

## POHLIA

A. Jonathan Shaw<sup>1</sup> & Helen P. Ramsay<sup>2</sup>

*Pohlia* Hedw., *Sp. Musc. Frond.* 171 (1801); named after Johann E. Pohl (1782–1834), a physician from Dresden.

Type: *P. elongata* Hedw.

*Webera* Hedw., *Sp. Musc.* 168 (1801), *nom. illeg., non Webera* Schreb.

*Lamprophyllum* Lindb., *Öfvers. Förh. Finska Vetensk.-Soc.* 20: 12 (1863), *nom. illeg., non Lamprophyllum* Miers.

*Mniobryum* Schimp ex. Limpr., *Laubm. Deutschl.* 4(2): 272 (1892); *Pohlia* subg. *Mniobryum* (Limpr.) Ochyra, *Biodiv. Poland* 3: 158 (2003). T: *M. carneum* Limpr., *nom. illeg.* [= *Pohlia melanodon* (Brid.) A.J.Shaw].

Dioicous, paroicous or rarely autoicous. Plants small to medium-sized, erect, dull or glossy, scattered among other mosses or occasionally forming extensive turfs. Stems short to long, unbranched, sparingly forked, or with subfloral innovations below the gametangia. Rhizoids colourless, papillose. Leaves erect to erect-spreading, usually unaltered, rarely somewhat contorted when dry, narrowly lanceolate to ovate-lanceolate, rarely linear-lanceolate; costa single, narrow, in section with large outer cells and a few thickened central cells, ending below the apex or subpercurrent, rarely excurrent; margins finely serrate to serrulate near the apex, rarely entire; apex acute or short-acuminate. Upper median laminal cells elongate-hexagonal to linear-vermicular, with thin or ±thickened walls; marginal cells in some species longer and narrower than the median cells, but not forming a distinct border; Gemmae axillary, clustered or solitary in the leaf axils of some species; rhizoidal tubers occasional.

Perigonia and perichaetia terminal. Perigonial leaves with an ovate-concave reddish base and a ±elongate erect-spreading to squarrose acumen. Perichaetial leaves gradually larger and longer than stem leaves. Setae erect, curved just below the capsule, often long-exserted. Capsules symmetrical or nearly so, variously inclined, broadly to narrowly cylindrical to pyriform, with a well-developed sterile neck region sometimes as long as the urn (rarely longer); stomata usually superficial, occasionally immersed; exothecial cells rectangular, sometimes with ±sinuose walls; annulus revoluble, rarely absent; operculum short-to tall-conical, sometimes short-rostrate. Peristome double, well developed, rarely absent; exostome teeth 16, brown to red-brown, orange, or yellow; endostome with a short to tall (to c. half the length of the exostome teeth), smooth or rarely papillose basal membrane and 16 narrow keeled segments; cilia long and nodulose or absent. Spores small to medium-sized, 13–26 µm diam., finely roughened. Chromosome numbers  $n = 10, 11, 12, 20, 22, 33, 40$ , *vide* R.Fritsch, *Bryophyt. Biblioth.* 40: 234–236 (1991).

The genus is characterised by inclined to pendent capsules with a well-defined sterile neck region, and lanceolate leaves (rarely linear-lanceolate, as in the Australian species, *P. tenuifolia*) with elongate-hexagonal to linear-vermicular upper cells. In contrast to *Bryum* and *Brachymerium*, *Pohlia* has non-excurrent costae (rarely shortly and stoutly excurrent in *P. nutans*) and longer laminal cells that do not form a distinct border. No species of *Pohlia* has appendiculate cilia or synoicous gametophytes, and bisexual gametophytes in *Pohlia* are typically paroicous, rarely autoicous. *Pohlia* can be distinguished from *Mielichhoferia* by having terminal inflorescences in which the perichaetial leaves are enlarged relative to vegetative leaves.

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*Pohlia*, a cosmopolitan genus of c. 85 species, is most diverse in temperate to boreal latitudes of the Northern Hemisphere. In the Southern Hemisphere, it occurs as far south as the Antarctic Peninsula, Subantarctic Islands and in temperate Australia and New Zealand, as well as southern Africa and South America. Most species grow on mineral soil, often in disturbed habitats, and many taxa are restricted to mountainous regions.

Australian species exhibit a broad range of breeding systems. Gametophytes can be bisexual (e.g. *P. clavaeformis* and *P. nutans*), unisexual (e.g. *P. annotina* and *P. wahlenbergii*), or polyoicous (*P. cruda* and *P. elongata*). Only four of the ten Australian taxa produce axillary gemmae that are presumed to be effective in asexual reproduction (*P. bulbifera*, *P. camptrochaela*, *P. annotina* and *P. inflexa*).

