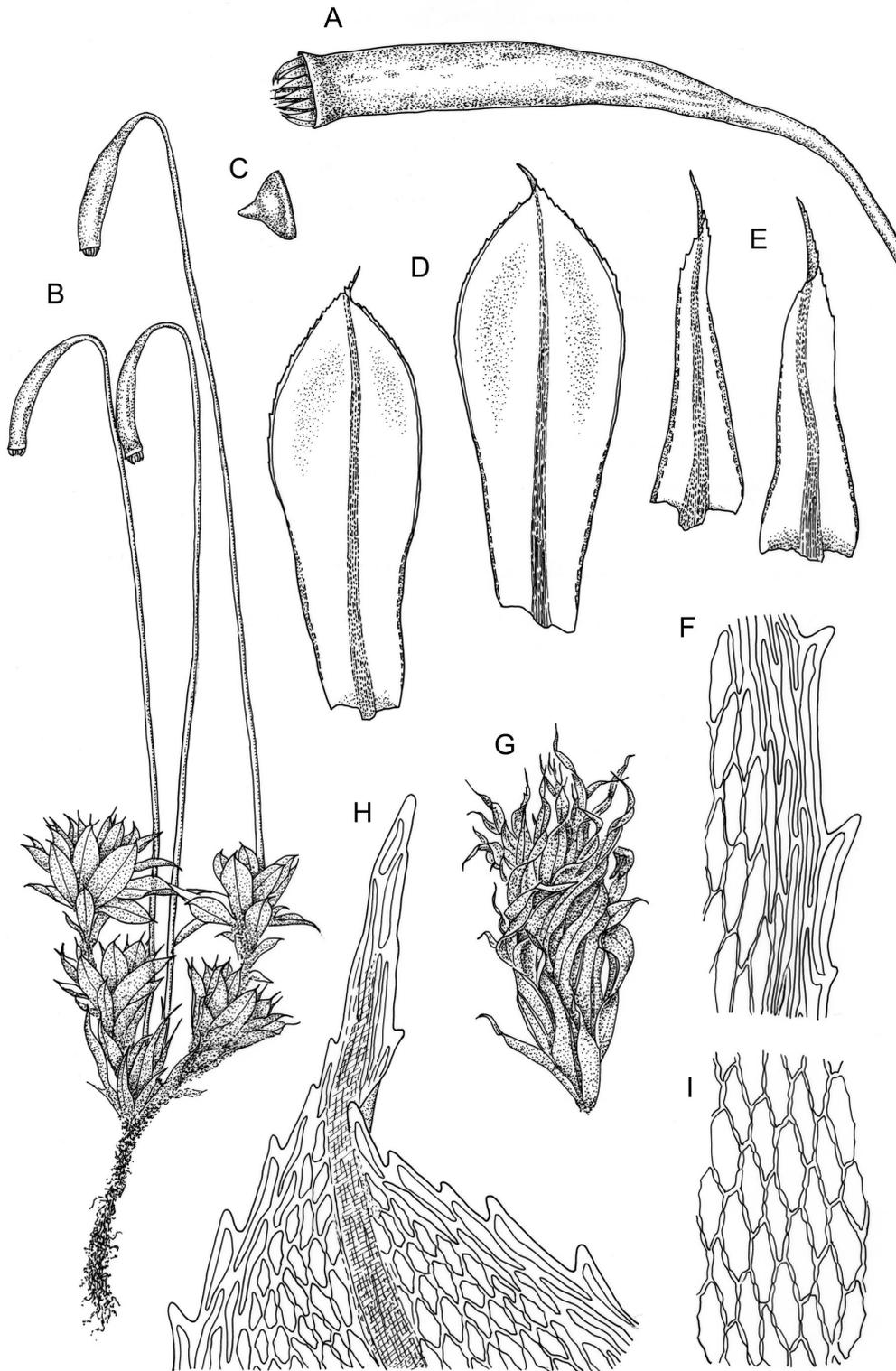


Plate 25: *Rosulabryum*. A–I: *R. subtomentosum*. A, capsule, dry. B, habit with capsules. C, operculum. D, leaves. E, inner perichaetial leaves. F, border at widest part of leaf. G, shoot, dry. H, leaf apex. I, upper laminal cells. Drawn from *J.E. Beaver 32-38a, CHR 406070*.

