THE FAMILY SEMATOPHYLLACEAE (BRYOPSIDA) IN AUSTRALIA,
PART 2. ACROPORIUM, CLASTOBRYUM, MACROHYMENIUM,
MEIOTHECIELLA, MEIOTHECIUM, PAPILLIDIOPSIS,
RADULINA, RHAPHIDORRHYNCHIUM,
TRICHOSTELEUM, AND WARBURGIELLA

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ABSTRACT. The ten Australian genera not dealt with in the Sematophyllaceae Part 1 are discussed. Eight of these are the primarily tropical or subtropical genera (Acroporium, Clastobryum, Macrophymenium, Meiotechiella, Meiotechium, Papilliopsis, Radulina, Trichosteuleum) with a total of 17 species. Many of these are confined to northeast Queensland with only a few extending south to subtropical northeastern New South Wales. In addition the genera Rhaphidorrhynchium, with a single species and two varieties, and Warburgiella, with three species, are discussed. Although these latter two genera extend into the tropical and subtropical regions they are more widespread in southern temperate Australia. Illustrations of all species and maps representing the Australian distributions are provided.

INTRODUCTION

In Part I of our analysis of the Sematophyllaceae in Australia we dealt with the family and its characteristics (Ramsay, Schofield & Tan 2002b) and considered the various views on its classification. A key to all Australian genera in the family was provided and the three genera Wijkia, Acanthorrhynchium, Trismegistia, each with a single species, and Sematophyllum with five species, were dealt with in detail. In Part 2 we discuss the ten remaining Australian genera, Acroporium, Clastobryum, Macrophymenium, Meiotechiella, Meiotechium, Papilliopsis, Radulina, Rhaphidorrhynchium, Trichosteuleum, and Warburgiella, with a total of 21 species. The genus Taxithelium, with six species, (Ramsay, Schofield & Tan, 2002a) has been published, while several other taxa sometimes included in the family, e.g., Isocladiella, Pseudohypnella, are to be published separately from the rest of the family as their placement in the Sematophyllaceae has been disputed. Genera are arranged alphabetically in the following study.

[Etymology: The generic name refers to an apical pore or channel – it may refer to the branches ending in tubulose points, or to the furrowed peristome teeth].

Autoicous, dioicous or phylloidioicous. Plants slender to robust, glossy, forming dense

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yellowish-green mats. Stems elongate, creeping, pinnately branched; branches suberect, rigid, densely foliate frequently cuspidate at tips. Leaves erect to nearly squarrose, wide-spreading, sometimes strongly secund, recurved or roughly concave, ovate-lanceolate from a more or less cordate-auriculate base, short to subulate pointed, apex sometimes subtubular, margin entire or faintly denticulate near apex; ecostate. Laminal cells linear, smooth, often thickened and porose, or with single papilla on upper leaf cells; alar region usually a single basal row of 2–3 inflated, coloured cells curving inwards at base; supra-alar cells 1 to 2 rows of quadrate coloured cells, present in a few species. Perigonia on branches; perichaetia on stems or branches; inner perichaetal leaves erect, from a sheathing base, abruptly or gradually long pointed, apices serrulate, alar cells not strongly developed. Calyptra cucullate, smooth. Seta elongate, slender, red, tuberculate above, usually strongly papillose; capsules suberect to nodding, ovoid to elongate-cylindric, short-necked; exothecial cells collenchymatous, operculum from a conic base, long, finely rostrate; peristome double, exostome of 16 lanceolate teeth, finely striate with median zig zag line; endostome segments yellowish, basal membrane wide, segments same length as exostome teeth, broad-keeled; cilia single, short, occasionally rudimentary. Spores large, sometimes varying in size. No chromosome number available.

There are more than 80 species validly published for the genus Acroporium, which is restricted to tropical and subtropical regions. The genus is common in the palearctic including Indo-Malesia with 22 species and 5 varieties, in western Malesia (the Philippines, Borneo and Java), also in Indochina, China, Japan, Africa, tropical America and the Pacific. In Australia there are four species, all distributed in and confined to tropical northeast Queensland.

The genus has been clearly delimited by Tan (1994). It can be distinguished by the ovate-lanceolate leaves, a concave lamina with incurved to involute margins, a somewhat involute to tubulose apex and a well differentiated alar region consisting of 3–5 large, oblong-kidney shaped cells that are light coloured and thin-walled. The outermost alar cells on both sides of the leaf base are the largest and the most curved. The median laminal cells are narrowly oblong to elongate, rarely linear, and are arranged in oblique rows, with walls strongly incrassate and porose; margins are generally entire except for a few teeth near the apex. Perichaetial leaves lack differentiated alar cells but have a coloured and expanded base sheathing the vaginula. The seta is usually papillose or tuberculate, at least near the base of the capsule.