### References

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|----|--|-----------------------------|
| 1  | Plants with axillary gemmae .....  | 2                           |
| 1: | Plants lacking axillary gemmae .....   | 5                           |
| 2  | Gemmae solitary in each leaf axil, red, with conspicuous laminate leaf primordia.....  | <b>7. P. inflexa</b>        |
| 2: | Gemmae numerous in each leaf axil, variable in color but not red .....   | 3                           |
| 3  | Gemmae obconical or variously elongate and vermicular .....  | <b>1. P. annotina</b>       |
| 3: | Gemmae spherical or nearly so .....  | 4                           |
| 4  | Gemmae 70–150 µm diam., glossy- translucent when dry, with 1–4 short peg-like primordia near the apex .....                              | <b>3. P. camptotrachela</b> |
| 4: | Gemmae 175–400 µm diam., dull or slightly glossy, with 4 broadly laminate apical leaf primordia that form a dome over the apex .....     | <b>2. P. bulbifera</b>      |
| 5  | Plants less than 5 mm tall; leaves linear-lanceolate .....   | <b>9. P. tenuifolia</b>     |
| 5: | Plants 8–50 mm tall; leaves lanceolate to ovate-lanceolate.....  | 6                           |
| 6  | Plants very pale; leaf cells broad, 10–18 µm wide.....   | <b>10. P. wahlenbergii</b>  |
| 6: | Plants pale to dark green, not notably pale; leaf cells 6–10 (–12) µm wide.....  | 7                           |
| 7  | Plants dull; leaf cells elongate-hexagonal, with ±thickened walls .....  | 8                           |
| 7: | Plants ±glossy; leaf cells rhomboidal to linear-rhomboidal, with thin walls .....  | 9                           |
| 8  | Capsule neck as long as or longer than the urn; endostome segments narrowly perforate along the keels; cilia absent or rudimentary ..... | <b>6. P. elongata</b>       |
| 8: | Capsule neck shorter than the urn; endostome segments broadly perforate along the keels; cilia long and nodulose .....                   | <b>8. P. nutans</b>         |

- 9 Leaf cells rhombic; capsules erect; endostome segments irregular, with narrowly (or non-) perforate segments; cilia absent..... **4. *P. clavaeformis***
- 9: Leaf cells linear-vermicular; capsules  $\pm$ inclined; endostome segments well-developed, broadly perforate; cilia present..... **5. *P. cruda***

### 1. *Pohlia annotina* (Hedw.) Lindb., *Musc. Scand.* 17 (1879)

*Bryum annotinum* Hedw., *Sp. Musc. Frond.* 183, pl. 43 (1801). T: "Habitat locis arenosis argillosis humidis, ad aggres, fossas, aquas stagnantes continentes Germaniae [Germany]; lecto: G ("Olim Chemnitzii sax. Lectum, no. 1"), fide A.J.Shaw (1981).

Illustration: A.J.Shaw, *J. Hattori Bot. Lab.* 50: 62, fig. 27; 64, fig. 28 (1981).

Dioicous. Plants dull (when dry) pale to dark green, generally in small populations of restricted size, more rarely forming somewhat extensive turfs. Stems 3–30 mm long. Lower leaves lanceolate, acute, 0.6–1.0 mm long; costa strong, percurrent; margins recurved, rather strongly serrulate near the apex. Upper laminal cells elongate-rhomboidal to linear-hexagonal, 35–70 (–90)  $\times$  6–11  $\mu$ m, with firm to thickened walls. Gemmae clustered in the upper leaf axils, oblong, obconical, occasionally vermicular, 180–290  $\mu$ m long, hyaline to greenish white, with (1–) 2–4 peg-like leaf primordia.

Perichaetial leaves strongly differentiated in Australian material, linear-lanceolate to lanceolate, decurrent. Sporophytes not known from Australia (following description after Shaw, 1981), tan to brown when mature. Setae 15–30 mm long. Capsules pyriform, inclined at 45–95° from vertical, the neck shorter than the urn; exothecial cells rectangular, with sinuose walls; stomata superficial. Peristome double; exostome teeth well developed, pitted below (appearing papillose under LM), smooth to coarsely roughened above, yellow-brown; endostome hyaline,  $\pm$ smooth; segments keeled, broadly perforate; basal membrane c. 1/3–1/2 the height of the exostome teeth; cilia absent or rudimentary. Spores 16–23  $\mu$ m diam.

Occurs in Tas. Widely distributed in northern North America, Europe and Asia.

Tas.: Mt Wellington, *J.Spence 4506* (Hb. Spence, DUKE); *loc. id.*, *A.Fife 8822* (CHR); Central Plateau, *A.Fife 8894* (CHR); Hartz Mtns, *J.Spence 4555* (Hb. Spence, DUKE).

Although sporophytes are not known in Australia, examination of plants in the field (and microscopically) suggests that the gametophytes, including gemmae, of Tasmanian plants cannot be distinguished from those of the Northern Hemisphere species, *P. annotina*. Australian specimens of *P. annotina* were previously misidentified as *P. flexuosa*, a widespread Northern Hemisphere species, by Shaw (2006). Although the Tasmanian sites represent a bipolar disjunction for this species, two other northern gemmiferous taxa, *P. camptotrachela* and *P. bulbifera*, are similarly disjunct in Australia (in alpine New South Wales). *Pohlia flexuosa* is more typical of warmer regions, and the identification of the Tasmanian plants as *P. annotina* seems more likely from an ecological perspective.

### 2. *Pohlia bulbifera* (Warnst.) Warnst., *Krypt.-Fl. Brandenburg* 2: 429 (1904)

*Webera bulbifera* Warnst., *Bot. Centralbl.* 66: 230 (1896). T: Germany, *Grutter s.n.*; neo: fide K.Lewis & A.J.E.Smith (1978: 16) "sample no 164, Bank of River Fillan, Crianlarich W. Perth, Scotland, October 1967, K.Lewis (NMW)" n.v.

Illustrations: A.J.Shaw, *J. Hattori Bot. Lab.* 50: 51, fig. 22; 53, fig. 23 (1981); H.A.Crum & L.E.Anderson, *Mosses of Eastern North America* 1: 522, fig. 240 (1982); A.J.Shaw, *Syst. Bot.* 31: 253, fig. 2L, M (2006).

