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# MOSSES

## RHABDOWEISIACEAE

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Cover image: *Amphidium cyathicarpum*, habit with capsule, moist. Drawn by Rebecca Wagstaff from *B.H. Macmillan 91/17*, CHR 413681.

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# Contents

## Introduction

The Rhabdoweisiaceae are a small to medium-sized family in the Dicranales, centred on the predominantly northern hemisphere genus *Rhabdoweisia*. Brotherus recognised it as a subfamily within the Dicranaceae, and included only three genera: the type genus, the widespread *Amphidium*, and the poorly known Philippine *Rhabdoweisiella*. Modern Floras have variously recognised the family or subsumed it within the Dicranaceae. In recent years the family has received wider recognition and has been expanded using molecular evidence to include as many as 15 genera. Three genera of Rhabdoweisiaceae, excluding the type genus, are accepted in the New Zealand Flora: *Amphidium*, *Dicranoweisia*, and *Holodontium*. *Amphidium*, with two species here, is widely distributed in temperate and cooler parts of both hemispheres. In part because of its lack of a peristome, its affinities have been controversial for many decades and will probably continue to be so. *Dicranoweisia* is also distributed widely in temperate to cool parts of the northern and southern hemispheres, but it also occurs on tropical mountains; one species is widespread in N.Z. *Holodontium* is probably monotypic. It exhibits a characteristic subantarctic distribution but extends into the South American tropics at high elevations in the Andes. It is known in N.Z. only from a few high-elevation sites on the South I.

## Typification

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

***Zygodon integrifolius*** **Beckett, Trans. & Proc. New Zealand Inst. 25: 297 (1893)**
Lectotype (designated here): N.Z., Canterbury, Ben More, alt. 4000 ft., Nov. 1890, *T.W.N. Beckett 297,* CHR 622472! Isolectotype: WELT M002564!

***Blindia antarctica*** **Müll.Hal., Syn. Musc. Frond. 1: 344 (1848)**
Lectotype (designated here): Hermite Island, C. Horn, *J.D. Hooker*, BM-Hampe! Isolectotype: "W.[ilson] 126", BM-Wilson!

***Blindia chrysea*** **Müll.Hal. *in* Beckett, Trans. & Proc. New Zealand Inst. 25: 290 (1893)**
Lectotype (designated here): N.Z., Kaikoura, Maungamauna (Mangamauna) Bay, Dec. 1889, *T.W.N. Beckett 263*, CHR 534984!

***Weissia webbii*** **R.Br.bis, Trans. & Proc. New Zealand Inst. 31: 440 (1899)**
Lectotype (designated here): N.Z., Canterbury, Moa Creek, June 1885, *R. Brown*, CHR 335696!

## *Rhabdoweisiaceae*

**Plants** small to medium-sized, occasionally robust. **Stems** erect, mostly lacking a central strand (but present in *Dicranoweisia*), with firm-walled cortical cells. **Leaves** mostly lanceolate, often strongly contorted when dry. **Upper laminal cells** short, often with some oblate, smooth or papillose, sometimes bearing longitudinal cuticular striations that extend over the cell walls (present in all N.Z. taxa).

**Autoicous**. **Perigonia** often on short branches at the base of the perichaetia. **Setae** elongate or short; **capsules** mostly erect, symmetric, and short-cylindric to ellipsoid, less often asymmetric, sometimes furrowed when dry; **operculum** rostrate. **Peristome** single or sometimes absent, with 16 teeth mostly undivided, variously ornamented. **Calyptra** cucullate, smooth.

**Taxonomy:** There is little consensus concerning the size or the limits of this morphologically diverse family. The brief description above is derived primarily from the type genus and the genera occurring in N.Z. The type genus, the predominantly northern hemisphere *Rhabdoweisia*, was placed (with *Amphidium*) in a subfamily Rhabdoweisioideae within the Dicranaceae by Brotherus (1924). Modern Floras have either recognised that subfamily at the family rank (Smith 2004) or subsumed it within the larger Dicranaceae (e.g., Crum & Anderson 1981; Ireland et al. 1994). While retaining it in the Dicranales, Goffinet et al. (2009) presented a much expanded interpretation of the family, which is largely adopted here. Only three of the 15 genera they include in the family occur in N.Z. (They also included *Kiaeria* in the Rhabdoweisiaceae, but that genus is retained here in the Dicranaceae.)

| | |
|---|---|
| **1** | **Plants** robust, with **vegetative leaves** 3.0–6.5 mm long and not contorted when dry; **costa** broad, ⅓ to ½ the widest part of the leaf, bordered on both sides by bistratose juxtacostal bands of laminal cells; **peristome** present; documented only from elevations of >1500 m on the South I. .... ..... *Holodontium* |
| **1'** | **Plants** small to medium-sized, with **vegetative leaves** ≤4.0 mm and much contorted when dry; **costa** narrower, <¼ the widest part of the leaf, not bordered by bistratose laminal cells; **peristome** present or absent; documented from a wide elevational range on both main islands ..... 2 |
| **2** | **Peristome** absent; **capsules** immersed to weakly exserted relative to the perichaetial leaves, strongly ribbed when dry; **alar cells** not differentiated; **central strand** absent ..... ..... *Amphidium* |
| **2'** | **Peristome** present (but fugacious); **capsules** exserted on an elongate seta, smooth or wrinkled when dry; **alar cells** inflated; **central strand** present .... ..... *Dicranoweisia* |

## *Amphidium* Schimp., *Coroll. Bryol. Eur.* 39 (1856), nom. cons.

**Type taxon:** *Amphidium lapponicum* (Hedw.) Schimp.

**Plants** small to medium-sized, usually light green above and dark or olive-green below, caespitose on rock or soil. **Stems** erect, branching repeatedly by subperichaetial innovation, sparsely beset with smooth, brown rhizoids, in cross-section with small, firm-walled cortical cells and lacking a central strand. **Leaves** crowded, in moderately distinct spiral ranks, erect-spreading and flexuose when moist, strongly contorted and often reflexed when dry, linear-lanceolate or oblong-linear, acute or acuminate, keeled, entire or irregularly and weakly toothed, ± recurved or plane at margins; **upper laminal cells** rounded-subquadrate or rounded-oblate, firm-walled, unistratose, not bulging, densely and finely papillose (sometimes obscuring the cell outlines), with papillae not restricted to the cell lumens, appearing longitudinally striate; **basal laminal cells** pale or hyaline, becoming gradually more elongate-rectangular, thin- or thick-walled, and less papillose-striolate towards leaf base; **alar** and **marginal cells** not differentiated. **Costa** strong and subpercurrent, in N.Z. species rounded and projecting abaxially in cross-section, with a single layer of median guide cells, 1 layer of adaxial substereids, and (1–)2 layers of abaxial substereids.

**Autoicous** in N.Z. species. **Perichaetial leaves** differentiated or not, sheathing the costa or erect-spreading. **Perigonia** on short bud-like branches immediately below the perichaetium. **Setae** short, straight or ± curved; **capsules** emergent or weakly exserted, erect or slightly inclined, urceolate, 8-ribbed when moist, the mouth transverse or nearly so, becoming very strongly ribbed and flared at mouth when dry, at maturity red-brown and often with a distinctly green neck; **exothecial cells** ±

rectangular, in alternate bands of thin- and thick-walled cells; **stomata** superficial; **annulus** lacking; **operculum** apiculate or rostrate, oblique**. Peristome** absent. **Calyptra** cucullate, smooth, and naked. **Spores** spherical, unicellular, red-brown, nearly smooth.

**Taxonomy:** *Amphidium* is a modestly sized genus of 12 or fewer species (Magill & van Rooy 1998) occurring mostly in temperate regions in the northern and southern hemispheres; two species are documented from N.Z.

The familial placement of *Amphidium* is problematic, largely because of its lack of a peristome. Brotherus (1924) included it in a subfamily Rhabdoweisioideae within the Dicranaceae. The family placement has been discussed by many more recent workers, including Lewinsky (1976), Crum & Anderson (1981, p. 685), Goffinet & Vitt (1998), and Stech (1999), who placed it variously in the Orthotrichaceae, Dicranaceae, and a segregated Rhabdoweisiaceae. It is also sometimes placed in its own family in the general relationship with the Orthotrichaceae (Smith 2004). Its placement here in the Rhabdoweisiaceae follows Goffinet et al. (2009) and is consistent with the phylogenetic reconstructions using nucleotide sequence data of the chloroplast rbcL gene by Goffinet & Vitt (1998) and Goffinet et al. (1998).

*Amphidium* can be recognised, even when sterile, by the faintly striate appearance (under a compound microscope) of its laminal cells and the adjacent cell walls. The relationship of the striations to the papillae seen in the upper laminal cells is obscure. The upper laminal cells in both N.Z. species have very numerous (to 12 or more per cell) small papillae over the lumina. The very small (≤3 µm diam.) papillae extend over both the cell lumina and the contiguous cell walls; they may be protrusions of the cuticle. The papillae appear to become elongate towards the leaf base and are most conspicuous in the juxtacostal cells and in the transition region between the upper laminal cells and the smooth basal cells. Here they are mostly c. 3–4 µm long, 3–4:1, and lack pigmentation. They are most easily viewed at medium (c. 300×) magnification under the compound microscope and give the leaves a subtly striate appearance that is characteristic of the genus as a whole, as well as the other family members occurring in N.Z. It is unclear whether the papillae of the upper laminal cells transition to the “striations” or whether these represent two distinct morphological structures. The striations, if they are present on the upper laminal cell walls, are obscured. This relationship would be best resolved by study with the scanning electron microscope.

The cyathiform (cup-shaped) immersed or weakly exserted capsules usually retain a green neck, even at maturity when the urn is red-brown. These features, together with the strongly ribbed urn, give this genus a recognisable appearance when fresh.