The leaves of Acroporium, which should be examined when moist, are of two types: the “stramineum-type” which is broadly ovate to ovate-lanceolate with an acute to short acuminate or cuspidate tip; the slender apical portion is at most 1/3 of the entire leaf length, the basal part is expanded, cordate, with strongly curved marginal alar cells; and the “strepsiphyllum-type”, with a more narrowly lanceolate leaf which tapers gradually from base to leaf tip, the lamina is more or less incurved throughout, and becomes tubular or subulate apically; the tapering upper portion of the leaf comprises more than 1/3 of whole leaf length with the basal portion not clearly cordate and the alar cells are nearly straight throughout.

The species are epiphytic on branches and in tree crowns, or occur on decaying logs.
along trails within forests. A few are epiphyllous in humid lowland rainforests. *Acroporium* is abundant in semi-open to semi-dry habitats in tropical rainforest.

Streimann and Curnow (1989) reported four *Acroporium* species from Australia based on earlier publications. Of these, *A. scalarirete* Dixon has been moved to *Eucamptodon* as *E. scalarirete* (Dixon) B.C. Tan, H.P. Ramsay & W.B. Schofield (Tan et al., 1996).

The Australian report of *A. rufum* (Reinw. & Hornsch.) M. Fleisch. in Streimann and Curnow (1989) is based on a confusion of the synonymy between *Leskea rufa* Hornsch. & Reinw. and *Macrohymenium rufum* Müll. Hal. Brotherus and Watts (1918) first reported *M. rufum* for the Australian moss flora. The fact that the two authors accepted *Macrohymenium* in their publication and placed the species under Rhegmatodontaceae indicates that their specimens from Malanda and Ravenshoe were a *Macrohymenium* and not an *Acroporium* as reported in Streimann and Curnow (1989).

*Acroporium kerianum* Broth., a *nomen nudum*, represents a very long leafed specimen of *Trichosteleum wattsii* (Paris) B.C. Tan, W.B. Schofield & H.P. Ramsay. Lastly, the only surviving species of Australian *Acroporium*, *A. erythropodium* (Hampe) Broth., is here considered to be a synonym of the widespread Malesian *A. stramineum* (Reinw. & Hornsch.) M. Fleisch.

During this revision, three taxa of *Acroporium* have been added to the Australian moss flora, namely, *A. lamprophyllum* Mitt. var. *percaudatum* (E.B. Bartram) B.C. Tan, H.P. Ramsay & W.B. Schofield (in Tan et al., 1996), *A. microcladon* (Dozy & Molk.) B.C. Tan var. *rhizogemmae* B.C. Tan, W.B. Schofield & H.P. Ramsay (in Tan et al., 1998) and *A. strepsiphyllum* (Mont.) B.C. Tan.

**Key to species**

1. Plants robust; leaves broadly ovate to oblong-lanceolate, more than 0.5 mm wide .......... 2
2. Leaves broadly ovate to ovate-lanceolate, acute to short acuminate .......... 1. *A. stramineum*
3. Plants with numerous erect, slender penicillate branchlets; no rhizoidal gemmae produced at branch tips ............................................. 3. *A. lamprophyllum* var. *percaudatum*
4. Plants lacking erect, slender branchlets; clusters of rhizoidal gemmae produced at branch tips .............................................................. 4. *A. microcladon* var. *rhizogemmae*


*Autoicous. Plants* robust, glossy, yellowish to golden-green creeping; *stems* long,
pinnate, forming compact wefts or tufts; branches prostrate, 0.5–1 cm long, densely arranged. Stem and branch leaves erect-spreading, 1.5–2 mm × 0.5–0.75 mm, often falcate towards apex, apical group imbricate-cuspidate, ovate to ovate-lanceolate, concave, apex acute to very short acuminate, subtubulose above, margins entire above, at base strongly cordate-auriculate. Laminal cells linear, 55–80 μm × 3–5 μm, thick-walled, porose towards ends, some upper cells unipapillose; alar region well differentiated with 3–5 enlarged, coloured basal alar cells, outer ones often curved inwards towards stem; basal cells across insertion orange. Perigonia on branches; perichaetia usually on secondary stems. Seta 1–2.5 cm, long, papillose above; capsules 0.8–1.0 mm, narrowing towards apex; exothecial cells strongly collenchymatous; operculum long rostrate; peristome well developed, exostome teeth striate below, papillose above; endostome segments finely papillose. Spores 10–15 μm. Fig. 1.