Dioicous. Plants slender, glossy (when dry) light green or  $\pm$ yellow-green; in the Northern Hemisphere often mixed with other gemmiferous species or more rarely forming somewhat extensive turfs. Stems 3–30 mm long. Leaves 0.9–1.4 mm long, erect, lanceolate to ovate-lanceolate, acute; costa ending just below the apex; margin serrulate to serrate in the upper third,  $\pm$ recurved below. Upper laminal cells elongate-rhomboidal to linear-rhomboidal, 35–80  $\times$  6–11  $\mu$ m, thin-walled. Gemmae in clusters of 3–8 in upper leaf axils, spheroidal to obovoid, green, yellow-green, yellow or orange, with 4 or 5 broadly triangular-laminate leaf primordia in a whorl forming a dome over the gemma apex.

Perigonal leaves lanceolate and spreading widely from the ovate base. Perichaetial leaves scarcely differentiated. Sporophytes not known from Australia, typically tan to orange-brown

when mature. Setae 18–35 mm long. Capsules pyriform, occasionally curved, inclined at 55–110° from vertical; neck as long as or somewhat shorter than the urn; exothecial cells rectangular, with strongly sinuose walls; stomata superficial. Peristome double; exostome teeth well developed, pitted below, papillose above, yellow-brown to brown; endostome hyaline; segments broadly keeled and perforate; basal membrane 1/3–1/2 the height of the exostome teeth; cilia typically well-developed, long, nodulose. Spores 16–23 µm diam.

Known only from the alpine late snowmelt area of south-eastern N.S.W. Apparently circumboreal; in the Northern Hemisphere this species grows on sandy soil, often in disturbed habitats such as roadside banks; also rather common on peaty soils in and along the edges of bogs.

N.S.W.: Mount Kosciuszko State Park, 1968, *W.A. Weber & D. McVean s.n.* (COLO).

The Australian plants are completely sterile (no gametangia nor sporophytes were seen), but they are typical in terms of gametophyte morphology, including the characteristic obovoid gemmae. The leaves, unlike those of *P. annotina* and *P. camptotrachela*, are somewhat glossy when dry. Shaw & Fife (*New Zealand J. Bot.* 23: 183–186, 1985) discussed gemmiferous species of *Pohlia* in New Zealand which might eventually be found in eastern or southern Australia.

### **3. *Pohlia camptotrachela* (Renauld & Cardot) Broth., in H.G.A. Engler & K.A.E. Prantl, *Nat. Pflanzenfam.* I, 3: 552 (1903)**

*Webera camptotrachela* Renauld & Cardot, *Bot. Gaz.* 13(8): 199 (1888). T: *s. loc.*, U.S.A., *Lesquereux s.n.*; iso: NY.

Illustrations: A.J. Shaw, *J. Hattori Bot. Lab.* 50: 75, fig. 32 (1981); A.J. Shaw, *Syst. Bot.* 31: 253, fig. 2F–I (2006); D.-C. Zeng *et al.*, *Moss Fl. China* (English version) 4: 70, fig. 199(1–8) (2007).

Dioicous. Plants dull (when dry) light green or ±yellow-green. Leaves lanceolate, acute; costa ending just below the apex; leaf margin entire. Upper laminal cells elongate-rhomboidal to linear-rhomboidal, 45–80 × 6–11 µm, with thin walls. Gemmae in clusters of 3–10 in upper leaf axils, spheroidal to obovoid, 70–150 µm diam., yellow or yellow-green, or occasionally orange, highly glossy-translucent when dry, with 1–4 short peg-like leaf primordia at or near the gemma apex.

Perigonal leaves lanceolate and spreading widely from the ovate base. Perichaetial leaves scarcely differentiated. Sporophytes not known from Australia, elsewhere typically tan to orange-brown when mature. Setae 15–35 mm long. Capsules pyriform, occasionally curved, inclined at 55–110° from vertical; neck as long as or somewhat shorter than the urn; exothecial cells rectangular, with strongly sinuose walls; stomata superficial. Peristome double; exostome teeth well developed, pitted below, papillose above, yellow-brown to brown; endostome hyaline; segments broadly keeled and perforate; basal membrane 1/3–1/2 the height of the exostome teeth; cilia usually well-developed, long, nodulose. Spores 14–20 µm diam.

Very rare in alpine N.S.W. Widespread in mountainous areas of western and eastern North America and western Europe; also known from New Zealand.

N.S.W.: Schink Pass, Mount Kosciuszko Natl Park, *J. Spence* 4728 (DUKE).

The Australian plants grew on damp soil along a roadside, a habitat typical of this species in the Northern Hemisphere. It is intriguing that *P. camptotrachela* and *P. bulbifera*, both widespread in the Northern Hemisphere, are disjunct in Mount Kosciuszko National Park in alpine New South Wales.

The clusters of small, highly glossy (when dry), yellow, yellow-green, or sometimes orange gemmae are diagnostic. This species is similar to *P. flexuosa* in appearing dull when dry but the two species are readily distinguished by gemma shape, size and colour.

**4. *Pohlia clavaeformis* (Hampe) Broth., in H.G.A.Engler & K.A.E.Prantl, *Nat. Pflanzenfam.* I, 3: 547 (1903)**

*Bryum clavaeforme* Hampe, *Linnaea* 36: 519 (1870); *Webera clavaeformis* (Hampe) A.Jaeger, *Ber. Tätigk. St. Gallischen Naturwiss. Ges.* 1873–74: 129 (1875). T: Mt Disappointment, Vic., *N.Taylor*; holo: BM; iso: MEL.

*Bryum mielichhoferia* Müll.Hal., *Hedwigia* 37: 86. (1898); *Webera mielichhoferia* (Müll.Hal.) Paris, *Index Bryol. Suppl.* 328 (1900); *Pohlia mielichhoferia* (Müll.Hal.) Broth., in H.G.A.Engler & K.A.E.Prantl, *Nat. Pflanzenfam.* I, 3: 547 (1903). T: Mt Ararat, Grampians, Vic., Oct. 1883, *D.Sullivan*; iso: MEL, NSW.