Both Dixon (1926) and Sainsbury (1955a) accepted one species of *Amphidium* in N.Z. Both, however, noted considerable variability, even within single collections. Dixon noted the close similarity of N.Z. *A. cyathicarpum* to *A. mougeotii* (Bruch & Schimp.) Schimp. [Coroll. Bryol. Eur. 40 1856] of northern hemisphere temperate and cold regions. Most N.Z. material is characterised by having unsheathing perichaetial leaves that are scarcely differentiated from the vegetative leaves; these are also features of *A. mougeotii*. Both N.Z. material of *A. cyathicarpum* and northern hemisphere material of *A. mougeotii* have variably toothed vegetative leaves. However, N.Z. material appears to be predominantly or completely (as noted by Dixon) autoicous, while *A. mougeotii* is considered by both Crum & Anderson (1981) and Smith (2004) to be dioicous.

Sainsbury (1955a, p. 198) seemed to suspect that some of his N.Z. collections might belong to *A. lapponicum*, but he was reluctant to commit to this interpretation.

Magill & van Rooy (1998) treated two species of *Amphidium* for southern Africa, and suggested that both these species occurred in Australasia. Their application of the African name *A. tortuosum* (Hornsch.) Cufod. is not accepted here, for reasons discussed below.

Both the species of *Amphidium* recognised here could easily be confused with epilithic species of *Zygodon*, particularly *Z. intermedius.* The vegetative leaves of our species of *Amphidium* are longer (2.5–4.0 mm vs. c. 0.6–1.8 mm) and more contorted when dry than those of *Zygodon*. The upper laminal cells of both species of *Amphidium* tend to be oblate and have lower, unbranched papillae that are not restricted to the cell lumen, while those of *Z. intermedium* are isodiametric, with relatively high and branched papillae restricted to the area over the cell lumen. When fruiting, the urceolate capsules borne on short setae in both species of *Amphidium* clearly contrast with the ellipsoid capsules on slender setae in *Z. intermedius*.

**Etymology:** According to Crum & Anderson (1981, p. 685), *Amphidium* is “a revised version of *Amphoridium* (which in nomenclaturally unavailable)” and means like an urn or amphora, in reference to the capsule shape.

| | | |
|---|---|---|
| **1** | **Perichaetial leaves** differentiated from vegetative leaves, tubulose and sheathing the seta, 1.2–2.0 mm, oblong-elliptic or oblong-lanceolate, rather abruptly narrowed to broadly or narrowly acute apices, **capsules** emergent to short exserted relative to the inner perichaetial leaves; **vegetative leaf margins** entire ..... | *A. lapponicum* |
| **1'** | **Perichaetial leaves** not or scarcely differentiated from vegetative leaves, neither tubulose nor sheathing, longer, (2.0–)2.5–3.8 mm, linear-lanceolate; **capsules** immersed or emergent relative to the inner perichaetial leaves; **vegetative leaf margins** variable, irregularly and bluntly serrate, undulate, or nearly entire ..... ..... | *A. cyathicarpum* |

## *Amphidium cyathicarpum* (Mont.) Broth., *Nat. Pflanzenfam. [Engler & Prantl] 1(3),* 460 (1902)

≡ *Zygodon cyathicarpus* Mont., *Ann. Sci. Nat., Bot. sér. 3,* 4: 106 (1845)
Type material: Chile, *M. Gay 46*. Image seen online, JSTOR Global Plants, accessed 1 June 2017.

= *Zygodon integrifolius* Beckett, *Trans. & Proc. New Zealand Inst.* 25: 297 (1893)
Lectotype: N.Z., Canterbury, Ben More, alt. 4000 ft., Nov. 1890, *T.W.N. Beckett 297*, CHR 622472! Isolectotype: WELT M002564!

= *Zygodon compactus* Müll.Hal., *Hedwigia* 37: 134 (1898) nom. illeg.
Type: N.Z., Canterbury, Kowai, 29 April 1892, *T.W.N. Beckett 380*, CHR 622473!

**Plants** small to medium-sized, yellow-green above, brown below. **Stems** commonly 15–25(–35) mm in N.Z. material, in cross-section c. 8 cells across, otherwise as per genus. **Leaves** erect-spreading when moist, strongly contorted when dry, linear-lanceolate and narrowly acute, usually weakly and rather bluntly toothed or less often undulate to nearly entire, plane at margins, mostly 2.5–3.0(–4.0) mm; **upper laminal cells** oblate or subquadrate, rounded, incrassate, mostly 9–12 µm in greater dimension, with 8 or more small round papillae over the lumen and the contiguous cell walls; **papillae** apparently becoming elliptic and non-pigmented towards the insertion and in the juxtacostal cells (see discussion under the genus); **basal cells** pale or hyaline, becoming gradually more elongate-rectangular, thinner-walled, and less papillose-striolate towards insertion; **alar** and **marginal cells** not differentiated. **Costa** strong and subpercurrent, the abaxial surface with elongate and smooth superficial cells nearly to the apex, the adaxial surface with ± quadrate and papillose superficial cells, with a single layer of median guide cells.

**Autoicous**. **Perichaetial leaves** not or scarcely differentiated from the vegetative leaves, linear-lanceolate, neither tubulose nor sheathing the setae, the longest usually exceeding the mouth of the capsule, (2.0–)2.5–3.8 mm. **Perigonia** on short bud-like branches immediately below the perichaetium. **Setae** 1 or occasionally 2 per perichaetium, (1.0–)1.7–2.1 mm (excluding vaginula), straight or flexuose; **capsules** immersed or emergent relative to the inner perichaetial leaves, c. 1.0 × 0.6 mm, otherwise as per genus; **exothecial cells**, **stomata**, **annulus**, and **operculum** as per genus. **Peristome** absent. **Calyptra** as per genus. **Spores** 11–15 µm.

**Illustrations:** Plate 1. Beckett 1893, pl. 37 (as *Zygodon integrifolius*); Magill & van Rooy 1998, fig. 136, 1–12; Malcolm & Malcolm 2003, p. 2.

**Distribution:** NI: Gisborne (East Cape, Mt Whanakao, Lake Waikaremoana), Taranaki (Dawson Falls), Wellington (Otūpae near Taihape, near Martinborough); SI: Nelson, Marlborough, Canterbury, Westland (Ōtira River), Otago.

Apparently Austral-Andean. The records of Magill & van Rooy (1998) of *A. tortuosum* (Hornsch.) Cufod. are likely this species. They record *A. tortuosum* from a wide range of southern hemisphere localities, including Australasian, and north to Mexico.

**Habitat:** On rock faces and sides of boulders in stream gorges, waterfall margins, and other sheltered sites; occurring on a wide range of rock types including greywacke, limestone, basalt, papa, gneiss, and sandstone. Ranging on the SI from near sea level (Akatore Stream, Otago L.D.) to at least 1500 m (Temple Basin, Canterbury L.D.). It is frequently associated with *Zygodon intermedius*, *Bartramia papillata*, *Fissidens leptocladus*, *Austrohondaella limata*, *Tortella knightii*, and *Gymnostomum calcareum*. Collections suggest that it is far more common on the South I. than on the North I. There are at least 20 independent collections in CHR herbarium from Canterbury L.D., and

more than 10 collections from Otago L.D. Only a single Westland collection, from c. 760 m in the Ōtira Gorge, has been seen.

**Notes:** The present species seems to differ from the northern hemisphere *A. mougeotii* primarily by its autoicous sexuality and by its southern distribution. The placement of *A. cyathicarpum* in synonymy with the South African *A. tortuosum* (Hornsch.) Cufod. by Magill & van Rooy (1998) is not followed here, in part because they were unable to sight type material of the latter name. Under the circumstances it is preferable to continue use of the well-known name *A. cyathicarpum*, based on a Chilean type. The full resolution of both these taxonomic and nomenclatural questions exceeds the scope of this Flora.

**Recognition:** *Amphidium cyathicarpum* is best distinguished from *A. lapponicum* by the features in the key (above); in my opinion sterile material cannot be reliably distinguished from its congener despite the tendency for the vegetative leaves of the present species to become weakly toothed.

*Amphidium cyathicarpum* can also be confused with other epilithic acrocarps, especially *Dicranoweisia antarctica, Anoectangium bellii*, *Gymnostomum calcareum*, and even some *Zygodon* spp. Sporophytic characters readily distinguish *A. cyathicarpum* from the also autoicous *Dicranoweisia antarctica*. The leaves of *Amphidium* are generally broader in appearance and less strongly cork-screwed when dry, but this difference is subtle and microscopic leaf features are more reliable. The upper laminal cells in *Amphidium* are subquadrate to oblate and very densely and obviously papillose. In *Dicranoweisia* the upper laminal cells are generally longer (to 3:1), not noticeably papillose, but bear very fine and often faint linear striations, which sometimes require staining to be observed. The alar cells in *Amphidium* are not differentiated, while in *Dicranoweisia* they form a well-differentiated group. *Amphidium* generally grows on more cation-rich rock types than the *Dicranoweisia*, although the two species can occur in close proximity.

*Amphidium cyathicarpum* is a more robust plant with generally longer leaves (2.5–4 mm vs c. 1.5–2.0 mm) than *Anoectangium bellii*. In cross-section the costal guide cells in *A. cyathicarpum* are enclosed by abaxial and adaxial substereids, while in *Anoectangium* the guide cells are exposed on the adaxial surface. In addition, *Anoectangium bellii* is dioicous and has sheathing perichaetial leaves and a stem central strand.

Compared to *Gymnostomum calcareum* (with which it often occurs), *A. cyathicarpum* is a more robust and browner plant (*G. calcareum* is usually a bright yellow-green plant when fresh). The leaves of *A. cyathicarpum* are longer (c. 2.5–4.0 mm), less lingulate, and more acute apically than those of *Gymnostomum*, which are shorter (c. 1 mm), decidedly lingulate, and often obtuse apically. The costa in *Amphidium* usually occupies c. ⅕ the width of the leaf base and is subpercurrent, while that of *Gymnostomum* is relatively stouter (c. ⅓ the leaf base) and ends several cells beneath the leaf apex. Sporophyte characters also serve to clearly differentiate these two genera.