Distribution: Widespread from S China, Indochina, Sri Lanka, Malesia, to Oceania and northeast Australia.

In Australia, A. stramineum (as A. erythropodium) is a common species in northeast Queensland from the Windsor Tableland south to Cardwell. Although we have not seen the type of Hypnum erythropodium, all the herbarium specimens so named belong to A. stramineum. Map 1, Fig. 28.

Habitat: Epiphytic on stems and branches in upland forests.

Notes: This is a distinct, relatively robust species of Acroporium characterised by the yellowish-green to golden-green colour and broadly ovate leaves with acute apices and cordate-auriculate bases; the 3–5 large outer alar cells occur in the auricle and their tips curve in strongly towards the stem. The species differs from A. strepsiphyllum which is similar in appearance but often more golden in colour with narrower leaves and more acuminate apices. Plants of A. stramineum are often similar in general appearance to the sterile plants of Eucamptodon scalarirete (Dixon) B.C. Tan, H.P. Ramsay & W.B. Schofield (syn A. scalarirete Dixon), and are often misidentified as this, but E. scalarirete is a greener, smaller plant with smaller leaves (only ca. 1.0 mm long) and with a distinctly different scalariform alar region.

Studied specimens:

Queensland: Tully Gorge N.P., 25 km S.E of Ravenshoe, G.E. Kantak & S.P. Churchill 838 (NSW); Tree above Tully Falls, WW Watts Q591 (NSW); Majors Falling, Ravenshoe, WW Watts Q588 (NSW); Windsor Tableland, H. Streimann 29593 (CANB), I.G. Stone 16045, 15975 (MELU), 15996 (MEL); Echo & Davidson Creeks, Cardwell Ra., H. Streimann 29109 (CANB); Walter Hill Range, H. Streimann 30469 (CANB); Upper Downey Creek, I.G. Stone 19271 (MELU); near Mt Molloy, H. Streimann 27148 (CANB); Kennedy Falls, W.B. Schofield 90329, 90332 (UBC, NSW); Atherton Forest Reserve No 194, B. de Winter 1036 (NSW); Malanda, WW Watts Q625 (NSW); Car-

Fig. 1. Acroporium stramineum: a. habit with sporophytes; b. capsule enlarged showing peristome teeth; c. perichaetial leaf; d. apex of (c) enlarged; e. vegetative leaf from type specimen; f. vegetative leaf; g. apical cells of branch leaf; h. mid-laminal cells of branch leaf; i. alar region of branch leaf; j. peristome: endostome segment (left), exostome tooth (right); k. spores; l. exothecial cells. Scale bars — a–c, e–f = 1 mm; g–l = 100 μm [a–c, g–i, as A. erythropodium, WW Watts Q591 (NSW); f, I.G. Stone 15975 (MEL)].
1. Hattori Bot. Lab. No. 95

ron Creek Road, Cardwell, I.G. Stone 16536 (MELU); Thornton Peak, H. Flecker 7081 (CANB ex QRS); Mt Haig, Lake Tinarioo, W.B. Schofield 43805 (NSW, UBC); Josephine Falls, Mt Bartle Frere, B.C. Tan 94-599 with E.A. Brown & R.G. Coveny (NSW, FH); Mt Lewis Road, B.C. Tan 94-736 (NSW, FH); Mt Baldy, 4 km S of Atherton, H. Streimann 29291 (CANB); Cardwell Range, H. Streimann 28530, 29069 (CANB); Lamb Range, Atherton, H. Streimann 29834 (CANB); NW of Mt Molloy, H. Streimann 30370 (CANB); Culpha Catchment, Cardwell Range, H. Streimann 29064, 29016 (CANB); Walter Hill Range, 26 km SSE of Ravenshoe, H. Streimann 30493 (CANB); Mt Bartle Frere, south slopes, B.O. van Zanten 68.1454A, 68.1525, 68.1502 (GRO, NSW); Summit of Black Mtn, 50 km NW of Cairns, B.O. van Zanten 68.1343, 68.1346B, 68.1337C, 68.1347D (GRO, NSW); Mt Lewis, below summit, B.O. van Zanten 68.1185 (GRO, NSW); near Mossman, B.O. van Zanten 68.1398 (GRO, NSW); Thornton Peak, D.H. Norris 44073 (BRI, CANB); Mt Finnigan, H. Streimann 57232, 57255 (CANB); Kirrima, I.G. Stone 16536 (MEL); Tully, I.G. Stone 16663 (MEL).