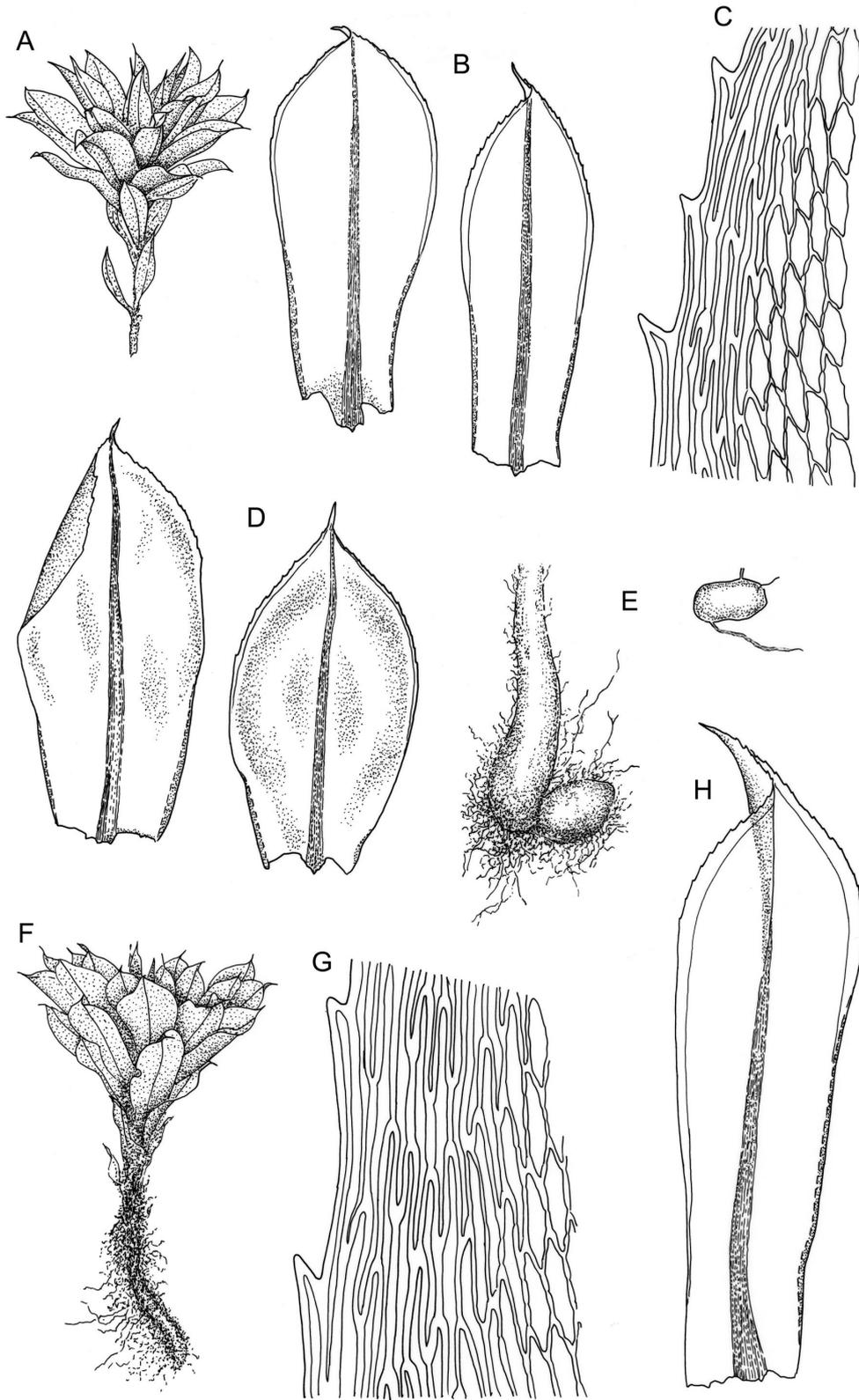