Species of *Amphidium* could be confused (and sometimes grow together) with *Zygodon* species with acute leaves, such as *Z. intermedius*. The longer, narrower, and more crisped leaves together with the large area of pale basal cells in *Amphidium* should preclude confusion with any *Zygodon*. Also, the laminal cells of *Amphidium* tend to be oblate and have low and unbranched papillae, which are not restricted to the cell lumen, in contrast to the relatively high and branched papillae over the cell lumen in some species of *Zygodon*. When fruiting, the immersed to emergent, ± erect, and urceolate capsules borne on short setae in the N.Z. species of *Amphidium* contrast with the exserted ellipsoid capsules borne on elongate setae in all *Zygodon* species.

**Etymology:** The species epithet refers to the shape of the capsule; cyath- means cup-shaped.

## *Amphidium lapponicum* (Hedw.) Schimp., *Coroll. Bryol. Eur.* 39 (1856)

≡ *Anictangium lapponicum* Hedw., *Sp. Musc. Frond.* 40 (1801)
≡ *Amphoridium lapponicum* (Hedw.) Schimp., *Syn. Musc. Eur.* 247 (1860)
Type: Finland. Not seen.

**Plants** small to medium-sized, yellow-green above, brown below. **Stems** as per genus, commonly c. 15 mm in N.Z. material. **Leaves** erect-spreading when moist, strongly contorted when dry, linear-lanceolate and narrowly acute, entire, plane at margins, mostly c. 3 mm in upper part of shoots; **upper laminal cells** oblate or subquadrate, rounded, incrassate, mostly 9–12 µm in greater dimension, with numerous (c. 8 or more over each lumen), small (c. 3 µm diam.), and round papillae over the lumen and the contiguous cell walls; **papillae** apparently becoming elliptic and non-pigmented towards the

insertion and in the juxtacostal cells; **basal cells** gradually differentiated towards insertion, becoming oblong-rectangular and smooth, pale or golden, occasionally papillose nearly to the insertion; **alar** and **marginal cells** not differentiated. **Costa** strong and subpercurrent, the abaxial surface with elongate and smooth superficial cells nearly to the apex, the adaxial surface with ± quadrate and papillose superficial cells, with a single layer of median guide cells.

**Autoicous. Perichaetial leaves** differentiated, tubulose and sheathing the seta, oblong-elliptic or oblong-lanceolate, rather abruptly narrowed to a broadly or narrowly acute apex, 1.2–2.0 mm, ending at or below the lower urn**. Perigonia** on short stalked buds a short distance below the perichaetium, but some antheridia also naked among outer perichaetial leaves. **Setae** 1 per perichaetium, 1.0–1.5 mm (excluding vaginula), straight; **capsules** emergent to short exserted relative to the inner perichaetial leaves (when moist), c. 0.9–1.3 × 0.6 mm. **Spores** 12–15 µm.

**Illustrations:** Plate 1. Brotherus 1924, fig. 156; Crum & Anderson 1981, fig. 324, A–E; Magill & van Rooy 1998, fig. 136, 13–25.

**Distribution:** NI: Taranaki (near Manganui Lodge, near Stratford Mountain House), Wellington (Mt Ruapehu); SI: Nelson (Lake Peel, St Arnaud Range), Canterbury (Temple Basin, Broad Stream, near Lake Lyndon, De la Bêche Ridge), Westland (upper Ōtira Valley).

Bipolar. Widespread in the northern hemisphere; reported from Macaronesia, northern and southern Africa by Magill & van Rooy (1998), and from Chile by Smith (2004).

**Habitat:** Apparently restricted to relatively cation-rich outcrops of greywacke and volcanic rocks. One doubtful collection from the Eyre Range in Southland occurred on schist. Ranging from 880 (Broad Stream, Canterbury) to c. 1525 m (De la Bêche Ridge) and commonly associated with *Distichium capillaceum.*

*Amphidium lapponicum* is very difficult to distinguish in the field from *A. cyathicarpum*, and consequently the distribution given above may markedly underestimate its distribution. There appear to be no published records of *A. lapponicum* from either Tasmania or mainland Australia.

**Notes:** Although Sainsbury (1955a) clearly suspected the occurrence of this species in N.Z., *A. lapponicum* was first recorded here by Bartlett (1984) on the basis of two collections determined by D.H. Vitt. Material of one of these specimens (*J.K. Bartlett 18437* from Mt Cobb, WELT M007474) has been examined; it lacks both sporophytes and perichaetia, and its specific identity therefore cannot be confidently confirmed.

**Recognition:** *Amphidium lapponicum* is most likely confused with its congener, *A. cyathicarpum*; the nature of the perichaetial leaves is the most reliable means of distinguishing between these two species. The elliptic papillae, which occur over the laminal cell walls as well as the cell lumens, give the lamina a distinctive papillose-striolate appearance under the compound microscope, but these are a feature of all species of *Amphidium*. Confusion can also occur between the present species and unrelated species, which are discussed under *A. cyathicarpum*.

**Etymology:** The epithet *lapponicum* refers to Lapland, the type locality.

## *Dicranoweisia* Lindb. ex Milde, *Bryol. Siles.* 48 (1869)

**Type taxon:** *Dicranoweisia crispula* (Hedw.) Milde

**Plants** small to medium-sized, dull, yellow- or brown-green, forming cushions on rock. **Stems** erect, branching by forking and innovation, in cross-section with a central strand and firm-walled cortical cells. **Leaves** lanceolate or subulate, crisped and often spirally twisted when dry, usually entire, strongly concave or tubulose; **mid** to **upper laminal cells** quadrate or short-rectangular, mostly with cuticular striations that extend across cell walls, sometimes smooth, firm-walled, unistratose or bistratose at margins; **cells of lower leaf** rectangular to linear, often ± quadrate near margins; **alar cells** usually well differentiated, inflated. **Costa** narrow, in cross-section with two stereid bands.

**Autoicous** (paroicous in N.Z. species). **Perichaetial leaves** sheathing, abruptly tapered to a stout subula in N.Z. species. **Setae** erect and elongate, single; **capsules** erect and symmetric, short-cylindric to obovoid, not strumose, smooth but becoming wrinkled with age; **annulus** absent; **operculum** long-rostrate, curved. **Peristome teeth** inserted below rim, undivided, often fugacious, papillose or baculate throughout (not striolate in N.Z. species). **Calyptra** cucullate, smooth, entire at base. **Spores** spherical.

**Taxonomy:** A medium-sized genus distributed in temperate and colder regions of both hemispheres and mostly occurring on non-calcareous rock. Brotherus (1924) recognised 18 species. Only one species is accepted for N.Z.

The combination of strongly crisped dry leaves, erect capsules, and undivided and coarsely papillose teeth is a feature of the genus as a whole. Longitudinal cuticular thickenings of the laminal cells are characteristic of both the type and the N.Z. species.

The genus is traditionally (e.g., Brotherus 1924) placed in the Dicranaceae, but Goffinet et al.'s (2009) placement in the Rhabdoweisiaceae is followed here. Ochyra (1993; 1998, p. 122) proposed its placement (with *Holodontium* and *Verrucidens*) in a subfamily Dicranoweisioideae of the Seligeriaceae.

Bell (1976) presented a treatment of three *Dicranoweisia* species occurring on Signy I. in the South Orkneys, and Ochyra (1998) has considered the species occurring on King George I. These two authors presented very different taxonomic interpretations. *Dicranoweisia spenceri*, although accepted as a *Dicranoweisia* by both Sainsbury (1955a, p. 120) and by Fife (1995), is here referred to *Kiaeria*.

**Etymology:** The generic name "reflects a relationship to *Dicranum* and some resemblance to *Weissia*" (Crum & Anderson 1981, p. 186).

**Excluded Taxa:** *Weissia crispula* var. *ambigua* Hook.f. & Wilson, *Bot. Antarct. Voy. I. (Fl. Antarct.) Part I*: 127 (1845). The type specimen of this name (BM) is heterogeneous. Only a small fraction of the type is unquestionably referable to *D. antarctica* and this name is therefore considered a *nomen dubium*.

*Weissia tortifolia* Hook.f. & Wilson (*London J. Bot. 3*: 540, 1844) was described from Kerguelen. Combinations based on this name have been made in several genera, including both *Dicranoweisia* and *Verrucidens*. This species has been reported from Macquarie I. (Clifford 1953, quoted by Seppelt 2004, p. 241). Irrespective of its possible occurrence on Macquarie I., Seppelt's suggestion that it may be conspecific with *Dicranoweisia antarctica* deserves further investigation. If Seppelt's suggestion is proven correct, *W. tortifolia* would have nomenclatural priority.

## *Dicranoweisia antarctica* (Müll.Hal.) Kindb., *Enum. Bryin. Exot.* 54 (1888)

≡ *Blindia antarctica* Müll.Hal., *Syn. Musc. Frond. 1,* 344 (1848)
Lectotype: Hermite Island, C. Horn, *J.D. Hooker*, BM-Hampe! Isolectotype: "W. [ilson] 126", BM-Wilson!

= *Blindia chrysea* Müll.Hal. in Beckett, *Trans. & Proc. New Zealand Inst.* 25: 290 (1893)
Lectotype: N.Z., Kaikoura, Maungamauna (Mangamauna) Bay, Dec. 1889, *T.W.N. Beckett 263*, CHR 534984!

= *Weissia webbii* R.Br.bis, *Trans. & Proc. New Zealand Inst.* 31: 440 (1899)
Lectotype: N.Z., Canterbury, Moa Creek, June 1885, *R. Brown*, CHR 335696!