Previous illustration: Tan (1994), figs. 78-87, p. 287.

Dioicus. Plants small to robust, glossy, yellow to golden green. Stems irregularly branched, forming loose mats or wefts: branches to 2.5 cm long somewhat complanate. Leaves erect-spreading, often falcate, oblong-lanceolate, 2-3 mm x 0.2-0.3 mm, subtubulose, long acuminate, minutely denticulate near apex. Laminal cells linear, 45-70 μm x 3-4 μm, smooth, incrassate, strongly pitted; alar region well defined with 3-4 basal cells, large, thin-walled, oblong, kidney-shaped, curved inwards at base, supra-alar cells several, irregular in shape. Perichaetia on branches; perichaetial leaves abruptly narrowed into a short or long acumen, with little denticulation on one shoulder. Seta at least 15 mm long, smooth below, papillose above; single squashed capsule seen, no details of peristome possible to observe. Fig 2.

Distribution: In tropical Asia, widespread and common in east and west Malesia, rare in Australia.

In Australia the species is so far known from two collections in northeast Queensland. Map 3, Fig. 28.

Habitat: Epiphytic in upland rainforest.

Notes: Acroporium strepsiphyllum was reported erroneously in early publications as A. secundum (Reinw. & Hornsch.) M. Fleisch. This nomenclatural misapplication was clarified by Tan (1994). Acroporium strepsiphyllum, like A. stramineum, is a robust polymorphic species. Typical leaves of A. strepsiphyllum are characteristically narrowly lanceolate to oblong-lanceolate, short to long acuminate, and lack a well defined cordate base. Although somewhat similar in appearance to A. stramineum the more oblong-lanceolate leaf outline and the longer acuminate apex distinguishes it. This is the most variable and widespread species of Acroporium in Malesia.

A study of peristome details was not possible as only young sporophytes and one old squashed capsule were found in the Australian collections.

Studied specimens:
Fig. 2. *Acroporium strepsiphyllum*: a. habit with young sporophyte; b. capsules showing peristome; c. leaves; d. apical leaf cells; e. mid-laminal cells; f. basal alar region; g. perichaetia at base of seta. Scale bars — a–c, g = 1 mm; d–f = 100 μm [D.H. Norris 43914, UC].


This species has an Indo-Malesian distribution including the Philippines, Papua New
Guinea, also Indochina and Oceania. *A. lamprophyllum* var. *lamprophyllum* has not been recorded from Australia. *Acroporium lamprophyllum* var. *percaudatum* is present, but rare, in northeast Queensland. Map 2, Fig. 28.


Previous illustration: none.

**Dioicus.** Plants slender, golden-green, slightly glossy, in dense mats; stems creeping, closely bipinnate, branches procumbent or suberect, often penicillate, tips cuspidate. Leaves erect often slightly falcate, narrowly lanceolate, 0.8–1.0×0.3 mm, concave, acuminate, subtubulos above, minutely denticulate near apex, margins entire, involute above. Laminal cells oblong-elongate, 32–55×5–6 μm, unipapillose at back; alar region with a basal group of 3–4 large hyaline or coloured cells, cells across insertion coloured. Perichaetia borne on primary stems, perichaetial leaves abruptly narrowing to an acuminate apex, toothed in upper half. Sporophytes not seen. Fig. 3.

**Notes:** This is a distinctive species characterised by the slender habit. The oblong leaves with an acuminate apex are erect spreading or falcate, at times being homomallous on some branches. Only *A. diminutum* and *A. lamprophyllum* produce perichaetia and setae from primary stems; in other species, perichaetia and setae are borne on secondary stems and branches. The small size of this species makes it easy to overlook. *A. lamprophyllum* var. *percaudatum* is similar to *A. lamprophyllum* var. *lamprophyllum* in branching habit, leaf orientation, leaf morphology and sporophytic details. It differs in being larger, more golden in colour with fewer vertical elongate penicillate shoots. Laminal cells are strongly unipapillose whereas they are smooth or slightly papillose in var. *lamprophyllum*. Sporophytes not seen in Australian collection.

**Studied specimens:**

Queensland: Mossman River Gorge, near Daintree, B.C. Tan, 94-700, 94-702 with E.A. Brown & R.G. Coveny (FH, NSW); Blencoe, Cardwell Range, H. Steimann 36867 (CANB); Mossman Gorge, I.G. Stone 15864 (MELU); Sullivan’s Track near Cardwell, W.B. Schofield 90426 (NSW, UBC); Mossman’s Gorge, W.A. Weber & D. McVean B-31690 (CANB, COLO); Golboro track to Boulders, Bellenden Ker Range, W.B. Schofield 90179A (NSW, UBC); Downey Creek, Innisfail, I.G. Stone 24704 (MEL); Kennedy Falls, I.G. Stone 24398 (MEL).