*Mielichhoferia turgens* Broth., *Proc. Linn. Soc. New South Wales* 41: 858 (1916); *Pohlia turgens* (Broth.) A.J.Shaw, *Mem. New York Bot. Gard.* 45: 683 (1987). T: Koorawatha, N.S.W., *W.W.Watts 7219*; holo: H-BR; iso: NSW.

Illustration: A.J.Shaw, *Syst. Bot.* 31: 252, fig 2A–E (2006).

Parioicous. Plants pale whitish green. Leaves ±broadly ovate-lanceolate to lanceolate, acute; costa ending just below the apex; margins loosely recurved, serrate to serrulate near the apex. Upper laminal cells linear-rhomboidal, ±vermicular, 65–125 × 5–9 µm, thin-walled. Axillary gemmae absent.

Perichaetial leaves scarcely differentiated but slightly larger than vegetative leaves; costa weaker; areolation laxer. Sporophytes 1 or 2 from each perichaetium, tan to brown when mature. Setae 7–15 mm long. Capsules pyriform, erect to horizontal, inclined at 10–80° from vertical, c. 5 mm long; neck shorter than to as long as the urn; exothecial cells rectangular, with straight or slightly sinuose walls; stomata superficial. Peristome double; exostome teeth well developed or somewhat irregular, 180–240 µm long, pitted below, papillose above, sometimes obliquely or vertically striate in the upper half, pale yellow to brown; endostome hyaline; segments narrow and scarcely tapered to the apex, weakly keeled and narrowly or not at all perforate; basal membrane up to one-third the height of the exostome teeth; cilia absent. Spores 13–20 µm diam.

This rather rare endemic species is known only from soil in N.S.W. and Vic.

N.S.W.: Green Gully, near Young, *W.W.Watts 7209, 7210, 7212* (NSW); Argalong Rd, *H.Streimann 3726* (H, CANB); Weedallion Mtn, *W.W.Watts 7231, 7232, 7234* (NSW); Mt Talbingo, *M.Mueller 2149* (AD, MEL, NSW); Tumut, *H.Streimann 3726* (AD); Koorawatha, *W.W.Watts 7219* (MEL); Mt Coglean, near Cootamundra, *W.W.Watts 7875, 7890* (NSW). Vic.: Mt Ararat, *D.Sullivan 10d* (MEL).

Although the pale whitish green colour of *P. clavaeformis* is somewhat similar to *Mielichhoferia bryoides*, the placement of this species in *Pohlia* is confirmed by its terminal inflorescences in which the perichaetial leaves are larger than vegetative leaves. The peristome is double and comparatively well-developed, with the exostome teeth as long as or longer than the endostome segments. At least one or a few inflorescences in most collections are polysetous.

This species has been compared to *P. nutans* (G.A.M.Scott & I.G.Stone, *Mosses of Southern Australia* 301, 1976), and while both taxa are parioicous with pyriform capsules, *P. clavaeformis* has long, thin-walled leaf cells, erect to horizontal capsules, and a reduced endostome lacking cilia. In contrast, *P. nutans* has elongate-hexagonal upper cells with firm to thickenend walls, capsules that are inclined to pendulous with the neck shorter than the urn and an endostome with well-developed, long, nodulose cilia. The type specimen of *P. clavaeformis* in the Hampe herbarium (BM) consists of three minute plants with perichaetia and sporophytes only. The distinctive sterile shoots, with whitish overlapping leaves reminiscent of *Mielichhoferia bryoides*, are not present in the type material.

**5. *Pohlia cruda* (Hedw.) Lindb., *Musc. Scand.* 18 (1879)**

*Mnium crudum* Hedw., *Sp. Musc. Frond.* 189 (1801); *Hypnum crudum* (Hedw.) F.Weber & D.Mohr, *Index Musc.* 3 (1803); *Webera cruda* (Hedw.) Fürnr., *Flora* 12: 35 (1829); *Lamprophyllum crudum* (Hedw.) Lindb., *Acta Soc. Sci. Fenn.* 10: 87 (1871). T: Germany, coll. unknown; lecto: G, fide A.J.Shaw (1981).

*Bryum erythrocaule* Hampe, *Linnaea* 37: 516 (1872), *nom. illeg., non B. erythrocaulon* (Schwägr.) Brid.; *Pohlia erythrocaulis* Watts & Whitel., *Proc. Linn. Soc. New South Wales, Suppl.*, 30: 122 (1906). T: Blue Mtns, N.S.W., *F.Mueller*; lecto: BM, fide A.J.Shaw (2006: 251); isolecto: H, MEL.

Illustration: H.A.Crum & L.E.Anderson, *Mosses of Eastern North America* 1: 531, fig. 244 (1981); A.J.Shaw, *Contr. Univ. Michigan Herb.* 15: 238, fig. 6 (1982); A.J.Shaw, *Syst. Bot.* 31: 250, fig. 11–L (2006).

Usually paroicous, less commonly dioicous. Plants blue-green to whitish green, occasionally tinged with red, with a strong metallic sheen, generally in small populations, often mixed with other species. Stems 5–25 mm long. Leaves  $\pm$ broadly lanceolate to ovate-lanceolate or elliptic, sometimes slightly asymmetrical, 0.8–2.0 mm long, acute; costa ending just below or in the apex, serrate to serrulate near the apex. Upper laminal cells linear-rhomboidal, vermicular,  $65\text{--}145 \times 4\text{--}9 \mu\text{m}$ , with thin walls. Axillary gemmae absent.