= *Dicranum mackayi* Broth. & Dixon in Dixon, *J. Linn. Soc., Bot.* 40: 437 (1912)
≡ *Holodontium mackayi* (Broth. & Dixon) Broth., *Nat. Pflanzenfam., ed. 2 [Engler & Prantl] 10,* 199 (1924)
≡ *Dicranoweisia mackayi* (Broth. & Dixon) Broth., *Nat. Pflanzenfam., ed. 2 [Engler & Prantl] 10,* 198 (1924)
Type: N.Z., Nun's Veil Mt., Mt Cook district, alt. 6000 ft., Dec. 1907, *Dr MacKay 130*, BM-Dixon!

**Plants** medium-sized, forming dull brown-green cushions on rock. **Stems** c. 15–25(–40) mm, in cross-section with a distinct central strand and firm-walled cortical cells, with sparse, smooth, dark brown rhizoids restricted to the base. **Leaves** mostly loosely secund, sometimes ± falcate when moist, strongly cork-screwed when dry, narrowly lanceolate, entire, c. 3.5–4.0 mm, strongly concave to tubulose; **mid** to **upper laminal cells** short-rectangular or quadrate, sometimes oblate near margin, c. 4–6 µm wide and mostly 1–3:1, incrassate, unistratose, with longitudinal striations, which often

extend across cells walls and appear as crenulations of the cell wall in cross-section (more conspicuous on abaxial surface); **cells of lower leaf** linear and thick-walled, weakly porose, lacking striations; **alar cells** ± inflated, unistratose, forming a strongly differentiated and weakly auriculate group extending to the costa, brown. **Costa** ± ill-defined below, occupying <⅙ the leaf base, not filling the subula except at extreme apex, shortly excurrent, in cross-section (mid leaf) with median guide cells and both abaxial and adaxial stereid groups. **Axillary hairs** not seen.

**Paroicous**. **Perichaetial leaves** c. 2.0–2.5 mm, the innermost with a tubulose and oblong base that sheathes the lower seta and a subula ⅓–½ the leaf length. **Perigonia** budlike at base of perichaetia, with filiform paraphyses, sometimes reduced to a single broadly ovate bract with axillary antheridia and paraphyses. **Setae** (4–)8–15(–22) mm, weakly flexuose, slender, weakly sinistrorse when dry, pale yellow-brown; **capsules** short-cylindric or obovoid, 1.0–1.8 mm, narrowed to the mouth, smooth (but becoming wrinkled with age); **exothecial cells** mostly oblong-hexagonal, not in columns, thin-walled; **stomata** absent or few, restricted to base, apparently superficial; **annulus** absent; **operculum** ± equalling the capsule, falling early. **Peristome teeth** orange throughout, fugacious, inserted c. 45–60 µm below rim, c. 200 × 40 µm (extending c. 150–160 µm beyond rim), lanceolate, very coarsely baculate throughout on both surfaces. **Spores** 15–24 µm, green, finely papillose.

**Illustrations:** Plate 2. Beckett 1893, plate 34 (as *Blindia chrysea*); Malcolm & Malcolm 2003, p. 22; Seppelt 2004, fig. 95.

**Distribution:** NI: Gisborne (Mt Hikurangi), Hawke's Bay (Kaweka Range), Taranaki (Mt Taranaki), Wellington (Mt Ruapehu, Ruahine Range, Mt Holdsworth, Mt Hector, summit of Rimutaka Road, Turakirae Head); SI: Nelson, Marlborough, Canterbury, Westland, Otago, Southland; A; C; M.

Austral. Mainland Australia (Vic.*), Patagonia*, South Shetland Is.*, South Orkney Is.* Recorded from Tasmania by Sainsbury (1955a) and by Dalton et al. (1991).

**Habitat:** Forming cushions from 10 to >100 mm diam. on non-calcareous rock (greywacke, gneiss, conglomerate, etc.) or on soil over rock, often in very exposed sites. Especially common in subalpine and alpine areas and often well-developed on streamside boulders. Rarely on exposed tree roots. The species is widespread in all the L.D. of the South I., but is less well-documented on the North I. The absence of records from Stewart I. may be a collection artefact. On the North I. recorded from low elevation (at Turakirae Head) and c. 600 m (summit of Rimutaka Road) to 1830 m (Mt Ruapehu). On South I. ranging from c. 140 m (near Dunedin) to 2550 m (Mt Cook, Canterbury L.D.). Occurring with a wide range of epilithic bryophyte species, including *Andreaea acuminata*, *Brachythecium paradoxum*, *Breutelia* spp., *Ditrichum* spp., *Racomitrium crispulum s.l.*, *Rhacocarpus purpurascens*, *Schistidium apocarpum*, *Frullania* spp., *Gackstroemia weindorferi*, and *Jamesoniella colorata*.

**Notes:** Although *Dicranoweisia antarctica* varies greatly in stature, the characteristic cork-screw twisting of the dry vegetative leaves generally permits recognition in the field. The longitudinal striations of the leaf cells are highly diagnostic of the genus but sometimes can be obscure in surface view. The striations are sometimes clearer if leaves are stained with toluidine blue or a similar stain. The erect capsules with undivided peristome teeth are frequently produced.

The complicated nomenclatural history of this species was summarised by Bell (1976), who nevertheless did not typify the basionym, *Blindia antarctica* Müll.Hal. Müller (1848–1849, p. 344) described *B. antarctica* using two syntypes collected by *J.D. Hooker* from "Insula Campbelli et Eremitae ad Cap. Horn"; his description could be applied to either collection. The Hermite I. material (BM) is a homogeneous collection and corresponds well to modern concepts (Sainsbury 1955a; Bell 1976) of the species. One duplicate in BM-Hampe is labelled "*Blindia antarctica* mihi" in Müller's hand, and is therefore selected here as the most appropriate lectotype. The Campbell I. syntype includes two dicranaceous species. A small fraction of sterile material is certainly conspecific with the Hermite I. material, but the bulk of the specimen lacks the characteristic cork-screw-twisted leaves and the cuticular striations characteristic of *Dicranoweisia antarctica*. None of the Campbell I. material in BM was annotated by Müller, and the bulk of this collection does not correspond to a modern concept of *D. antarctica*. The Campbell I. material thus cannot be accepted as the lectotype, despite its having been so annotated by R. Ochyra (*in herb.* BM).

Ochyra (1998, p. 122) applied the name *Dicranoweisia brevipes* (Müll.Hal.) Cardot to material from the South Shetland Is, but this is considered here to be *D. antarctica*. The South Shetland and South Orkney material available for study is sparsely fruiting or sterile. When capsules are present, the seta length is at the low end of the range of continuous variation observed for *D. antarctica*, but the material is otherwise representative of the species.

Too little is known of the Kerguelen *Dicranoweisia antarctica* var. *robusta* (Cardot) Seppelt for comment here. *Dicranoweisia microcarpa* (Hook.f. & Wilson) Paris is a poorly known Tasmanian species accepted by Dalton et al. (1991). This species is discussed by Sainsbury (1955b) and by Scott

& Stone (1976, p. 158); it is briefly discussed and illustrated by Meagher & Fuhrer (2003), who recorded it from Victoria as well as Tasmania. It needs to be critically compared to the more widespread *D. antarctica*.

**Recognition:** *Dicranoweisia antarctica* could be confused with the generally larger *Holomitrium perichaetiale*, particularly when the latter species is growing on rock. As well as being smaller, *D. antarctica* lacks the subtle sheen on the abaxial surface of the costa seen in the *Holomitrium*. In *D. antarctica* the vegetative leaves are narrower, lack a distinct shoulder, and are strongly twisted in a cork-screw-like manner when dry, while in the *Holomitrium* the broader leaves are more distinctly shouldered and curved towards the stem when dry. Somewhat more difficult to observe are differences in sexuality (paroicous in the present species) and the length and shape (c. 2.0–2.5 mm and gradually tapered in the present species) of the perichaetial leaves; microscopically the cuticular striations of the laminal cells in the present species also separate it from *H. perichaetiale*.

*Dicranoweisia antarctica* differs from *Kiaeria pumila* in a number of features, including its undivided peristome teeth, which are coarsely and irregularly baculate (compared to the deeply split and longitudinally striate teeth of *K. pumila*), upper laminal cells that are shorter, thicker-walled, and striate, and the cork-screw twisting of its leaves when dry.

Sterile material of *D. antarctica* is also difficult to differentiate from the rare *Kiaeria spenceri*; the former nearly always grows on rock, while the latter appears to be exclusively corticolous. The gametophytes of the two are a similar yellow-green when fresh, but the leaves of the *Dicranoweisia* are longer (c. 4 mm) and obviously contorted when dry, while those of the *Kiaeria* are c. 2.5 mm, weakly secund, and not or only slightly contorted when dry. There are numerous sporophytic differences, including the nature of the peristome teeth, which distinguish the two species; these are detailed under *K. spenceri*.

Sporophytic characters readily distinguish *D. antarctica* from the N.Z. species of *Amphidium*. *Dicranoweisia antarctica* has exserted peristomate capsules in striking contrast to the immersed to weakly exserted and gymnostomous capsules of *Amphidium*. In the absence of sporophytes the distinction of these two genera is more difficult, at least in the field. The leaves of *D. antarctica* are more strongly cork-screwed than those of either species of *Amphidium*, and the alar cells form a well-differentiated group while those of *Amphidium* do not.

**Etymology:** The species epithet *antarctica* is an obvious reference to its southern or Antarctic provenance.

## *Holodontium* (Mitt.) Broth., *Nat. Pflanzenfam., ed. 2 [Engler & Prantl] 10,* 198 (1924)

≡ *Dicranum* sect. *Holodontium* Mitt., *J. Linn. Soc., Bot.* 12: 62 (1869)

**Type taxon:** *Holodontium inerme* (Mitt.) Broth. = *Holodontium strictum* (Hook.f. & Wilson) Ochyra

**Taxonomy:** *Holodontium* is a small genus of austral distribution. It was placed in the Dicranaceae (subfamily Dicranoideae) in the general relationship of *Dicranoweisia* by Brotherus (1924). Brotherus included five species in *Holodontium*, including three that occur in N.Z. These three species are here excluded from the genus and discussed under *Kiaeria* in the Dicranaceae.