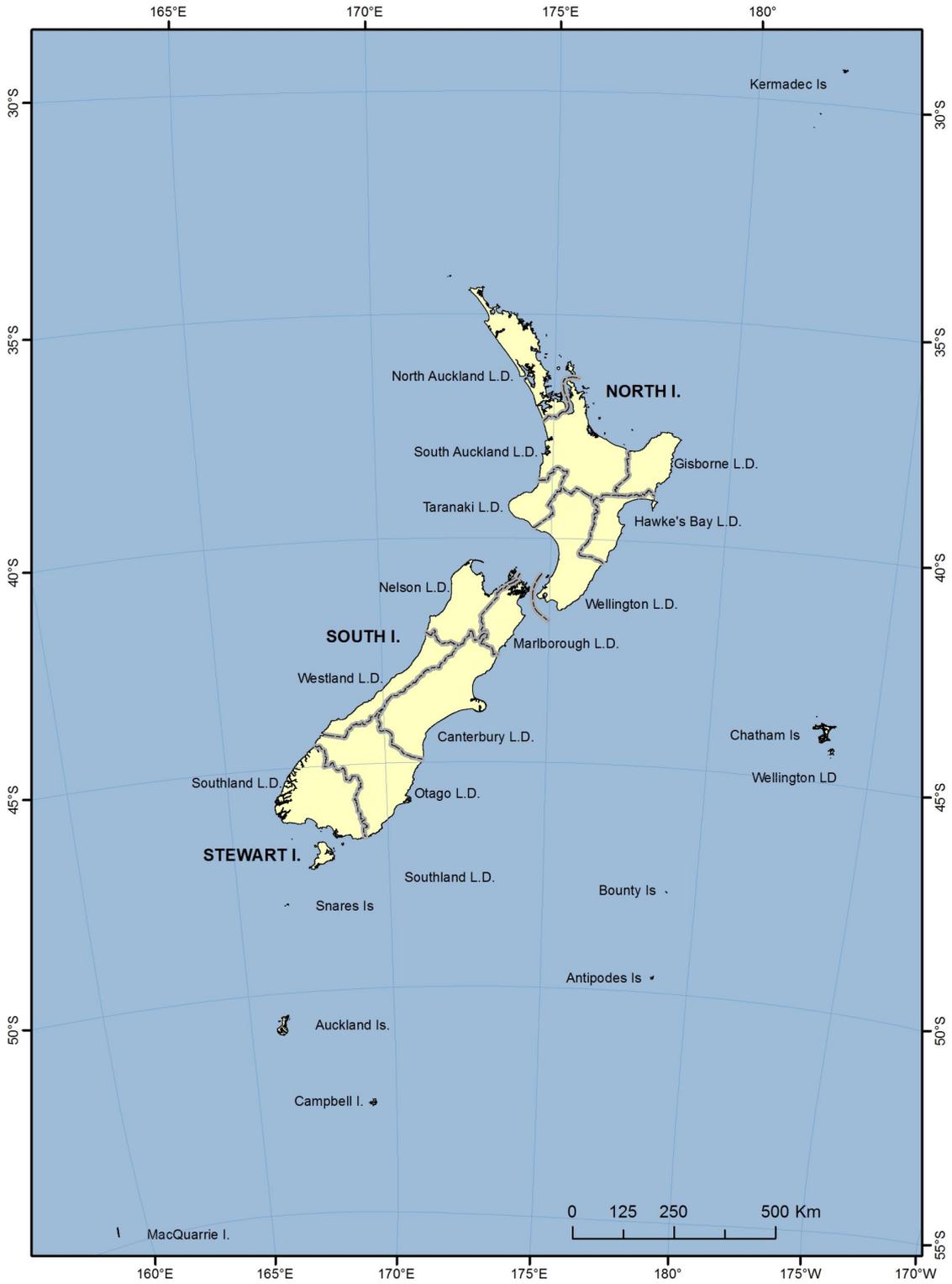