Perigonial leaves in dioicous plants conspicuously differentiated, linear-lanceolate and spreading widely from the ovate base. Perichaetial leaves linear-lanceolate to lanceolate. Sporophytes only occasional in Australian material, usually brown when mature. Setae 10–45 mm long. Capsules rather narrowly elongate-pyriform, sometimes curved, inclined at  $10\text{--}135^\circ$  from vertical, 4–6 mm long; neck shorter than to as long as the urn; exothecial cells rectangular, with straight or slightly wavy walls; stomata superficial. Peristome double; exostome teeth well developed, pitted below, papillose above, pale yellow to brown; endostome hyaline; segments broadly keeled and perforate; basal membrane  $1/3\text{--}1/2$  the height of the exostome teeth; cilia usually long, nodulose. Spores  $18\text{--}26 \mu\text{m}$  diam.

This almost cosmopolitan species occurs in south-eastern N.S.W., Vic. and Tas. Grows on soil in mountainous areas, usually in sheltered crevices.

N.S.W.: Yarrangobilly Caves, *W.W.Watts 8942* (NSW); Mt Jagungal, *J.A.Curnow, H.Lepp & M.Brenan 633* (CANB). Vic.: Mt Buller, *J.H.Willis 228w* (MEL). Tas.: Mt Wellington, *M.Fleischer B2225* (H); *loc. id.*, *A.V.Ratkowsky H345* (CANB).

*Pohlia cruda* is readily recognised by the broadly ovate to elliptic leaves that are pale and often have tinges of red here and there, with a strong metallic sheen when dry. Collections from the Subantarctic region often have erect and overlapping leaves, occasionally arranged in vertical rows. However, Australian plants, like those from the Northern Hemisphere, usually have the leaves more spreading in a clearly spiral phyllotaxy.

## 6. *Pohlia elongata* Hedw., *Sp. Musc. Frond.* 171 (1801)

*Bryum elongatum* (Hedw.) With., *Syst. Arr. Brit. Pl.*, 4th edn, 3: 815 (1801); *Leskea elongata* (Hedw.) F.Weber & D.Mohr, *Index Musc.* 3 (1803); *Mnium elongatum* (Hedw.) P.Beauv., *Prodr. Aethéogam.* 75 (1805). T: France, Scotland, Austria; **lecto: G, fide A.J.Shaw, Syst. Bot. 3:250 (2006); loc. & coll. unknown.**

*Pohlia novae-seelandiae* Dixon, *Bull. Torrey Bot. Club* 42: 102 (1915). T: Evans Flat, Tuapeka Co., New Zealand, Oct. 1891, *D.Petrie*; *holo: BM.*

Illustrations: H.A.Crum & L.E.Anderson, *Mosses of Eastern North America* 1: 529, fig. 243 (1981); A.J.Shaw, *Contr. Univ. Michigan Herb.* 15: 234, fig. 4; 236, fig. 5 (1982); A.J.Shaw, *loc. cit.* fig. 1E–H (2006).

Paroicous, rarely dioicous or (outside Australia) autoicous. Plants dull (when dry) pale to dark green, generally in small populations, more rarely forming rather extensive turfs. Leaves lanceolate, acute; costa strong, ending just below or in the apex; margins recurved, serrate to serrulate near the apex. Upper laminal cells elongate-rhomboidal to linear-hexagonal,  $40\text{--}90 \times 5\text{--}10 \mu\text{m}$ , with firm to thickened walls. Axillary gemmae absent.

Perigonial leaves in dioicous or autoicous plants short-lanceolate and spreading widely from the ovate base. Perichaetial leaves linear-lanceolate to lanceolate. Sporophytes common, typically tan to orange-brown when mature. Setae 10–45 mm long. Capsules narrowly pyriform, occasionally curved, inclined at  $10\text{--}90^\circ$  from vertical, 5–8 mm long; neck as long as or longer than the urn; stomata superficial; exothecial cells rectangular, with straight or slightly wavy walls. Peristome double; exostome teeth well developed, pitted below, papillose above, pale yellow to brown; endostome hyaline or rarely slightly yellow; segments rather narrow (weakly tapered to the apex), keeled but narrowly (or not) perforate; basal membrane c. one-third the height of the exostome teeth; cilia absent or rudimentary. Spores  $16\text{--}23 \mu\text{m}$  diam.

Known from alpine N.S.W. and Vic.; on soil usually in protected habitats, occasionally in rock crevices. This widely distributed but never common moss is known throughout much of

the Northern Hemisphere as well as southern South America, southern Africa, New Guinea and New Zealand.

N.S.W.: Mount Kosciuszko Natl Park, *J.Spence 4744* (Hb J.Spence, DUKE). Vic.: Mt Buffalo, 1952, *K.W.Atkins* (MEL); Bogong High Plains, *J.H.Willis 177* (MEL); Lake Mtn, 1967, *J.H.Willis* (MEL).

The gametophytes are similar to those of *P. nutans*; they share a dull appearance (when dry), parocious inflorescences, and elongate-hexagonal leaf cells with thickened walls. Sporophytes of *P. elongata* lack the diagnostic, although not constant, orange colour of *P. nutans*, they have longer sterile necks, and narrower, more weakly keeled endostome segments that are scarcely or not at all split along the keels. Endostomial cilia are generally lacking or rudimentary in *P. elongata*.

This species is far less common than *P. nutans* in Australia and elsewhere. Sterile plants are generally referred to the latter, and it is possible that some sterile collections of *P. elongata* are thus misidentified. *Pohlia elongata* rarely forms conspicuous sterile colonies, and it is so much more restricted than *P. nutans* in terms of habitat range. The comparative rarity of *P. elongata* is probably an accurate indication of its distribution.