More recently, *Holodontium* was monographed by Ochyra (1993), who reduced it to a single species and placed it in the Seligeriaceae, while continuing to postulate a relationship to *Dicranoweisia*. The placement by Goffinet et al. (2009) of *Holodontium* in the Rhabdoweisiaceae is accepted for the purposes of this Flora. The description of *H. strictum*, which is the sole accepted species (and an earlier name for the nomenclatural type), applies to the genus.

**Etymology:** The generic name means whole-toothed, and refers to undivided peristome teeth. At the time of the description of *Dicranum* sect. *Holodontium* Mitten's diagnosis contrasted it with *"D*. sect. *Eudicranum*", which were characterised by having wide and divided peristome teeth.

## *Holodontium strictum* (Hook.f. & Wilson) Ochyra, *Fragm. Florist. Geobot.* 38: 84 (1983)

≡ *Weissia stricta* Hook.f. & Wilson, *London J. Bot.* 3: 540 (1844)

Lectotype: Kerguelen, *J.D. Hooker 243*, BM (Designated by Ochyra 1993.) Image seen online, JSTOR Global Plants, accessed 29 May 2017.

= *Dicranum inerme* Mitt., *J. Linn. Soc., Bot.* 12: 63 (1869)
≡ *Holodontium inerme* (Mitt.) Broth., *Nat. Pflanzenfam., ed. 2 [Engler & Prantl] 10,* 199 (1924)
Type: Ecuador, Andes of Colombia, *Jameson 129*, BM. (Cited by Ochyra 1993.) Image seen online, JSTOR Global Plants, accessed 29 May 2017.

= *Chorisodontium burrowsii* Allison, *Trans. Roy. Soc. New Zealand, Bot.* 2: 134 (1963)
Holotype: N.Z., Rough Creek Basin, Arthur's Pass, 4800–5500 ft., March 1960, *C.J. Burrows s.n.*, CHR 374035!

**Plants** robust, yellow-green when fresh and moist, becoming brown-green when dry, dull, forming extensive turves on irrigated rock. **Stems** c. 40–50 mm, much branched by both forking and innovation, in cross-section lacking a central strand, with 2–3 layers of small, thick-walled cortical cells, sparsely beset with red-brown, smooth, weakly branched, and ± straight rhizoids (mostly arising in leaf axils). **Leaves** secund and strongly curved or falcate both moist and dry, linear-lanceolate and evenly tapered throughout, ± auriculate and clasping at insertion, the distal ⅓ to ½ filled by the costa (see notes below), rounded at the apex, entire, broadly U-shaped throughout, 3.0–6.5 mm, variable in size on single stem; **laminal cells** (c. ⅓ above base) quadrate to short-rectangular, c. 6–12 × 5–6 µm, firm-walled, forming a broad bistratose juxtacostal band (not well illustrated in Plate 3), unistratose in 4–5 marginal rows, with fine cuticular striations (apparently on both surfaces) that extend between cells; **laminal cells closer to the leaf base** becoming unistratose and more pellucid, not elongate, forming a large area of more clearly defined cells immediately above the alar cells; **alar cells** strongly inflated and rounded, to c. 30–40 × 25 µm, ± pigmented, forming a large, well-defined, and ± auriculate group extending to the costa and sometimes remaining attached to the stem when the leaves are removed. **Costa** stout, c. 290–325 µm wide, c. ⅓ to ½ the leaf width, and well-defined in lowest 1 mm of leaf, rapidly becoming ill-defined above; in surface view with short-rectangular cells on the adaxial surface and quadrate cells on the abaxial surface; in cross-section (at mid leaf) C-shaped, with a row of median guide cells and with the abaxial surface cells appearing finely papillose due to cuticular striations.

**Autoicous**. **Perichaetia** terminal but usually overtopped by innovation, often 2 or more per shoot, with perichaetial leaves differentiated, usually shorter than vegetative leaves, sheathing at base and ± distinctly shouldered. **Perigonia** on very short shoots at the base of the perichaetia, with the inner bracts short, oblong-ovate, and weakly costate; **antheridia** <10 per perigonium, mixed with filiform, uniseriate paraphyses. **Setae** (12–)18–23 mm, flexuose and sinistrorse, yellow-brown; **capsules** broadly ellipsoid and scarcely constricted below the mouth when dry, scarcely altered when moist, 1.3–1.5 × 0.8–0.9 mm, smooth; **exothecial cells** at mid urn rounded-polygonal, firm-walled, weakly collenchymatous, becoming isodiametric or ± oblate in several rows at the mouth; **stomata** restricted to capsule base, superficial; **operculum** long-rostrate from a conic base, oblique, ± equal the capsule in length, probably systylious. **Peristome teeth** well-developed, inserted close to rim, yellow-brown, very irregular in outline, often anastomosing and then the paired teeth appearing cribose, to 270 µm long × 75 µm wide (when paired, the fused teeth collectively to c. 120 µm wide), the outer surface trabeculate-lamellate, either coarsely verrucose or sometimes nearly smooth, the inner surface with an irregular median line, thicker cell walls, and moderately to strongly verrucose; **preperistome** absent in N.Z. material. **Calyptra** cucullate, smooth. **Spores** 22–30 µm, finely papillose, brown.

**Illustrations:** Plate 3. Allison 1963, figs. 1–5 (as *Chorisodontium burrowsii*); Ochyra 1993, figs. 1–3; Ochyra 1998, fig. 78; Cardot 1908, pl. 4 is probably also this species (cited as *Verrucidens turpis*).

**Distribution:** SI: Canterbury (Rough Creek Basin, Mt Wakefield), Otago (Old Man Range, Lake Alta on Remarkable Range).

Austral-Andean. South Georgia*, Argentina (Tierra del Fuego)*. Reported from Chile, Crozet Is, Kerguelen, South Shetland Is, and from high elevation (c. 4200 m) in Ecuador by Ochyra (1993).

**Habitat:** Growing at alpine stream margins and at base of late snowbanks. At Lake Alta this species formed turves to c. 15 cm diam. in a flush on a steep, insolated, north-west-facing schist slope at 1900 m. A similar habitat was described (*in herb*.) by H.D. Wilson for a lower elevation collection from Mt Wakefield. Documented from 1520 m (Old Man Range) to 1900 m (Lake Alta).

**Notes:** Ochyra (1993) determined that the Kerguelen basionym of *Holodontium strictum* is both conspecific and earlier than the Ecuadorian type of *Dicranum inerme*. His conclusion that these two names are conspecific is accepted here. He provided both a detailed description and detailed illustrations of *H. strictum* based on type and non-type material. Although type material of these names has been seen only online for the present study, the images of this robust plant agree well with N.Z. material. Numerous British Antarctic Survey collections from South Georgia (named as *H. inerme* (Mitt.) Broth.) have been examined, including duplicates of South Georgian collections cited by

Ochyra. Comparison to his description and illustrations permits no doubt that the ample and often fruiting N.Z. material is conspecific with *H. strictum*. The conspecifity of a high-alpine N.Z. species with plants occurring on both Kerguelen and the northern Andes has other examples in the N.Z. moss flora.

The placement in synonymy here of *Chorisodontium burrowsii* Allison (which never sat comfortably in the genus *Chorisodontium*) clarifies a long-standing confusion.

A likely addition to the synonymy of *H. strictum* is suggested by the single setae-bearing specimen of *Verrucidens turpis* (Cardot) Cardot (from Ushuaia, Argentina, and named by C. Matteri) in CHR. The basionym of this name, *Blindia turpis* Cardot, was described from Tierra del Fuego and subsequently transferred to the monotypic genus *Verrucidens* by Cardot (1908, p. 85). Type material of this species name has not been available for study. However, the Ushuaia specimen so-named (Musci Fuegiana Exsiccati no. 15, CHR 457017!) compares extremely well to published illustrations and to N.Z. and South Georgian material. All have falcate-secund leaves, subquadrate laminal cells, rounded leaf apices, and strongly differentiated, inflated alar cells. The area of juxtacostal bistratose cells is less well-developed in the Patagonian material. The likelihood that *Verrucidens turpis* (Cardot) Cardot is conspecific with *H. strictum* deserves further investigation.

The nature and extent of the costae in *H. strictum* are difficult to interpret. The costae in the basal c. 1 mm of the leaves are relatively clearly defined and c. 290–325 µm wide, with the adjacent laminal cells pellucid and unistratose. Approximately 1 mm above the insertion, the definition of the costae becomes more obscure. This is partly because of the U-shaped leaf cross-section, but is also due to the narrow and partially bistratose lamina (c. 10–15 cells on each side of the costa, inadequately illustrated here), becoming increasingly opaque. At mid leaf the lamina is roughly 6–8 cells wide, including the bistratose portion, and the boundary between the costa and the lamina is indistinct, even in cross-section. When viewed under the stereoscope the lamina appears to extend ½ to ⅔ the total leaf length. Ochyra (1993, figs 16–24) provided an excellent and detailed series of costal illustrations.

The laminal cells (c. ⅓ above base) bear fine cuticular striations that extend across cell boundaries; these striations can be difficult to interpret under the light microscope but they are similar to those found in some species of *Amphidium*. They can be readily observed in leaf cross-sections.

The ornamentation of the peristome teeth is also very difficult to interpret with the light microscope and seems to vary between populations. The verrucae are interpreted here as occurring on both surfaces of the teeth. The outer surface of the tooth has thinner walls (best seen in cross-section) and bears transverse lamellae. The development of the verrucae on the outer surface appears to vary between populations.