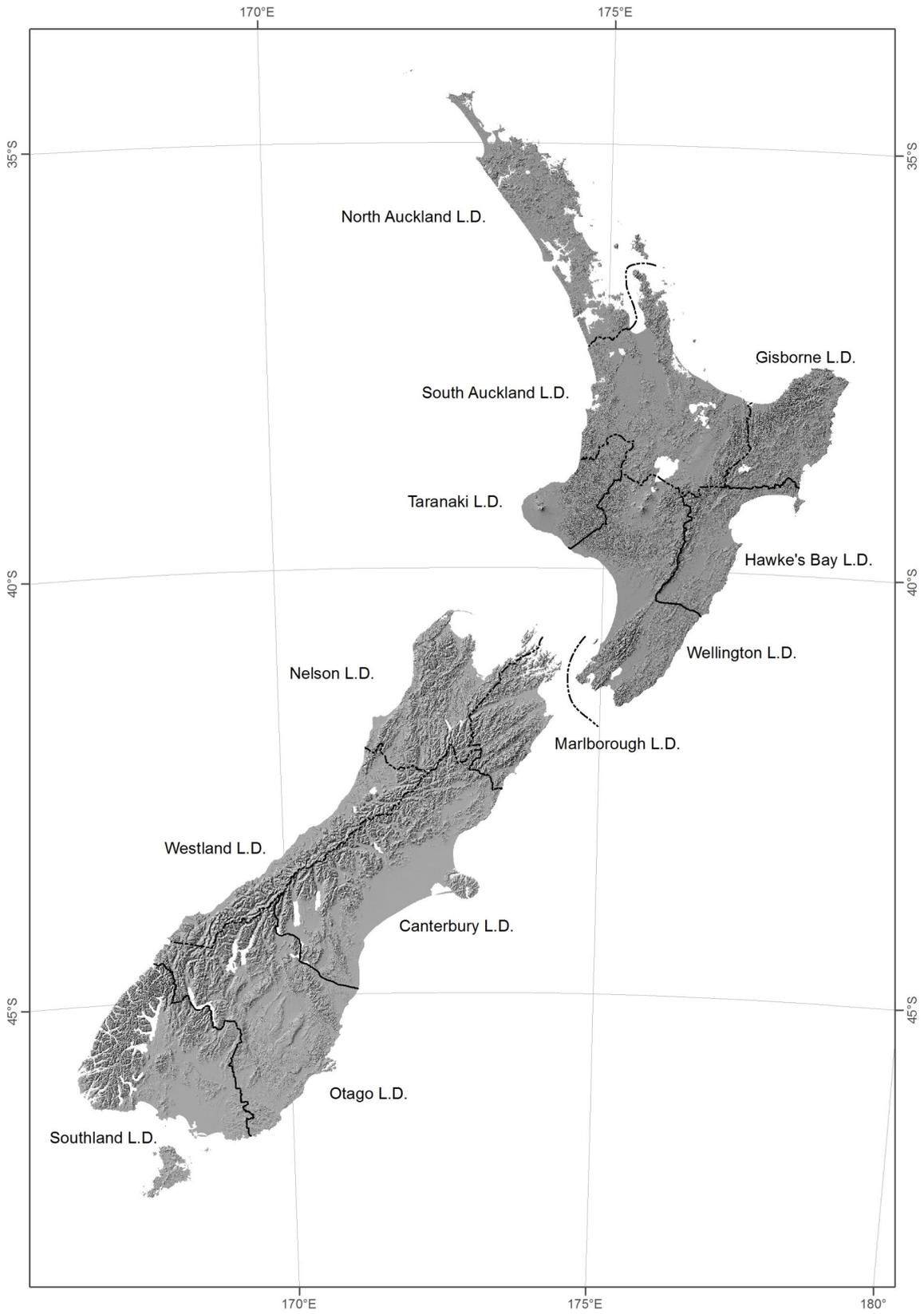


