The genus *Ptychomitrium* Fürnr. 
(Bryophyta: Ptychomitriaceae) in Australia

David Meagher

School of BioSciences, The University of Melbourne, Victoria, 3010 
Australia dameag@unimelb.edu.au

Abstract

Five species of *Ptychomitrium* have been recognised in Australia: *P. acutifolium*, *P. australie*, *P. laxifolium*, *P. mittenii* and *P. muelleri*. Apart from *P. mittenii* these species have been confused in the literature and in herbarium identifications. Here *P. acutifolium*, *P. australie* and *P. mittenii* are accepted. *P. laxifolium* is synonymised under *P. acutifolium*, and *P. muelleri* is synonymised under *P. australie*.

Introduction

Five species of the moss genus *Ptychomitrium* Fürnr. have been reported from Australia: *P. acutifolium* Hook.f. & Wilson, *P. australie* (Hampe) A.Jaeger, *P. laxifolium* (Müll.Hal.) Paris, *P. mittenii* A.Jaeger and *P. muelleri* (Mitt.) A.Jaeger (Scott and Stone 1976, Cao et al. 2001, Cao et al. 2005, Streimann and Klazenga 2006). The Australian species have never been treated in their entirety. Instead, species have been gradually added, subtracted and synonymised, resulting in confusion about their identities, as Cao et al. (2005) noted in relation to *Ptychomitrium acutifolium*. Further confusion has arisen because some gatherings consist of two species growing together. The confusion has been worsened by a lack of accurate illustrations of the species and a consequent plethora of incorrectly identified specimens in herbaria and images on the internet.

The following treatment is intended to resolve these problems. In the listings of types, !d indicates that a high-resolution digital image has been seen. When identifying specimens it is essential that leaves are fully wetted so that the shoulders and also the cells of the upper lamina are clearly visible. In older specimens the cell contents may be dark, so that sectioning or clearing and staining leaves may be necessary in order to see the upper leaf cells clearly. Because peristomes are difficult to draw accurately and have been poorly illustrated in the past, photographs rather than drawings are provided (Fig. 4).
Taxonomic Treatment

Key to Australian species of Ptychomitrium

1 Upper margins of most leaves coarsely toothed ................................................................. P. mittenii

1: Margins of leaves entire throughout ......................................................................................

2 Most leaves when fully wetted with a distinct shoulder and bluntly pointed apices;
leaf lamina wholly bistratose above shoulder ........................................................................... P. australé

2: Most leaves when fully wetted tapering gradually to the apex, without a distinct shoulder,
apices acutely pointed; bistratose region of upper lamina confined to margins and apex and
(if present) scattered longitudinal rows or patches of cells ...................................................... P. acutifolium

Ptychomitrium Fürnr., Flora (Jena) 12(2): 19 (1829)

Plants green to dark green in newer growth, brown to black in older growth, in cushions. Stems erect, often branched, with a well-developed central strand. Leaves contorted to strongly crisped when dry, spreading when wet, linear-lanceolate to broadly lanceolate or ovate-lanceolate, sometimes keeled; margins plane or recurved, entire to coarsely toothed in upper half; margins and all or part of leaf lamina often bistratose in upper half; cells thick-walled and densely chlorophyllose in upper leaf, larger and colourless in leaf base.

Autoicous, perigonia immediately below perichaetia. Perichaetial leaves similar to vegetative leaves. Seta smooth, length various, straight to flexuose. Capsule erect, symmetrically oblong-ovoid to ovoid, peristome of 16 deeply divided lanceolate to linear-lanceolate teeth, densely papillose; annulus of a single row of thick-walled cells, present or not. Operculum almost flat to conic with a short to long beak. Calyptra mitrate, split at the base into several lobes, covering the operculum and 1/3 to all of the urn. Spores spherical, papillose or smooth.

Ptychomitrium acutifolium Hook.f. & Wilson, Fl. Tasman. 2: 180 (1859).