**Recognition:** Plants of *Holodontium strictum*, both fresh and dried, have a characteristic dull, yellow-green coloration and linear-lanceolate, subtubulose leaves, which are curved to falcate-secund. These features, combined with the very broad but ill-defined costa, the quadrate to short-rectangular and obscure laminal cells, and its high elevation habitat, make this a relatively distinctive, albeit very rare, plant.

Many features of *H. strictum*, including its irrigated habitat, are suggestive of a *Blindia*. However, the exserted capsule here is ellipsoid rather than the hemispheric or turbinate capsules found in the genus *Blindia*, where it can be either immersed or exserted. Also, the combination of the secund leaves, a broad costa, and quadrate to short-rectangular, partially bistratose laminal cells extending nearly to the insertion is not found in any species of *Blindia*. Finally, the presence of laminal cell wall striations and the lack of a central strand in *H. strictum* preclude confusion.

**Etymology:** The epithet *strictum* means very straight and, presuming that it refers to the leaves, seems inappropriate for the species.

## References


Allison, K.W. 1963: New and rare mosses in New Zealand. *Transactions of the Royal Society of New Zealand. Botany 2*: 133–141.

Bartlett, J.K. 1984: New or interesting records of mosses from New Zealand. *National Museum of New Zealand Records 2*: 181–189.

Beckett, T.W.N. 1893 ("1892"): Description of new species of Musci. *Transactions and Proceedings of the New Zealand Institute 25*: 289–297.

Bell, B.G. 1976: Notes on Antarctica bryophytes: VI. The genus *Dicranoweisia* on Signy Island, South Orkney Islands. *Bulletin, British Antarctic Survey 44*: 97–106.

Brotherus, V.F. 1901–1909: Musci (Laubmoose) II Specieller Teil. *In*: Engler, A.; Prantl, K. (ed.) *Die natürlichen Pflanzenfamilien.* Teil 1. Abt. 3. Engelmann, Leipzig. 277–1246.

Brotherus, V.F. 1924: Musci (Laubmoose). II. Spezieller Teil. *In*: Engler, A. (ed.) *Die natürlichen Pflanzenfamilien.* Edition 2. Bd 10. Engelmann, Leipzig. 143–478.

Brown, R. 1899 ("1898"): Notes on the New Zealand Musci. *Transactions and Proceedings of the New Zealand Institute 31*: 437–442.

Cardot, J. 1908: *La Flore bryologique des Terres magellaniques de la Géorgie du Sud et de l'Antarctide. Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition.* Bd. 4, Abt. 2, Leif. 8. Lithographisches Institut des Generalstabs, Stockholm.

Crum, H.A.; Anderson, L.E. 1981: *Mosses of Eastern North America.* Columbia University Press, New York.

Dalton, P.J.; Seppelt, R.D.; Buchanan, A.M. 1991: An annotated checklist of Tasmanian mosses. *In*: Banks, M.R.; Curtis, W.M. (ed.) *Aspects of Tasmanian Botany – a Tribute to Winifred Curtis.* Royal Society of Tasmania, Hobart. 15–32.

Dixon, H.N. 1912: On some mosses of New Zealand. *Journal of the Linnean Society. Botany 40*: 433–459.

Dixon, H.N. 1926: Studies in the bryology of New Zealand, with special reference to the herbarium of Robert Brown. Part IV. *Bulletin, New Zealand Institute 3(4)*: 153–238.

Fife, A.J. 1995: Checklist of the mosses of New Zealand. *Bryologist 98*: 313–337.

Goffinet, B.; Bayer, R.J.; Vitt, D.H. 1998: Circumscription and phylogeny of the Orthotrichales (Bryopsida) inferred from *rbc*L sequence analyses. *American Journal of Botany 85*: 1324–1337.

Goffinet, B.; Buck, W.R.; Shaw, A.J. 2009: Morphology, anatomy, and classification of the Bryophyta. *In*: Goffinet, B.; Shaw, A.J. (ed.) *Bryophyte Biology.* Edition 2. Cambridge University Press, Cambridge. 55–138.

Goffinet, B.; Vitt, D.H. 1998: Revised generic classification of the Orthotrichaceae based on a molecular phylogeny and comparative morphology. *In*: Bates, J.W., Ashton, N.W.; Duckett, J.G. (ed.) *Bryology for the Twenty-First Century.* Maney Publishing and British Byological Society, Leeds. 143–159.

Hedwig, J. 1801: *Species Muscorum Frondosorum descriptae et tabulis aeneis lxxvii coloratis illustratae.* Barth, Leipzig.

Hooker, J.D.; Wilson, W. 1844: Musci Antarctici; being characters with brief descriptions of the new species of mosses discovered during the voyage of H.M. Discovery ships, Erebus and Terror, in the southern circumpolar regions, together with those of Tasmania and New Zealand. *London Journal of Botany 3*: 533–556.

Ireland, R.R.; Frahm, J.-P.; Crum, H. 1994: Dicranaceae. *In*: Sharp, A.J.; Crum, H.A.; Eckel, P.M. (ed). The Moss Flora of Mexico. *Memoirs of the New York Botanical Garden 69*: 111–169.

Kindberg, N.C. 1888: *Enumeratio Bryinearum Exoticarum quam alphabetice diposuit.* Officina Corresp. Ostrogoth, Linkoeping.

Lewinsky, J. 1976: On the systematic position of *Amphidium* Schimp. *Lindbergia 3*: 227–231.

Magill, R.E.; van Rooy, J. 1998: *Bryophyta, Part 1 Mosses, Fascicle 3, Erpodiaceae-Hookeriaceae.* Leistner, O.A. (ed.) *Flora of Southern Africa.* Botanical Research Institute, Pretoria.

Malcolm, B.; Malcolm, N. 2003: *A Colour Atlas of the Genera of New Zealand's Mosses.* Micro-Optics Press, Nelson.

Meagher, D.; Fuhrer, B.A. 2003: *A Field Guide to the Mosses & Allied Plants of Southern Australia. Flora of Australia Supplementary Series.* Vol. 20. ABRS, Canberra.

Milde, J. 1869: *Bryologia Silesiaca: Laubmoos-Flora von nord- und mittel-Deutschland mit besonderer Berücksichtigung Schlesiens und mit Hinzumahme der Floren von Jütland, Holland, der Rheinpfalz, von Baden, Franken, Böhmen, Mähren und der Umgegend von München.* Felix, Leipzig.

Mitten, W. 1869: Musci Austro-Americani, sive enumeratio muscorum omnium Austro-Americanorum mihi hucusque cognitorum, eorum praecipue in terris Amazonicis Andinisque Ricardo Spruceo lectorum. *Journal of the Linnean Society. Botany 12*: 1–659.

Montagne, C. 1845: Cinquième centurie de plantes cellulaires exotiques nouvelles. Décades I á VI. *Annales des Sciences Naturelles; Botanique sér. 3, 4*: 86–123.

Müller, C. 1848–1849 ("1849"): *Synopsis Muscorum Frondosorum omnium hucusque cognitorum.* Vol. 1. Foerstner, Berlin.

Müller, C. 1898: Symbolae ad Bryologiam Australiae II. *Hedwigia 37*: 76–171.

Ochyra, R. 1993: Antipodal mosses: I. A revision of the genus *Holodontium* (Seligeriaceae). *Fragmenta Floristica et Geobotanica 38*: 75–98.

Ochyra, R. 1998: *The Moss Flora of King George Island, Antarctica.* Polish Academy of Sciences, Cracow.

Sainsbury, G.O.K. 1955a: A handbook of the New Zealand mosses. *Bulletin of the Royal Society of New Zealand 5*: 1–490.

Sainsbury, G.O.K. 1955b: Notes on Tasmanian mosses from Rodway's herbarium: II. *Papers and Proceedings of the Royal Society of Tasmania 89*: 1–11.

Schimper, W.P. 1856 ("1855"): *Corollarium Bryologiae Europaeae.* Schweizerbart, Stuttgart.

Schimper, W.P. 1860: *Synopsis Muscorum Europaeorum.* Schweizerbart, Stuttgart.

Scott, G.A.M.; Stone, I.G. 1976: *The Mosses of Southern Australia.* Academic Press, London.

Seppelt, R.D. 2004: *The Moss Flora of Macquarie Island.* Australian Antarctic Division, Kingston.

Smith, A.J.E. 2004: *The Moss Flora of Britain and Ireland.* Edition 2. Cambridge University Press, Cambridge.

Stech, M. 1999: A molecular systematic contribution to the position of *Amphidium* Schimp. (Rhabdoweisiaceae, Bryopsida). *Nova Hedwigia 68*: 291–300.