The species is widely scattered in Malesia but the variety *microcladon* has no Australian specimen record. In Australia *Acroporium microcladon* is represented by var. *rhizogemmaceae* which occurs in northeast Queensland.

4a. *Acroporium microcladon* var. *rhizogemmaceae* B.C. Tan, W.B. Schofield & H.P. Ram-
Fig. 3. *Acroporium lamprophyllum* var. *percaudatum*: a. Branch leaves; b. leaf from flagelliferous shoot; c. apex of perichaetial leaf; d. perichaetium with archegonia; e. leaf apical cells; f. mid-laminal cells; g. basal alar region; h. habit; i. habit with flagelliferous shoot. Scale bars—a–d, h–i=1 mm; e–g=100 μm [W.B. Schofield 90426 (UBC, NSW)].


Plants small and slender, creeping, stems pinnate, branches short, 1.5–2.2 mm. Leaves small to 1.0 mm, concave, somewhat ranked, ovate-lanceolate, nearly entire; laminal cells oblong-elongate, 40–50 μm×3–4 μm, incrassate, smooth and occasionally weakly unipapillose; alar region differentiated, alar cells 2, enlarged, coloured, with thick walls, a few smaller ones present; supra-alar cells few. Gemmae of segmented fusiform structure on adaxial surface of leaves at or near branch apex. Perigonia not seen; perichaetia on base of branches, perichaetial leaf margins clearly toothed in upper half. Seta 10–15 mm long, smooth; capsule 1 mm long, mouth wide; exothecial cells mostly collenchymatous; peristome double, exostome teeth 16, striate below, papillose above, 250 μm long, endostome segments 16, from a broad base, narrow, papillose, same length as exostome teeth; cilia not seen. Spores 18–20 μm. Fig. 4.

This seems to be an endemic Australian variety which occurs in northeastern Queensland. Map 4, Fig. 28.

Habitat: A. microcladon var. rhizogemmae grows as an epiphyte on tree trunks and branches in rainforest.

Notes: Acroporium microcladon var. rhizogemmae shows some degrees of leaf dimorphism. The branch leaves are often become broadly ovate in outline and weakly toothed at the obtuse apex. The distinct and abundant gemmae are produced from a cluster of rhizoid branches that are attached to the adaxial surfaces of the leaves at or near the branch tips, resulting in a brownish bud-like structure. The gemmae are segmented and fusiform with thick papillose walls.

Specimens consisting of leafy branches that lack the rhizoidal branch tip can be mistaken for Clastobryum conspicuum M. Fleisch. The latter, however, has a capsule with non-collenchymatous exothecial cells and smooth peristome teeth. The report of C. conspicuum from Australia (Tan, Ramsay & Schofield, 1996) was based on a non-gemmiferous specimen of Acroporium microcladon var. rhizogemmae. Thus C. conspicuum should be excluded from the moss flora of Australia. Clastobryum sp. recorded by I.G. Stone (1982) belongs to this variety.

Studied specimens:
Queensland: Top of Bellenden Ker, near Telecommunication station, W.B. Schofield 90258 (as Clastobryum conspicuum, UBC, NSW); Woopen Creek, I.G. Stone 15095, 18144, 18165 (MELU); Cardwell, Stony Creek, I.G. Stone 14879 (MEL); Cardwell, Dallachy Creek, I.G. Stone 16431, 16445 (MEL); Cardwell, near Sullivan Track, W.B. Schofield 90408 (NSW), 90401 with I.G. Stone & M.I. Schofield (NSW, UBC); Cooroo logging area, 16 km WNW of Innisfail, H. Streimann 29998 (CANB); Mt Bellenden Ker, I.G. Stone 12133, 15567 (MEL).

Tristichella Dixon, Ann. Bryol. 5: 44 (1932). T: T. spiculifera Dixon; combined with Clastobryum by
Fig. 4. Acroporium microcladon var. rhizogemma: a. vegetative leaves; b. apical cells; c. midlaminal cells; d. alar region; e. habit bearing sporophyte; f. capsule; g. apex of stem bearing gemmae; h. leaf with rhizoids on surface and gemmae; i. gemmae enlarged, note branching; j. perichaetial leaf; k. peristome—exostome tooth (left), endostome segment (right); l. side view of apex of exostome tooth showing trabeculae; m. spore; n. exothecial cells. Scale bars—a, e–j = 1 mm; b–d, k–n = 100 μm [W.B. Schofield 90408 (UBC, NSW)].