Type: Australia, Tasmania, 'On banks and trap rocks near the Derwent, Glen Leith', without date, J.D. Hooker s.n. (lectotype fide Cao et al. (2005): BM-575709!d; isolecotype: H not seen); 'On rocks: Port Sorrell', without date, Archer s.n., (paralectotype fide Cao et al. (2005): BM not seen) =Ptychomitrium laxifolium (Müll.Hal.) Paris, Index. Bryol. Suppl. 289 (1900) syn. nov.

Basionym: Brachysteleum laxifolium Müll.Hal., Index Bryol. Suppl. 289 (1900)

Synonyms: Glyphomitrium laxifolium Müll.Hal. (Broth.), Nat. Pflanzenfam. 1(3): 442 (1902)

Type: Australia, New South Wales, Parramatta, Decembri 1884: Whitelegge in Hb. Melbourne', Whitelegge 209 (holotype: MEL-1002626A!).

Plants in dense cushions to about 10 mm tall, green to dark green above when fresh, commonly yellow-green or brownish yellow in herbarium specimens, dark brown to black below. Leaves strongly crisped when dry, spreading widely when moist, linear-lanceolate, mostly 3.0–3.5 × 0.4–0.5 mm, apex acute; margins plane, entire, bistratose in the upper half or more and usually across the extreme leaf apex; upper leaf lamina often also bistratose in longitudinal rows or patches; costa strong, failing just below the apex, narrowed slightly in the leaf base, often thickest in mid-leaf; cells in mid-leaf shortly rectangular, about 7–12 × 6–10 µm; smaller and ± quadrate towards the leaf apex, to about 7 × 7 µm with a rounded lumen; much longer and lacking chloroplasts towards the leaf base, 28–58 µm × 7–10 µm. Perichaetial leaves similar to vegetative leaves but slightly smaller. Seta straight to flexuose, 2.5–3.5 mm long. Capsule erect, oblong-ovoid; urn to about 1.7 mm long; operculum about 1 mm long, weakly convex at the base, with a long straight or slightly inclined beak; peristome single, pale yellow-brown, of 16 lanceolate to linear-lanceolate teeth split almost to the base; annulus present. Calyptra mitrate, split into lobes all around the base, covering the operculum and 1/3 to 1/2 of the urn.

Illustrations: Figs 1, 4a, 5a. Also Cao et al. (2005, figures 1–16, 29–40).
Fig. 1. *Ptychomitrium acutifolium*: a, whole plant, moist; b, typical leaves; c, leaf apex; d, upper leaf lamina; e, transverse sections of leaf; f, transverse section of stem; g, cells in lower leaf; h, marginal cells in leaf base. Drawn by R.D. Seppelt from *Jarman s.n.* (HO-511114). Scale bars: a = 1 mm, b–h = 100 µm.
**Habitat:** Almost exclusively on calcareous or basaltic rock; sometimes also on bitumen; occasionally on siliceous rock close to mortar or concrete.

**Distribution:** WA, SA, Tas, Vic, ACT, NSW, Qld, LHI; also New Zealand. This species appears to be more common in cold-temperate areas, although it extends into warm-temperate regions. It may occur in the Queensland tropics at higher altitudes.

**Discussion:** The original description of *P. acutifolium* was based on material collected by J.D. Hooker near Hobart, and at The Hummocks by Archer (Wilson, in Hooker 1859). Sainsbury (1955a) suggested that this species was identical to *P. australis*. This view seems to have been accepted by Scott and Stone (1976), and Catcheise (1980) formalised the synonymy. However, Cao et al. (2005) recognised *P. acutifolium* and *P. australis* as separate species on the basis of their assessment of the types (see the discussion under *P. australis*). They did not mention that the margins in the upper half of the leaf in *P. acutifolium* are bistratose, and did not illustrate a transverse leaf section, but the thickened margins are readily observable in specimens cited by them, e.g. Streimann 10679, CBG-8008341; Streimann 35711, CBG-566523; Streimann 55838C, CBG-9708351. The shapes of the leaves illustrated in the main illustration by Cao et al. (2005) (Figs 10 and 11) are atypical for the species, although not unusual; those illustrated in their Figs 37–40 are more typical.