# Conventions

### Abbreviations and Latin terms

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

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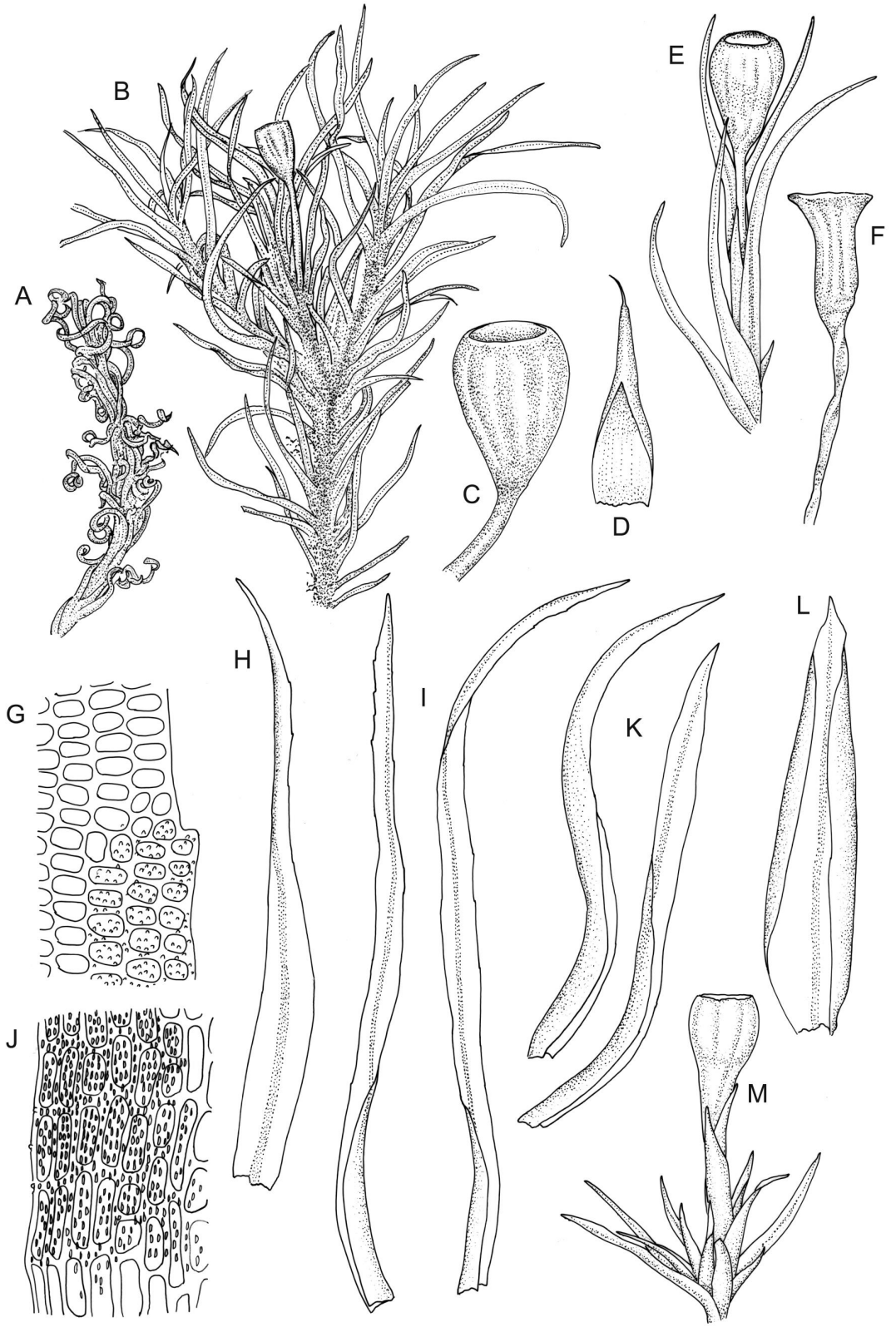



**Plate 1:** ***Amphidium*. A–J: *A. cyathicarpum***. A, portion of shoot, dry. B, habit with capsule, moist. C, capsule, moist. D, calyptra. E, perichaetium with capsule, moist. F, capsule, dry. G, upper laminal cells at margin, papillae shown on some cells. H, perichaetial leaf. I, leaves. J, basal laminal cells at margin, with elliptic papillae. **K–M: *A. lapponicum***. K, leaves. L, perichaetial leaf. M, perichaetium with capsule, moist. *A. cyathicarpum* drawn from *B.H. Macmillan 91/17*, CHR 413681. *A. lapponicum* drawn from *A.J. Fife 5935*, CHR 405848.

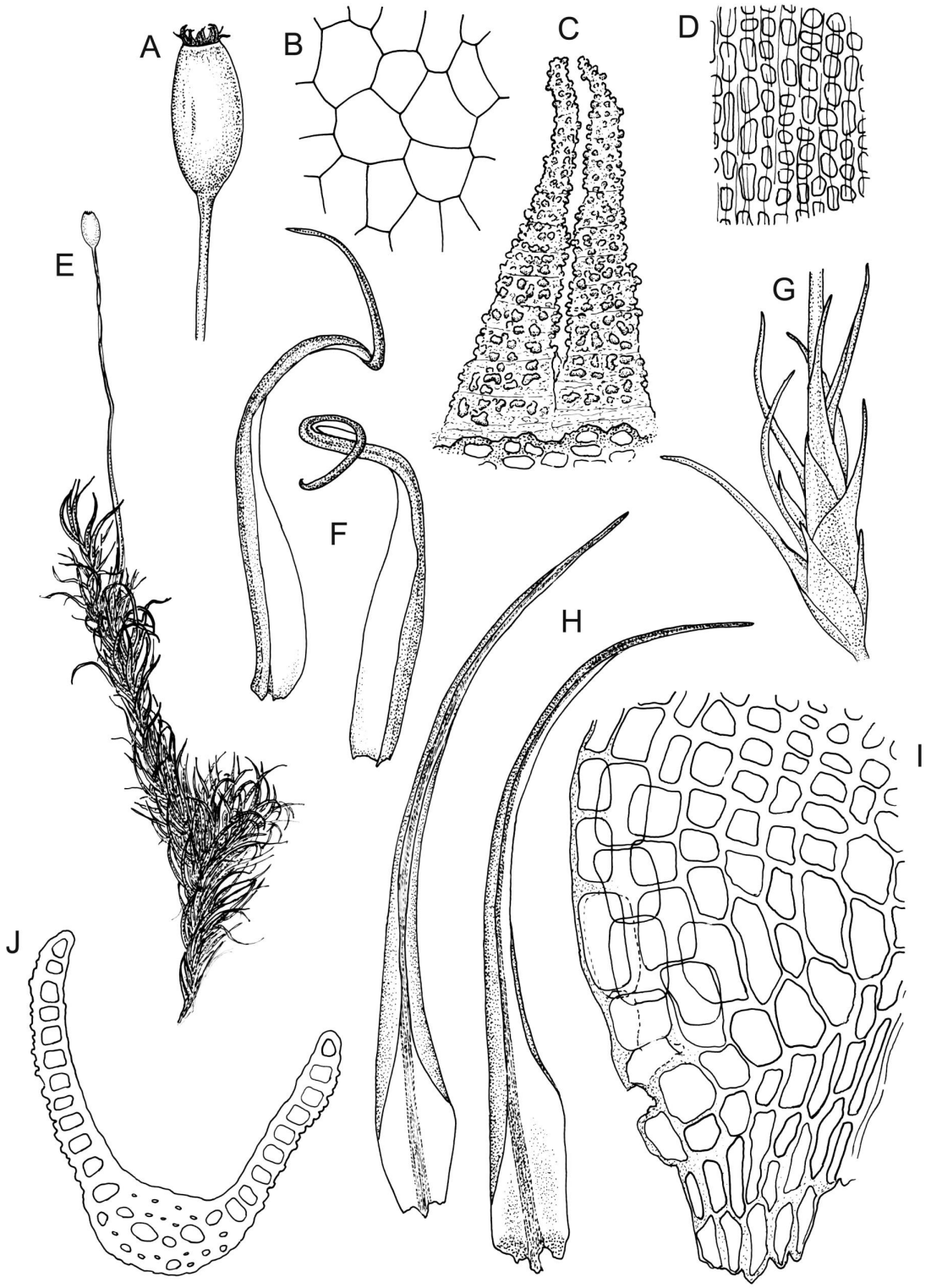



**Plate 2:** ***Dicranoweisia*. A–J: *D. antarctica***. A, capsule, dry. B, exothecial cells. C, peristome teeth, outer surface. D, upper laminal cells. E, habit with capsule, moist. F, leaves, dry. G, perichaetium, moist. H, leaves, moist. I, alar cells. J, cross-section of mid laminal cells including costa. Drawn from *A.J. Fife 5486*, CHR 104170, and *J. Lewinsky 1277*, CHR 351651.