[Etymology: the generic name is derived from the Greek 'clasto' and 'bryon' meaning split moss].

Dioecious. Plants slender forming glossy, golden-green sometimes reddish-brown turfs; main stem long, creeping, pinnate with closely arranged erect to ascending, terete or
complanate pinnate branches sometimes long and flagellate. *Rhizoids* short, in clusters, red, smooth to papillose. *Stem leaves* concave, narrowly elongate with acute apex or ovate-lanceolate and long acuminate. *Branch leaves* sometimes ranked, sometimes tristichous, small, narrow ovate-lanceolate, acuminate, base more or less decurrent; costa absent or very short and double. *Laminal cells* narrow elongate, rhomboid-linear, smooth or weakly papillose; alar region with 1 row of subquadrate basal alar cells, swollen, thick-walled and mostly coloured. *Gemmae* filiform, unbranched, papillose, on branch tips or in upper axils of upper leaves. *Perigonia* and *perichaetia* on stems; inner perichaecial leaves lanceolate, contracted to a long denticulate point. *Seta* slender, long, purple, smooth or papillose above; *capsules* erect, long-ovoid; operculum short, curved rostrate; annulus absent; *peristome* double, exostome and endostome alternate, exostome teeth 16, close together when dry, lanceolate, smooth, with low lamellae; endostome segments forming a stellate pattern, extending over mouth, filamentous with a tendency to complete suppression; basal membrane low. *Spores* irregular, small and large. No chromosome number available.

A genus of about ten species distributed in southeast Asia, Japan, the Philippines, Malesia and Australia. In Australia, the genus is confined to northeast Queensland.

Habitat: The genus is epiphytic on bark or epiphyllous.

Two species are accepted for the Australian flora.

Key to species

1. Leaves distinctly tristichous ................................................ 1. *C. dimorphum*
1. Leaves not tristichous ................................................... 2. *C. epiphyllum*


 Dioicus, male and female plants differ in size, female plants larger, glossy, pale green to red-gold. *Stems* prostrate. *Branches* short, numerous, 2.5–5 mm long, 1.5 mm wide, irregularly pinnate, ascending, often penicillate at apex; with long flagelliform branches 3–6 cm long, 1.3–1.5 mm wide, tapering and flexuose, becoming very attenuated at apex, arising from stem or apex of tristichous short branches. *Stem* and *branch leaves* differ, ecostate. *Stem leaves* sparse and scale-like, concave, tapered to abruptly acuminate, point straight or curved, appressed to stem, margin serrate, alar cells not usually swollen. *Branch leaves* larger than stem leaves, 0.8–1.5 mm×0.2–0.25 mm with long point, very concave, mostly cymbiform, equitant and often imbricate, regularly tristichous spreading from stem, abruptly narrowed to a serrated acumen usually with twist and tapered to a long fine point; *laminal cells* of branch leaves narrow, linear-rhomboidal, sometimes sigmoid or flexuose, thick-walled, 70–90 μm×3–5 μm, shorter above and at base, occasionally porose-sinuose; *alar region* with 3–4 basal, swollen, thick-walled, pale to reddish-gold alar cells, often curved, sausage-shaped and prominent; upper alar cells 2–3, smaller, irregularly quadrate to short rectangular; leaves of flagelliform shoots sometimes arranged in more
than 3 rows and distantly spaced, sub-erect to erect and appressed at apex, lanceolate, concave, occasionally cymbiform, abruptly contracted at base to a long piliferous point, flexuose and coarsely toothed, alar cells either not differentiated or similar to those of branch leaves, margin distantly serrate. **Gemmae** filamentous, unbranched, 1.5 mm long, 15–18 μm wide, in clusters between upper leaves, mostly on flagelliform shoots, papillose for most of length, golden. **Male** plants small, stems 10 mm long, branches distant, less regularly tristichous. **Perigonia** on stems; **perichaetial leaves** on main stems of female plants, at base of branch or lateral on a branch, perichaetial leaves often reddish-gold in patches, to 2 mm long, margins serrate to denticate, the upper with sheath-like base, piliferous with denticate and crista marginal cells, at apex contracted to long denticate point. **Calyptra** ca. 3.5 mm long, coiled, split, clasping seta below capsule. **Seta** reddish-gold, 7–12 mm long, twisted counter clockwise above, +/− smooth below; **capsules** ovoid with short neck, constricted below mouth when dry; exothecial cells irregularly rectangular with thickened radial walls, smaller and flatter at rim; exannulate; **peristome** double, exostome teeth 16, lanceolate, whitish, ca. 200 μm × 65–70 μm at base, usually curled back when dry, incurved when wet, with scattered papillae on plates and projecting trabeculae; endostome consisting of low basal membrane with 16 narrow papilllose segments to ca. 100 μm high, erect when dry. **Spores** 12–27 μm, papillose, pale reddish-brown. Figs. 5–7.