Plate 26: *Rosulabryum*. A–H: *R. subtomentosum*. A, habit of sterile shoot. B, leaves. C, border at widest part of leaf. D, leaves. E, tubers. F, habit of non-fruiting ♀ plant. G, border at widest part of leaf. H, leaf. A–C drawn from *K.W. Allison* 702, CHR 517740; D–E drawn from *G.B. Huang* 547, CHR 463072; F drawn from *V.D. Zotov* s.n., 31 Dec. 1933, CHR 7391; G–H drawn from *F.A.D. Cox* s.n., 19 Aug. 1896, CHR 618469.



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

Index

Page numbers are in **bold** for the main entry, and *italic* for synonyms.

- Anomobryum densum* Dixon 30
Anomobryum harriottii (R.Br.bis) Dixon 30
Brachymenium coarctatum Hook.f. 35
Brachymenium preissianum (Hampe) A.Jaeger 35
Bryaceae 4
Bryum Hedw. 1, 4, 5, 9, **10**, 15, 16, 21, 26, 30, 31, 33, 36, 44, 46
Bryum algovicum Müll.Hal. **12**
Bryum algovicum var. *rutheanum* (Warnst.) Crundw. **12**, 14, 35
Bryum amblyodon Müll.Hal. 13, **13**, 34, 42
Bryum appressifolium Broth. **14**, 18, 23, 27
Bryum argenteum Hedw. **15**, 29, 30, 44
Bryum austrobimum Broth. 17
Bryum austropallescens Broth. 24
Bryum bellii Müll.Hal. 27
Bryum billardierei Schwägr. 45
Bryum billardierei var. *platyloma* Mohamed 50
Bryum buchananii R.Br.bis 14
Bryum caespiticium Hedw. 15, **17**, 21, 23, 37, 48
Bryum caespiticium var. *austrobimum* (Broth.) Sainsbury 17
Bryum campylothecium Taylor 47
Bryum capillare Hedw. 48
Bryum clavatum (Schimp.) Müll.Hal. 11, 14, **18**, 27, 29, 30, 41
Bryum clavatum var. *extenuatum* Hook.f. & Wilson 18
Bryum coronatum Schwägr. **21**, 26, 27, 38
Bryum crassinerve Hook.f. & Wilson 31
Bryum crassum Hook.f. & Wilson 15, 18, **23**, 47
Bryum creberrimum Taylor 11, **24**, 35, 49
Bryum cuneatum R.Br.bis 12
Bryum curvicollum Mitt. 18
Bryum curvicollum var. *extenuatum* (Hook.f. & Wilson) Hook.f. 18
Bryum cylindrothecium R.Br.bis 17
Bryum dichotomum Hedw. 15, 21, 22, **25**, 40, 41, 48
Bryum duriusculum Hook.f. & Wilson 11, 20, **27**, 38-40, 42
Bryum erythrocarpoides Müll.Hal. & Hampe 18
Bryum eximium Mitt. 31
Bryum foresterii R.Br.bis 19
Bryum funkii Schwägr. 16, **29**, 29, 31
Bryum gibsonii R.Br.bis 40
Bryum gracilicarpum R.Br.bis 50
Bryum gracilithecium R.Br.bis 18
Bryum hapukaense R.Br.bis 18
Bryum harriottii R.Br.bis 9, 30, **30**, 44
Bryum heterofolium R.Br.bis 18
Bryum huttonii R.Br.bis 31
Bryum inclinatum (Brid.) Blandow 13
Bryum incurvifolium Müll.Hal. 31
Bryum kirkii Broth. 25
Bryum kirkii R.Br.bis 18
Bryum laevigatum Broth. 18
Bryum laevigatum Hook.f. & Wilson 26, 30, **31**, 37
Bryum leptothecium Taylor 50
Bryum levieri Müll.Hal. 18
Bryum linearifolium R.Br.bis 18
Bryum luteolimbatum Broth. 19
Bryum macrocarpum R.Br.bis 19
Bryum macroerythrocarpum Müll.Hal. 18
Bryum malacodictyon Müll.Hal. 27
Bryum maudii R.Br.bis 36
Bryum megamorphum Müll.Hal. 31
Bryum mucronatum Mitt. **33**
Bryum obesothecium R.Br.bis 36
Bryum otahapaense R.Br.bis 21
Bryum ovalicarpum R.Br.bis 25
Bryum ovatocarpum R.Br.bis 25
Bryum ovatothecium R.Br.bis 25
Bryum pachythea Müll.Hal. 21
Bryum pallescens Schwägr. 24, 25, **34**
Bryum pendulum (Hornsch.) Schimp. 12
Bryum pendulum var. *rutheanum* Warnst. 12
Bryum perlimbatum Cardot 49
Bryum petriei R.Br.bis 25
Bryum preissianum Hampe 9, **35**
Bryum pseudotriquetrum (Hedw.) P.Gaertn., E. Meyer & Scherb. 13, 14, 32, 33, **36**
Bryum radiculosum Brid. 11, 28, **38**, 38
Bryum rubens Mitt. 11, 28, 38, **38**, 42
Bryum ruderale Crundw. & Nyholm 11, 28, **39**
Bryum sauteri Bruch & Schimp. 11, 20, 27, 28, 39, **40**
Bryum schauinslandii Müll.Hal. 19
Bryum searliei R.Br.bis 48
Bryum stenotrichum Müll.Hal. 13
Bryum subtomentosum (Hampe) Mitt. 50
Bryum tenuidens Dixon & Sainsbury **41**
Bryum tenuisetum Limpr. 11, 28, **42**
Bryum thomasi R.Br.bis 34
Bryum torlessense R.Br.bis 17
Bryum traillii R.Br.bis 31
Bryum triangularifolium R.Br.bis 21
Bryum urceolatum Schimp. 25
Bryum varians Müll.Hal. 18
Bryum ventricosum R.Br.bis 19
Bryum waikariense R.Br.bis 25
Bryum webbianum R.Br.bis 19
Bryum webbii R.Br.bis 25
Gemmabryum caespiticium (Hedw.) J.R.Spence 17
Gemmabryum clavatum (Schimp.) J.R.Spence & H.P.Ramsay 18
Gemmabryum coronatum (Schwägr.) J.R.Spence & H.P.Ramsay 21
Gemmabryum crassum (Hook.f. & Wilson) J.R.Spence & H.P.Ramsay 23
-