### 7. *Pohlia inflexa* (Müll.Hal.) Wijk & Margad., *Taxon* 14: 197 (1965)

*Bryum inflexum* Müll.Hal., *Int. Polarforsch., Deutsch. Exped. 2*: 296 (1890); *Webera inflexa* (Müll.Hal.) Kindb., *Enum. Bryin. Exot.* 108 (1891); *Philonotis inflexa* (Müll.Hal.) Broth., in H.G.A.Engler & K.A.E.Prantl, *Nat. Pflanzenfam.* I, 3: 651 (1904). T: South Georgia, Jan. 1883, *H.Will*; n.v.

Illustration: A.J. Shaw, *Syst. Bot.* 31: 253, fig. 2N–R (2006).

Apparently dioicous. Plants ±glossy, whitish to yellow-green or green, occasionally tinged with red (especially the stem), sometimes forming extensive turfs of soft texture. Leaves lanceolate to ovate-lanceolate, rather conspicuously keeled, acute; costa ending below the apex; margins plane to weakly recurved below. Upper laminal cells elongate to linear-rhomboidal, 35–80 × 6–13 µm, thin-walled. Gemmae solitary in the upper leaf axils of some stems, infrequent, oblong-bulbiform, deep cherry-red, with 4–7 conspicuous broadly lanceolate pale to green laminate leaf primordia at the gemma apex and scattered lower on the gemma body. Reproductive plants not seen. Sporophytes unknown.

Occurs in alpine N.S.W. and Tas.; grows on moist or wet soil, often along streams. Widespread but incompletely known in the Subantarctic zone, including South America.

N.S.W.: Mt Kosciuszko, *D.G.Catcheside 68.72* (with gemmae; AD); between Charlotte Pass and Mt Kosciuszko, *W.A.Weber 26812* (CANB); Mt Clarke, *D.McVean 26630* (COLO). Tas.: Mt Field West, *D.McVean 267109* (CANB).

This species is rather variable in colour and size. In some collections the leaves are laxly pale yellow-green on pale stems, while others have darker green leaves on reddish stems; intermediates are not uncommon. Gemmae, which are never abundant, and were observed in about a third of the specimens examined, are rather similar to those of *P. drummondii* (Müll.Hal.) A.L.Andrews from the Northern Hemisphere. However, the gemmae of *P. inflexa* have larger, more numerous and conspicuous leaf primordia. It is likely that most or all Southern Hemisphere records of *P. drummondii* are in fact gemmiferous forms of this species, and that *P. inflexa* has a circum-Antarctic range.

### 8. *Pohlia nutans* (Hedw.) Lindb., *Musc. Scand.* 18 (1879)

*Webera nutans* Hedw., *Spec. Musc.* 168 (1801); *Bryum nutans* (Hedw.) Turner, *Musc. Hibern.* 117 (1804). T: Germany, coll. unknown; lecto: G, fide A.J.Shaw (1981).

*Bryum beccarii* Müll.Hal., *Hedwigia* 37: 87 (1898); *Webera beccarii* (Müll.Hal.) Paris, *Index Bryol.*, Suppl. 27 (1900); *Pohlia beccarii* (Müll.Hal.) Watts & Whitel., *Proc. Linn. Soc. New South Wales*, Suppl., 30: 122 (1906). T: Mt Wellington, Tas., 19 Feb. 1878, O.Beccarii ex Hb. Levier in Hb. Geheeb.

*Bryum longifolium* Müll.Hal. & Hampe, in Hampe, *Linnaea* 28: 205 (1856), nom. illeg., non *B. longifolium* (Hedw.) Dickson ex With.; *Pohlia longifolium* Watts & Whitel., *Proc. Linn. Soc. New South Wales Suppl.* 30: 122 (1906). T: Cobberas Mtns, Vic., *F.Mueller*; lecto: BM (here chosen).

*Bryum montanum* Müll.Hal., *Hedwigia* 37: 87 (1898); *Pohlia montana* (Müll.Hal.) Watts & Whitel., *Proc. Linn. Soc. New South Wales*, Suppl., 30: 122 (1906). T: Mt William, Vic., *D.Sullivan*; holo: MEL.

*Bryum leptopalmatum* Müll.Hal., *Hedwigia* 37: 87 (1898); *Pohlia leptopalmata* (Müll.Hal.) Watts & Whitel., *Proc Linn. Soc. New South Wales*, Suppl., 30: 122 (1906). T: Mt Kosciuszko [Kosciuszko], *D.Sullivan*; holo: MEL.

Illustrations: H.A.Crum & L.E.Anderson, *Mosses of Eastern North America* 1: 530, fig. 244 (1981); A.J.Shaw, *Contr. Univ. Michigan Herb.* 15: 227, fig. 3 (1982); J.E.Beever, K.W.Allison & J.Child, *Mosses of New Zealand* 91, fig. 39 (1992); A.Eddy, *Handb. Malesian Mosses* 3: 160, fig. 440 (1996); A.J.Shaw, *Syst. Bot.* 31: 250, fig. 1A–D (2006).

Paroicous. Plants dull (when dry), pale to dark green, in short or occasionally tall turfs. Lower leaves lanceolate, acute; costa strong, percurrent or rarely stoutly short-excurrent; margins narrowly recurved below, serrate to serrulate near the apex. Upper laminal cells elongate-hexagonal, 40–80 × 5–10 µm, with firm to thickened walls. Axillary gemmae absent.