**Clastobryum dimorphum** is an Australian endemic. The species is confined to montane forests of northeast Queensland, above 1200 m, e.g., Thornton Peak, Mt Bellenden Ker and Mt Bartle Frere. Map 5, Fig. 28.

**Habitat:** *C. dimorphum* is epiphytic on twiggy branches of shrubs and on trees.

**Notes:** The first specimen was collected by H. Flecker on 15 Dec 1940 at 4500 ft (1350 m) on Thornton Peak (BM #70896) with the unpublished herbarium name, *T. flagellifera* Dixon. The species was finally described based on a collection from Mt Bellenden Ker and published as **Triстиichella dimorpha** by Stone (1987) fide Ramsay & Seur (1994). It was later transferred to **Clastobryum** by Tan & Iwatsuki (1992).

**Clastobryum dimorphum** is unlikely to be confused with other taxa in the Sematophyllaceae. It is characterised by the short branches with regularly tristichous, subequitant, cymbiform leaves suddenly contracted to a point. Long filamentous branches are often present but may be absent in young plants. Smooth, filamentous, unbranched gemmae often occur in upper leaf axils. Details of the peristome are presented as detailed scanning electron micrographs in Fig. 7. Some information on the peristome was first published as **Triстиichella** sp. (I.G. Stone) in Ramsay (figs. 3a–c, p. 182, 1988).

**Studied specimens:**

**Queensland:** Mt Bellenden Ker, *I.G. Stone* 16926 (MEL), 15561, 15564, 15566 (MELU); Mt Lewis, *I.G. Stone* 19555 (MELU); Thornton Peak, *Phillips and Goodwin* s.n. (MELU); Mt Bellenden Ker, *D.H. Vitt* 27927, 27889 with H.P. Ramsay (NSW); Mt Bellenden Ker, *W.B. Schofield* 90227, 90242 with M.I. Schofield (NSW, UBC); Mt Bellenden Ker, *B. Thiers & R. Holling* 2436 (AD, NY); Mt Bartle Frere, south slopes, *B.O. van Zanten* 68.1523, 68.1515 (GRO, NSW); Mt Bartle Frere, near summit, *B.O. van Zanten* 68.1482D, 68.1485L, 68.1486 (GRO, NSW).
Fig. 5. Clastobryum dimorphum: a. habit; b. complete male plant; c. perichaetium and base of seta of sporophyte; d. capsule with calyptra; e. perichaetal leaves; f. branch leaves (2); g. apical leaf cells; h. mid-laminal cells; i. basal alar region. Scale bars—a–f=1 mm; g–i=100 μm [a, f–i, W.B. Schofield 90233 (NSW); b, redrawn from I.G. Stone (1987), fig. 2a, p. 694]; c, redrawn from I.G. Stone (1987), fig. 2k, p. 694; d, redrawn from I.G. Stone (1987), fig. 3a, p. 695 (1987); e, redrawn from I.G. Stone (1987), fig. 2l, p. 694 (MEL)].


Fig. 6. *Clastobryum* spp.: a–h. *Clastobryum dimorphum*: a. flagelliform shoot; b. gemma; c. sporophyte; d. capsule enlarged; e–h. peristome; e. side view of exostome tooth and spores; f. face of tooth, endostome segment to right; g. apex of exostome tooth with spore at tip, endostome to left; h. side view of endostome segment near apex; i–p. *Clastobryum epiphyllum*: i. habit; j. stem with axillary filamentous gemmae; k. gemma; l. leaf; m. apical cells; n. mid-laminar cells; o. side view showing papillae on cells; p. basal alar region.

Scale bars — a, c, d, i, j = 1 mm; b, e–h, k, m–p = 100 µm [a, c, d, B.O. van Zanten 68.1515 (NSW, GRO); b, redrawn from I.G. Stone (1987), fig. 3n, p. 695; e–h, redrawn from I.G. Stone (1987), fig. 3h–k, p. 695; i–p, H. Streimann 31253 (CANB)].
Luzon, Baguio, R.S. Williams 3159 (NY!).
Previous illustration: Fleischer, vol. 4, fig. 197a–f., p. 1196 (1923).