Müller (1898) described *Brachysteleum laxifolium* (= *Ptychomitrium laxifolium*) from a specimen collected by Thomas Whitelegge, citing the type material as 'Paramatta, December 1884: Whitelegge in Hb. Melbourne, cum fructibus senioribus deoperculatis.' The type material must therefore include that portion of the original material in MEL (MEL-1002626A). Müller presumably retained some of the original material (which would be an isotype) in B, but there is no record of it and it is likely to have been destroyed during the bombing of Berlin in the Second World War. Another specimen collected by Whitelegge in 1884 at Parramatta (NSW-779257) might be an isotype, but I have not seen it. Numerous other specimens identified as *P. laxifolium* are in NSW, but unfortunately I have not had the opportunity to examine them. Whether they are all *P. acutifolium* is uncertain.

The majority of specimens of *P. acutifolium* from Australia seen in this study have (as well as bistratose margins) occasional to frequent scattered bistratose lines or patches running longitudinally along the leaf (Figs 1d, e). When fresh leaves are viewed by transmitted light, these lines or patches often resemble lamellae because they are a darker green than the rest of the lamina, but the cells in these bistratose areas are much thinner than those in the unistratose parts, so that the leaf is hardly if at all thickened. There does not appear to be any geographical differentiation between specimens with and without these bistratose regions, or those with few and many bistratose regions. Occasional specimens referable to *P. acutifolium* because of the leaf shape have almost the whole upper lamina bistratose, but there are always some areas that are unistratose; in *P. australis* this is never the case. A more detailed study might provide evidence for the recognition of intraspecific taxa of *P. acutifolium*, perhaps at the varietal level.

Cao et al. (2005) suggested that the length of the calyptra (or more correctly, the proportion of the capsule urn that is covered) is a feature that can distinguish *Ptychomitrium acutifolium* from *P. australis*. This is partly true in that plants with very short calyptras will always be *P. acutifolium* (coinciding with long oblong-ovoid urns) and plants with calyptras more or less covering the whole urn will almost always be *P. australis* (coinciding with short ovoid urns). However, the calyptra length relative to the urn in both species is often intermediate because of the variability in the urn shape and length and also the maturity of the capsule. Young capsules naturally having the calyptra covering the urn in both species, and cannot always be relied upon to distinguish the species. Figures 35 and 36 in Cao et al. (2005) show two calyptras in *P. acutifolium* that are intermediate in length. Also, one specimen of *P. acutifolium* seen in this study (MEL-1002710A, from Tasmania) had calyptras more or less covering the capsules.

Cao et al. (2005) suggested that capsule shape could be used to distinguish the species because capsule urns in *Ptychomitrium acutifolium* are usually oblong-ovoid whereas in *P. australis* they are usually ovoid, but capsule shape is very variable in both species and cannot be used as a distinguishing character. Cao et al. (2005) treated *Ptychomitrium acutifolium* as an Australian endemic, but it is also in New Zealand, as evidenced by specimens in MELU (see representative specimens seen).

*Ptychomitrium acutifolium* has sometimes been confused with *Weissia controversa* Hedw., possibly because of the similar curving of the leaves and similar leaf shape. However, *W. controversa* is a smaller plant, the cells are distinctly papillose, the leaf margins are not bistratose, and the seta is much longer (6–8 mm).

The genus *Ptychomitrium* Fürn. Telopea 20: 49–60, 2017


Synonyms: *Brachysteleum adamsonii* (Mitt.) F. Muell., Frag. Suppl. 48 (1881), synonym fide Dixon (1926).


Type: 'Australia; common on trap-rocks, Melbourne, Mr. Adamson, No. 60' (syntypes: NY-1162728!d, NY-1162729!d).


Type: Zimbabwe, 'Matopos, alt. 5,000 feet (Sim, 8851); Zimbabwe, alt. 3,000 feet (Sim, 8808); on granite rocks, Macheke, alt. 5,000 feet (Eyles, 1994)' (cotypes: BM-870505!d [Sim 8851], BM-870506!d, PC-129577!d [Sim 8808], BM-870507!d [Eyles 1994]; see note at the end of the Discussion below).


= *Ptychomitrium howei* Hampe ex Kindb., Enum. Bryin. Exot. 73 (1888), nom. inval. (Art. 61, orth. var.).