Perichaetial leaves linear-lanceolate to lanceolate. Sporophytes common, typically orange when mature. Setae reddish, 1.0–8.5 cm long. Capsules pyriform, inclined at 85–160° from vertical or pendulous, c. 4–6 mm long; neck shorter than the urn; stomata superficial; exothelial cells rectangular, with straight or somewhat wavy walls. Peristome double (formula typically 4:2:6); exostome teeth well developed, pitted below, papillose above, pale yellow to dark brown; endostome hyaline or rarely slightly yellow; segments broadly keeled and perforate; basal membrane 1/3–1/2 the height of the exostome teeth; cilia generally long, nodulose. Spores 14–22 µm diam.

Occurs in S.A., N.S.W., A.C.T., Vic. and Tas.; on mineral or ±humus-rich soil, non-calcareous substrata, rarely on rock or rotting wood. Found in all continents, but especially at high latitudes and/or altitudes. In the Southern Hemisphere this moss is known from Australasia, the Antarctic Peninsula and South Georgia. *Pohlia nutans* is the most common species of *Pohlia* in Australia.

S.A.: Mt Lofty, Oct. 1952, *L.R.Williams* (AD). N.S.W.: Gordon Falls, *W.W.Watts 6165* (H); Mt Kosciuszko, *D.McVean 26426* (AD); Merritts Camp, Mt Kosciuszko, *W.Forsyth 191,194* (NSW); Seamens Hut, Snowy Mtns, *D.G.Catcheside 65.11* (AD); Yarrangobilly village, *W.W.Watts 8486* (NSW). A.C.T.: Canberra, *H.Streimann 2056* (CANB); Mt Bimberi, *H.Streimann 4389, 4418* (AD). Vic.: Grampians, *H.Streimann 3326* (MEL); Major Mitchells Plateau, *R.Melville 2006 & K.Harrop* (NSW); Mt Hotham, *J.H.Maiden 649* (NSW); Bogong High Plains, *L.D.Williams 2633, 2680* (AD). Tas.: Mt Wellington, *W.A.Weymouth 2954* (CANB); Queenstown, *M.Tindale s.n.* (NSW).

*Pohlia nutans* is characterised by its paroicous inflorescences, leaves that are dull when dry, and with elongate-hexagonal, thick-walled laminal cells. The peristome is well developed, with broadly keeled and widely perforate endostome segments and cilia. The capsules are usually rather orange, occasionally lighter or darker. Some Australian plants have stoutly excurrent costae; these are more rare in Northern Hemisphere plants.

This species is most similar to *Pohlia elongata*, which has longer, more narrowly pyriform capsules in which the sterile neck region is as long as or longer than the urn, as well as keeled but narrowly perforate endostome segments that lack cilia.

## 9. *Pohlia tenuifolia* (A.Jaeger) Broth., in H.G.A.Engler & K.A.E.Prantl, *Nat. Pflanzenfam.* I, 3: 549 (1903)

*Bryum tenuifolium* Hook.f. & Wilson, *London J. Bot.* 3: 546 (1844), *nom. illeg., non B. tenuifolium* Brid.; *Webera tenuifolia* A.Jaeger, *Ber. Tätigk. St. Gallischen Naturwiss. Ges.* 1873–74: 137 (1875) [Ad. 1: 599]. T: Bay of Islands, New Zealand, *J.D.Hooker*; lecto: BM, *fide* A.J.Shaw.

Illustration: G.O.K.Sainsbury, *Handb. New Zealand Mosses* 258, fig. 3 (1955); A.J.Shaw, *Syst. Bot.* 31: 250, fig. 1E–H (2006).

Paroicous, rarely dioicous. Plants minute, pale to dark green, neither noticeably glossy nor dull when dry, generally scattered as small discrete colonies, rarely in turfs. Leaves linear-lanceolate, narrowly acute; costa strong, ending just below or in the apex; margins serrate to serrulate near the apex. Upper laminal cells hexagonal to linear-rhomboidal, 40–90 × 4–10 µm, with thin to firm walls. Axillary gemmae absent.

Perigonal leaves in dioicous plants lanceolate and spreading widely from the ovate base. Perichaetial leaves gradually differentiated, linear to linear-lanceolate. Sporophytes common,



typically orange-brown to brown when mature. Setae exserted, 10–45 mm long. Capsules narrowly pyriform, curved, inclined 10–90° from vertical, c. 3 mm long; neck as long as to longer than the urn; exothecial cells rectangular, with straight or slightly wavy walls; stomata superficial. Peristome double; exostome teeth well developed, pitted below, papillose above, pale yellow to brown; endostome hyaline; segments broadly keeled and perforate; basal membrane 1/3–1/2 the height of the exostome teeth; cilia generally long, nodulose. Spores 18–26 µm diam.

Occurs in W.A. and N.S.W.; on soil and rock in rather moist or mountainous areas. Also in Chile, Brazil and New Zealand.

W.A.: Packsaddle Spring, *H.Streimann* 48348 (CANB); King Leopold Ra., *H.Streimann* 39382 (CANB); Rock Ck, *H.Streimann* 39475 (CANB). N.S.W.: Minyon Falls, *H.Streimann* 6855 (CANB); Sydney, *R.G.Coveny* 14090 (H, NSW); Cambewarra, *W.W.Watts* 6705,6377 (NSW).

This species is characterised by its very small stature, linear-lanceolate leaves and pyriform, ±horizontal, curved capsules. Sterile plants can be confused with *Orthodontium*, but they have shorter leaves, more sparsely foliate stems (i.e. the leaves are more widely separated in *P. tenuifolia*), and by habitat (on soil rather than burned or rotting wood).