Gemmabryum dichotomum (Hedw.) J.R.Spence
& H.P.Ramsay 25

Gemmabryum laevigatum (Hook.f. & Wilson)
J.R.Spence & H.P.Ramsay 31

Gemmabryum pachytheticum (Müll.Hal.)
J.R.Spence & H.P.Ramsay 21

Gemmabryum preissianum (Hampe)
J.R.Spence & H.P.Ramsay 35

Gemmabryum radiculosum (Brid.) J.R.Spence
& H.P.Ramsay 38

Gemmabryum rubens (Mitt.) J.R.Spence &
H.P.Ramsay 38

Gemmabryum ruderale (Crundw. & Nyholm)
J.R.Spence 39

Gemmabryum sauteri (Bruch & Schimp.)
J.R.Spence & H.P.Ramsay 40

Gemmabryum tenuisetum (Limpr.) J.R.Spence
& H.P.Ramsay 42

Imbribryum clavatum (Schimp.) J.R.Spence &
H.P.Ramsay 18

Imbribryum crassum (Hook.f. & Wilson)
J.R.Spence & H.P.Ramsay 23

Imbribryum laevigatum (Hook.f. & Wilson)
J.R.Spence & H.P.Ramsay 31

Mnium pseudotriquetrum Hedw. 36

Plagiobryum Lindb. 1, 4, 5, **42**

Plagiobryum novae-zeelandiae Broth. **43**

Pohlia clavata Schimp. 18

Ptychostomum creberrimum (Taylor)
J.R.Spence & H.P.Ramsay 24

Ptychostomum cylindrothecium (R.Br.bis)
J.R.Spence & H.P.Ramsay 17

Ptychostomum funkii (Schwägr.) J.R.Spence 29

Ptychostomum pallescens (Schwägr.)
J.R.Spence 34

Ptychostomum pseudotriquetrum (Hedw.)
J.R.Spence & H.P.Ramsay 36

Rhodobryum subtomentosum Hampe 50

Rosulabryum J.R.Spence 1, 4, 5, **44**, 47, 48, 51

Rosulabryum billardierei (Schwägr.) J.R.Spence
23, **45**, 51

Rosulabryum campylothecium (Taylor)
J.R.Spence 23, **47**, 49, 52

Rosulabryum capillare (Hedw.) J.R.Spence 12,
25, 35, 44, 47, **48**, 50, 52

Rosulabryum perlimbatum (Cardot) Ochyra **49**,
52

Rosulabryum perlimbatum J.R.Spence &
H.P.Ramsay 49

Rosulabryum rubens (Mitt.) J.R.Spence 38

Rosulabryum subtomentosum (Hampe)
J.R.Spence 1, 23, 33, 46, 47, 49, 50,
50

Webera megamorpha (Müll.Hal.) Paris 31

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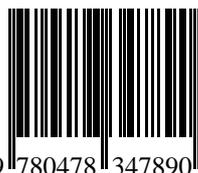
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