Type: Australia, 'Lord Howe's Island, ad rupes' (isotypes: BM-575703!d, BM-575704!d; NY-1225876!d).


Type: ‘Australia, New South Wales, Sydney, Domina Kaysser in Hb. Geheeb’ (location unknown, not seen).


Type: ‘Australia, Victoria, Rocky Mountains, called the Glass-houses, Moreton Bay, and Brisbane River, Dr. Ferd. Mueller’ (isosyntypes: NY-1163054!d, NY-1163055!d; BM-555228!d, BM-1006973!d).


Plants in dense cushions to about 20 mm tall, green to dark green above (commonly yellow-green or brownish yellow in herbarium specimens), dark brown to black below. Leaves strongly crisped when dry and upper lamina involute, spreading widely when moist, lingulate-subulate from an ovate base, mostly 3.0–4.5 mm × 0.4–0.5 mm, apex usually obtusely pointed and often cucullate; margins plane, entire; lamina bistratose throughout the subula, giving it a much darker appearance than the leaf base in transmitted light; margin often tristratose; costa strong, failing just below the apex; cells in mid-leaf shortly rectangular, about 7–13 × 6–7 µm, becoming smaller and roundly subquadrate to quadrate towards the leaf apex and leaf margin (to about 7.0 µm wide and long) and much longer and lacking chloroplasts towards the leaf base (19–56 µm × 7–14 µm). Perichaetal leaves similar to vegetative leaves but slightly smaller. Seta straight to flexuose, 2–6 mm long. Capsule erect, urn oblong-ovoid, to about 1.7 mm long, operculum almost flat, with a long beak about 1 mm long; peristome single, of 16 lanceolate to linear-lanceolate teeth split almost to the base; annulus present. Calyptra mitrate, split into lobes all around the base, covering 1/2 to 2/3 of the urn.


Habitat: Almost exclusively on calcareous or basaltic rock; sometimes also on bitumen; occasionally on siliceous rock close to mortar or concrete; rarely on thin soil over rock.

Distribution: Circumglobal in south-temperate to tropical regions, including South Africa, New Zealand, New Caledonia, Vanuatu and South America. This species appears to be a largely tropical to warm-temperate species that extends into cold-temperate regions.

Discussion: The description and illustration of Ptychomitrium australe by Sainsbury (1955b), who did not see the type, matches that of P. acutifolium in all aspects except the size of the calyptera, which he described as ‘covering the capsule’. His illustration also shows a very large calyptera relative to the capsule, but whether the scale given is correct is difficult to judge as it was clearly added (in set type) afterwards, all other scales being written by hand. It is noteworthy that he described only the leaf margin as being bistratose in the upper half of the leaf; that is, the entire upper lamina is not bistratose as in true P. australis (Figs 2c,e; also Cao et al. 2005, figure 27, as P. muelleri).

Scott and Stone (1976) described Ptychomitrium australe more or less as Sainsbury did, although noting that the leaf is bistratose also across the leaf tip. They pointed out that Sainsbury had suggested that P. acutifolium was the same species, but made no judgement themselves. Catcheside (1980) accepted Sainsbury's view.
Fig. 2. Ptychomitrium australic: a, whole plant, moist; b, typical leaves; c, leaf apex; d, marginal cells near leaf base; e, transverse sections of leaf; f, transverse section of stem. Drawn by R.D. Seppelt from Stone 22709 (HO). Scale bars: a, b = 1 mm, c–f = 100 µm.
Cao et al. (2005) demonstrated convincingly, by their examination of the types and other specimens, that *P. australe* and *P. acutifolium* are different species. Unfortunately they did not mention the most obvious difference, which is that the leaf lamina in *P. australe* is bistratose throughout the upper half of the leaf, whereas in *P. acutifolium* the bistratose region comprises only the margins and apex and (in most plants) scattered linear rows or patches of cells in the upper half of the leaf (compare Figs 2 and 4).