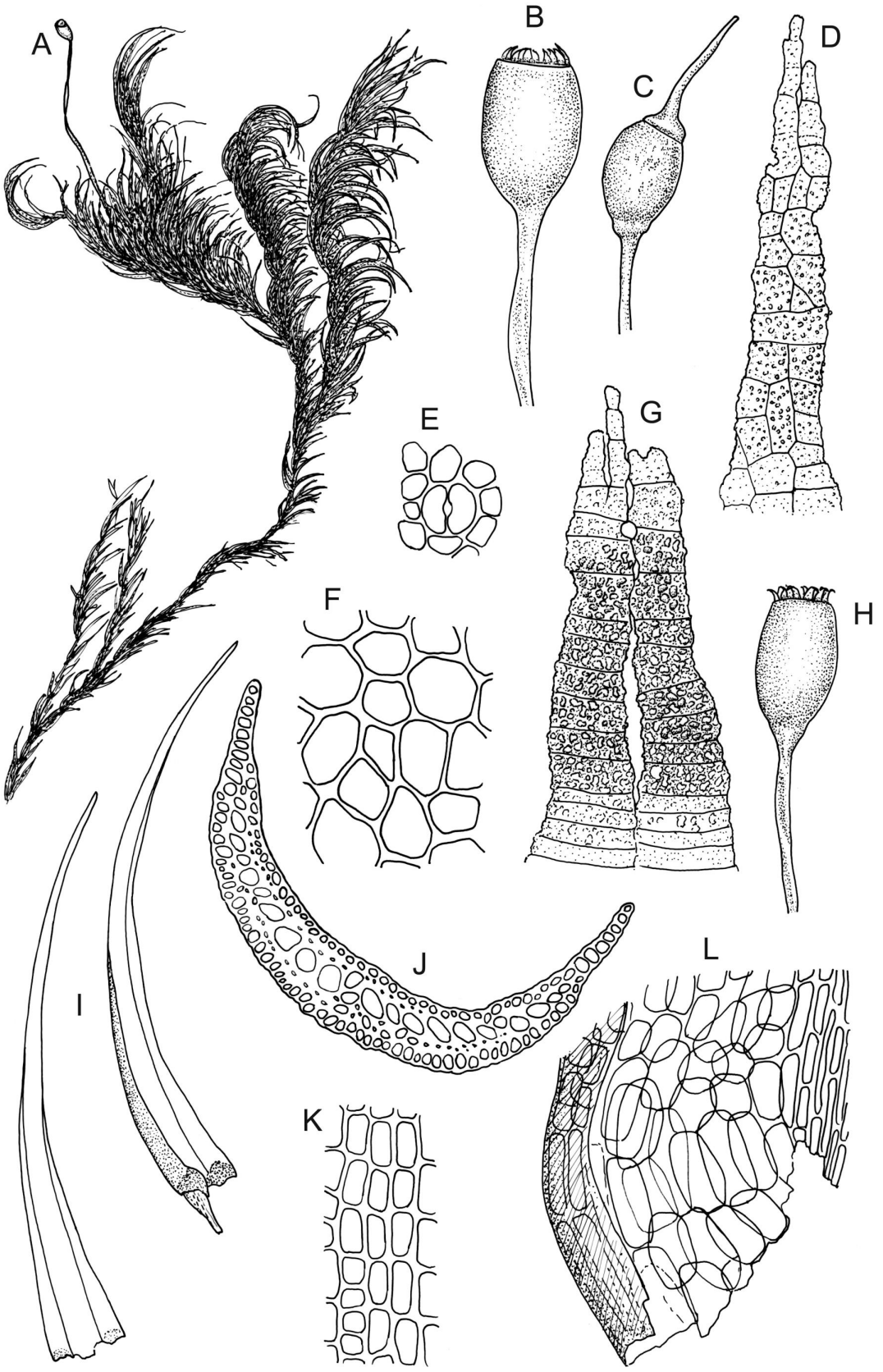
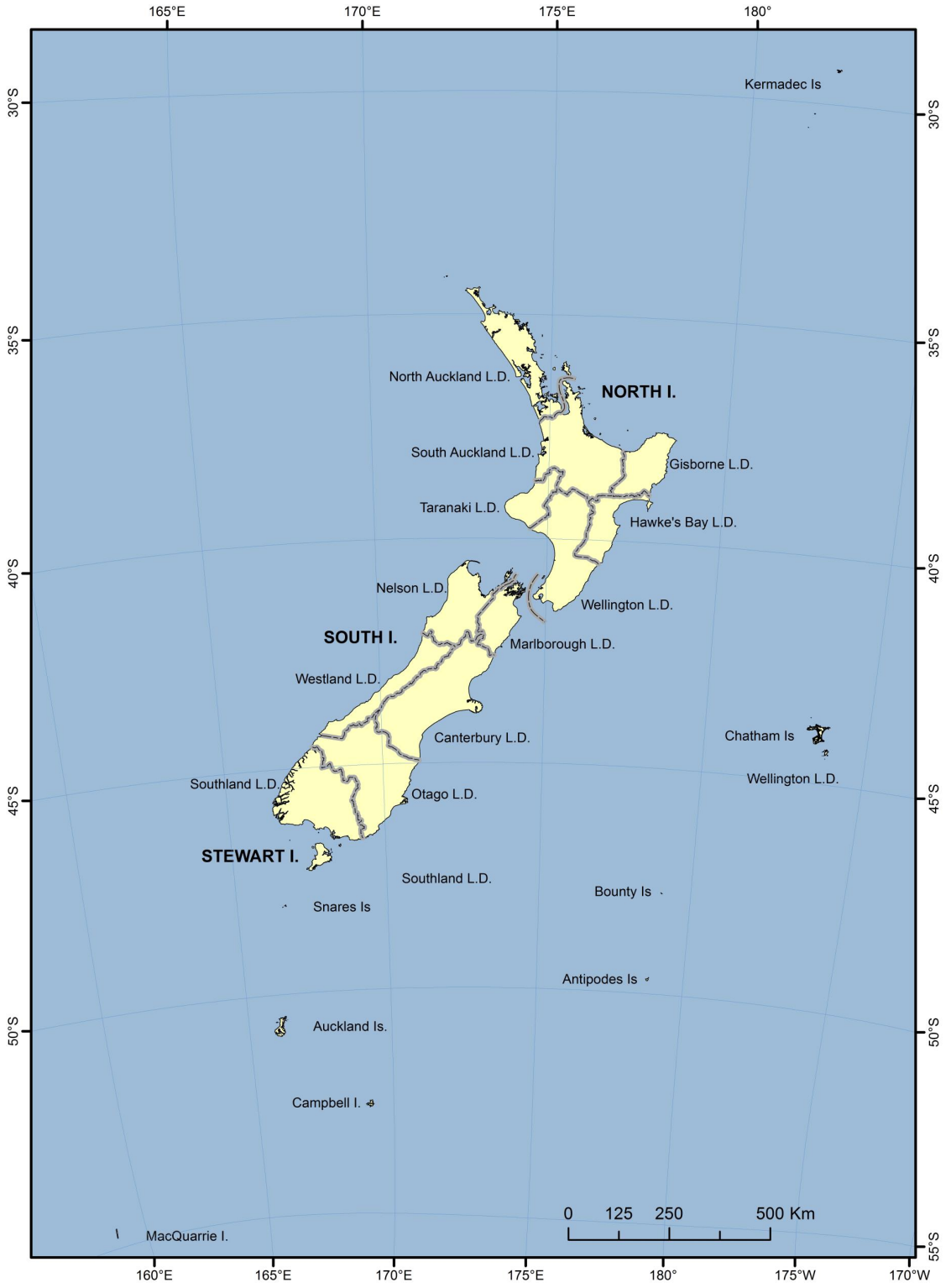
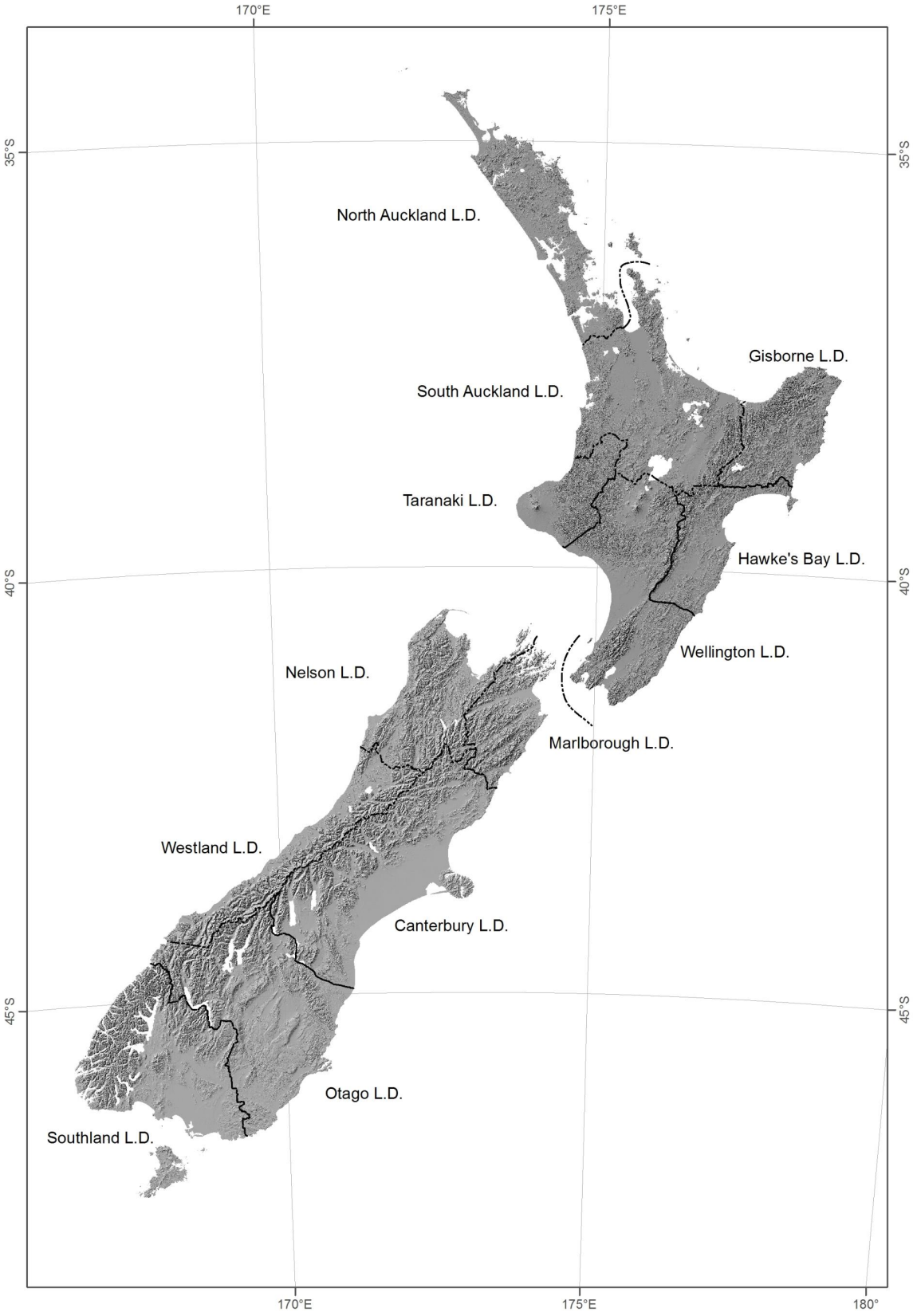



**Plate 3:** ***Holodontium*. A–L: *H. strictum***. A, habit with capsule, dry. B, capsule, moist. C, capsule with operculum, dry. D, peristome tooth, inner surface. E, stomate. F, exothecial cells. G, peristome detail, outer surface of two fused teeth. H, capsule, dry. I, leaves. J, cross-section of mid laminal cells including costa (lacking bistratose juxtacostal region). K, lower laminal cells. L, alar cells. A drawn from *J. Child s.n.*, 27 Jan. 1972, CHR 430635. B–L drawn from *P. Child s.n.*, 26 Jan. 1972, CHR 422913.




**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.

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