**10. *Pohlia wahlenbergii*** (F.Weber & D.Mohr) A.L.Andrews, *Moss Fl. N. America* 2: 203 (1935)

*Hypnum wahlenbergii* F.Weber & D.Mohr, *Bot. Taschenb.* 280, 475 (1807); *Webera wahlenbergii* (F.Weber & D.Mohr) Fümrr., *Flora* 12: 35 (1829); *Mniobryum wahlenbergii* (F.Weber & D.Mohr) Jenn., *Man. Moss. W. Pennsylvania* 146 (1913); *Bryum wahlenbergii* (F.Weber & D.Mohr) Schwägr., *Sp. Musc. Frond.*, Suppl., 1(2): 92 (1916). T: Germany, *Funck*; lecto: S n.v.

*Mniobryum tasmanicum* Broth., *Öfvers. Förh. Finska Vetensk.-Soc.* 35: 48 (1893); *Webera tasmanica* (Broth.) Paris, *Index Bryol.* 1361 (1898); *Pohlia tasmanica* (Broth.) Dixon, *Bull. New Zealand Inst.* 3(4): 201 (1926); *Mniobryum wahlenbergii* (F.Weber & D.Mohr) Jenn. var. *tasmanicum* (Broth.) Wijk & Margad., *Taxon* 10: 25 (1961). T: Mt Wellington, Tas., W.A. *Weymouth* 1151, 1153, 1154; syn: H.

Illustrations: A.J.Shaw, *Contr. Univ. Michigan Herb.* 15: 274, fig. 28 (1982); A.J.Shaw, H.Crum & P.M.Eckel, *Moss Fl. Mexico* 1: 510, fig. 386 (1994); R.D.Seppelt, *Moss Fl. Macquarie Island* 197, fig. 79 (2004); A.J.Shaw, *Syst. Bot.* 31: 253, fig. 2S, T (2006).

Dioicous. Plants dull or somewhat glossy when dry, pale whitish green to ±red, scattered among other mosses, occasionally forming extensive luxuriant turfs. Leaves narrowly to broadly lanceolate, acute, serrate to serrulate near the apex; costa rather weak, ending below the apex. Upper laminal cells broadly rhomboidal, 45–135 × 8–18 µm, with thin to very thin walls. Gemmae absent.

Perigonal leaves shortly and broadly lanceolate and spreading widely from the ovate base. Perichaetial leaves scarcely differentiated. Sporophytes uncommon, tan to brown when mature. Setae 6–30 mm long. Capsules broadly and short-pyriform when mature, becoming urceolate when dry and empty, inclined at 40–240° from vertical, 1.5–3.5 mm long; neck relatively short and inconspicuous; exothecial cells ±isodiametric, with strongly sinuose walls; stomata immersed; annulus lacking. Peristome double; exostome teeth well developed, pitted below, papillose above, light to dark brown; endostome yellow; segments broadly keeled and perforate; basal membrane half the height of the exostome teeth or slightly higher; cilia generally long, nodulose. Spores 13–18 (–24) µm diam.

Known from all States and Territories except S.A. Widespread on all continents; one of the most abundant species of *Pohlia* at high latitudes of the Northern and Southern Hemispheres. Grows on moist soil beside streams, near waterfalls and other damp habitats, especially on alkaline substrata.

W.A.: Mammoth Cave, Margaret River, *D.G.Catcheside* 74.327 (AD). N.T.: Kakadu Natl Park, *I.G.Stone* (MEL 2331297A). Qld: Helwellyn Rocks, *A.Curtis* s.n. (NSW). N.S.W.: Leatherbarrel Ck, *H.Streimann* 1458 (CANB); Yarrangobilly village, *W.W.Watts* 8502 (NSW); Mt Duval, *W.W.Watts* 7588, 7594, 7597 (NSW); Batlow, *W.W.Watts* 8072 (NSW). A.C.T.: Smokers Gap, *H.Streimann* 4287 (CANB); Brindabella Ra., *H.Streimann* 1353, 1766, 4037, 4215 (CANB); Cotter Dam Rd, *N.T.Burbidge* 7251 (NSW). Vic.: Eastern Highlands, 1956, *Kay* s.n. (MEL). Tas.: Mt Wellington, *W.A.Weymouth* 1573 (H).

This is one of the most variable species of *Pohlia*, and many varieties have been described. It is common and widespread in polar regions of both hemispheres where the var. *glaciale* (F.Weber & D.Mohr) A.L.Andrews (occasionally recognised as a separate species) has been used for robust plants with substantial red pigmentation. *Pohlia tasmanica* was described for plants with comparatively narrow leaves and cells, but those individuals (as represented by type and other collections in the Brotherus herbarium in Helsinki) fall well within the range of variation for *P. wahlenbergii*.

Australian plants range from slender to robust and from uniformly green to red. A few collections from Mt Duval, N.S.W. (e.g. *Watts 7597*) are distinctive in that the leaves are especially glossy. That such variants belong to *P. wahlenbergii* is demonstrated by one specimen from the same locality (*Watts 7594*) in which the upper leaves are glossy but the lower ones are typical of the species. It is not clear whether this glossy expression is a genetically determined variant or a habitat-induced modification. In any event, it does not appear to be worthy of taxonomic recognition.

*Pohlia wahlenbergii* is dioicous, and sporophytes are not common, although they do occur in Australia. When fruiting, this species can be recognised by the shortly and broadly pyriform to urceolate capsules with dark brown exostome teeth, yellow endostomes and immersed stomata. When sterile, it is characterised by its pale whitish green or sometimes reddish colour, spreading leaves with lax areolation, and its distinctive habitat (wet clay and mud mainly along streams or other water bodies).

Capsules differ from those of other Australian *Pohlia* species in becoming urceolate when dry, with wavy or sinuose exothelial cells walls, lacking an annulus and in having immersed stomata.