Cao et al. (2005) also did not compare either species with the widespread *P. muelleri*, which Cao et al. (2001) had described and illustrated in detail. I have examined numerous species cited by Cao et al. (2001) and Cao et al. (2005), and it is evident that these two species are the same. For example, Cao et al. (2005) identified six collections as *P. australe* (Streimann 15422, 27908, 50086, 52769 and Telford 5218), that Cao et al. (2001) had previously identified as *P. muelleri*. *Ptychomitrium muelleri* (being the later name) must become a synonym of *P. australe*. The protologue of *P. muelleri* contains a geographic confusion, since the localities mentioned (Glass-houses = Glasshouse Mountains, Moreton Bay, and Brisbane River) are in Queensland, not Victoria. It is noteworthy that NY-1163054 is annotated ‘On the Rocky Mountains called the Glasshouses Moreton Bay Dr. F. Mueller’, whereas NY-1153055 is annotated ‘Brisbane River Victoria Dr. F. Mueller’.

My suggestion is that the collection from ‘Brisbane River, Victoria’ was actually from the Brisbane Ranges in Victoria, near Melbourne, and the coincidence of ‘Brisbane’ (the city where the Brisbane River runs into Moreton Bay) might have caused a mistaken transcription of the handwritten locality, especially if abbreviated to ‘Brisbane Ra’. Whatever the case, the two specimens appear to be from different gatherings. If this is shown to be the case, a lectotype would need to be designated.

The report of *P. australe* from Tasmania by Scott and Stone (1976) was based on MUCV-1092 from Twisted Lake, Cradle Mountain National Park, according to an annotation on that specimen. However, that plant, which was growing as an epiphyte on *Nothofagus gunnii*, is *Ulota lutea* (Hook.f. & Wilson) Mitt.

Most reports of *P. australe* from New Zealand are likely to be *P. acutifolium*, judging from the description of *P. australe* by Sainsbury (1955b) and the slightly different geographic distributions of these species. However, genuine *P. australe* does exist there, as demonstrated by a specimen in MELU (see representative specimens seen).

*Ptychomitrium australe* has been commonly confused with *Holomitrium perichaetiale* (Hook.) Brid. when sterile, because the two species are very similar in size and leaf shape. However, *H. perichaetiale* can be distinguished by its unistratose leaf lamina, and by the costa, which is usually excurrent in a small colourless apicus. When fertile, *Holomitrium perichaetiale* is further distinguished by its long, sheathing perichaetial leaves. Furthermore, *H. perichaetiale* is commonly epiphytic (although it also grows on rock), whereas *P. australe* appears to be confined to rock or soil over rock.

Brown (1902) described *Grimmia turneri* from New Zealand, based on material he collected from Mount Torlesse, and *G. barrii* based on material he collected from around Weston, near Oamaru. Dixon (1926) synonymised *G. turneri* and *G. nigra* (Brown MS, in herb.) under *Ptychomitrium australe* and transferred *G. barrii* to *Ptychomitrium*. However, it is not clear whether he had the correct concept of *P. australe* when this was done, so I have not included *G. turneri* in the list of synonyms for *P. australe*. I am unable to comment on the identity of *P. barrii* as I have not seen any material of this species.

Guo & Cao (1999) stated that ‘Dixon published *P. eurybasis* based on a collection by Sim from Zimbabwe in 1922’. This is not correct, as seen from the type citation given in the list of synonyms above. (This error was repeated by Cao et al. (2001), who also gave the incorrect page number for the protologue.) Until a lectotype is selected, all type material (all of which are ex herb. Dixon) must therefore be considered to be syntypes.


**Synonyms:** *Brachysteleum mittenii* (A.Jaeger) Hampe, *Frag. Suppl.* 110 (1881).
Fig. 3. *Ptychomitrium mittenii*: a, whole plant, moist; b, typical leaves; c, calyptra; d, transverse sections of leaf; e, cells in (1) upper leaf margin, (2) mid-leaf margin, (c) lower leaf; f, transverse section of stem; g, leaf apex (toothed and untoothed examples); h, marginal cells in leaf base. Drawn by R.D. Seppelt from Seppelt 29172 (HO-566175). Scale bars: a–c = 1 mm, d–h = 100 µm.

Type: Australia, Tasmania, north side of the Cataract, Launceston, on rocks, date unknown, Archer s.n., ? herb. Mitten in NY, not seen.


Type: ‘On rocks: north side of the Cataract, Launceston, Archer’

Plants in dense cushions to about 30 mm tall, in life green to olive above (becoming yellow-green to yellow-brown in herbarium specimens), reddish brown to black below; leaves moderately crisped when dry, spreading widely when moist. Leaves lingulate-subulate from an ovate base, mostly 2.2–3.2 mm × 0.6–0.8 mm, plicate, apex acute; margins usually weakly recurved in the lower half, coarsely serratate towards the apex (occasionally ± entire), bistratose to tristratose in the upper part of the leaf; lamina usually irregularly bistratose in longitudinal rows or patches in the upper leaf; costa strong, failing just below the apex; cells arranged in regular longitudinal rows, in mid-leaf quadrate to shortly rectangular, about 6–8 × 6–11 µm, thick-walled with a rounded lumen, becoming smaller and subquadrate to quadrate towards the apex, much longer and lacking chloroplasts towards the leaf base except at the margins (to about 60 µm long), those in the extreme leaf base usually porose. Often polysetous. Perichaetial leaves similar to vegetative leaves but slightly smaller. Seta straight, 2.0–5.5 mm long. Capsule erect to slightly inclined; urn oblong-ovoid, 1.0–1.5 mm long; operculum to about 1.1 mm long, conical with a long beak; peristome single, of 16 finely and densely papillose teeth split almost to the base into pale to dark pink to orange filiform segments with paler tips; annulus present. Calyptra mitrate, split into lobes all around the base, covering 1/2 to 3/4 of the urn.

**Illustrations:** Figs 3, 4c, 5c. Also Wilson (in Hooker 1860, plate CLXXIII, figure 3) as *P. serratum*.

**Habitat:** Grows on rock in shaded situations; also occasionally on coarse-grained soil, and very rarely epiphytic.

**Distribution:** Tas, Vic, NSW, southern Qld; apparently endemic to south-eastern Australia.

**Discussion:** This species often grows with *P. acutifolium* or *Holomitrium perichaetiale*, or sometimes both, and can be easily overlooked when dry because the upper margins may be inrolled, hiding the marginal teeth. However, when wet the teeth are easily discernible under a hand lens. As in *P. acutifolium*, the upper leaf lamina in *P. mittenii* is usually bistratose in scattered longitudinal rows or patches. This character has not been reported previously.


**Acknowledgments**

I am extremely grateful to Rod Seppelt for allowing the use of his superb illustrations, and also for his insightful comments on the manuscript, which have greatly improved the paper. I am also grateful to Chris Cargill and Judith Curnow (CANB) for organising access to the collections in the Australian National Botanic Gardens, Canberra, and likewise Pina Milne (MEL) for access to the collections held at the National Herbarium Melbourne, Royal Botanic Gardens, Victoria. I am also grateful to an anonymous reviewer who made a number of corrections that I have incorporated into the paper. Digital images of types were obtained through the JSTOR Global Plants initiative via The University of Melbourne's portal. This study was undertaken as part of the author's doctoral studies at The University of Melbourne. Field-work was supported by a grant from The University of Melbourne Botany Foundation through the G.A.M. Scott Research Award.
The genus *Ptychomitrium* Fürnr. Telopea 20: 49–60, 2017

**Fig. 4.** Partial peristomes: **a**, *P. acutifolium* (Meagher LH-128); **b**, *P. australis* (Scott s.n., MELU-1741); **c**, *P. mittenii* (Scott s.n., MELU-2754). Scale bars: 100 μm.

**Fig. 5.** **a**, *P. acutifolium* (Scott s.n., MUCV-1274, herbarium specimen); **b**, *P. australis* (Meagher LH-348B); **c**, *P. mittenii* (Meagher 0159, MELU, herbarium specimen). Scale bars: 5 mm.

**References**


Sainsbury GOK (1955b) A handbook of New Zealand mosses, Royal Society of New Zealand Bulletin No. 5,
Royal Society of New Zealand, Wellington.
No. 17, Australian Biological Resources Study, Canberra.

Manuscript received 18 May 2016, accepted 26 September 2016