Plants small; leaves crowded, somewhat ranked, <1 mm long, bluntly acute; laminal cells fusiform to elongate, 40–50×4–5 μm, unipapillose, thin to thick walled; margins serrulate; alar region with basal row of alar cells, enlarged, thick-walled, reddish-brown; a few irregular supra-alar cells. Gemmae filamentous, unbranched, produced in clusters on stem, 15 to 20 cells long, walls almost smooth. Sporophytes not seen. Fig. 6.

Distribution: Sri Lanka, Philippines and Lesser Sunda Islands. Widespread as an epiphyte on branches in monsoonal forests.

In Australia known from only two collections in northeast Queensland. Map 6, Fig. 28.

Selected specimens:
Queensland: Dunn Creek, Kirrima Rd., Cardwell Range, H. Streimann 31253 (CANB); small collection mixed with Taxithelium kerianum, Babinda, W.W Watts Q 400 (NSW).


[Etymology: The generic name refers to ‘macro’ or large, and ‘hymenium’ or membrane, referring to the large membranaceous inner peristome].

About four species (Eakin 1976) are distributed in East Africa, Madagascar, Sri Lanka, Malesia, continental Southeast Asia. In Australia, one species, M. mitratum, occurs only in northeast Queensland.

When present, the capsules with a large rostrate operculum and the peristome with the endostome segments greatly exceeding the exostome teeth, distinguish this genus. In sterile collections, the ovate to ovate-lanceolate leaf outline abruptly narrowed to an acuminate apex is equally distinctive. The rhomboidal or short oblong lamina cells and the weakly differentiated alar region distinguishes this from most other genera but some sterile specimens may be mistaken for Meiothecium.

There is a nomenclatural confusion involving the alleged synonymy between Leskea rufa. Reinw. & Hornsch. and Macrohymenium rufum Müll. Hal. The author of the genus Macrohymenium (c. Mueller, 1847), the compilers of Index Muscorum, as well as Streimann and Curnow (1989) accepted them as homotypic synonymy. As explained by Eakin (1976), the two names, L. rufa and M. rufum, actually were based on two different specimens collected by Reinwardt from Java. The description of the leaves of Leskea rufa in its protologue (Reinwardt and Hornschuch, 1829) stated “...lanceolato-acuminata, su-
perne involuta et inde subulata...” which showed clearly that the specimen is an Acroporium and not a Macrohymenium (Fleischer, 1923). Furthermore, Reinwardt and Hornschuch (1829) admitted that the peristome of the type specimen of their species, L. rufa, was destroyed, and so this could not possibly be the same Javan specimen seen by C. Mueller (1847) who had described in vivid detail the peculiar peristome of Macrohymenium. According to Tan (1994), Leskea rufa Reinw. & Hornsch. from Malabar of Java is the type of Acroporium rufum (Reinw. & Hornsch.) M. Fleisch.

Eakin (1976: 47) regards M. mitratum as a synonym of M. rufum, however, we regard M. rufum as a synonym of M. mitratum based on Leskea mitrata Dozy & Molk.

The earliest Australian collections are those of M. mitratum by Watts in 1913 from northeast Queensland, incorrectly named as M. rufum.


Previous illustrations: Bartram (1939), pl. 25, fig. 424; Fleiserher (1923), vol. IV, p. 1365, fig. 221; Ramsay (1988), fig. 3f, p. 182 [SEM of peristome as M. rufum].

Autoicous. Plants creeping, pinnately branched. Stems short, to 1 cm. Branches upright, 7–8 mm long. Stem leaves somewhat smaller than branch leaves. Branch leaves ovate, 1.3 mm long, 0.4 mm wide, concave, abruptly short acuminate, margin entire. Laminal cells short-rhomboidal 30–45 μm×4–6 μm, thick-walled, non-porose except for some near the base, lower cells more rectangular; alar region with a basal row of slightly enlarged, oblong (2–3: 1), thin-walled, coloured alar cells; 2–3 rows of subquadrate upper alar cells. Perichaetial leaves ovate-lanceolate, short acuminate; perigonia towards base of branches, perigonal leaves ovate, short-acuminate. Calyptra cucullate, smooth. Seta 6–8 mm, smooth to slightly papillose; capsules erect, urn 1 mm, exothecial cells semi-collenchymatous to collenchymatous; operculum large, conic, rostrate; peristome double, exostome teeth 16, short, apices incurved between the endostome segments when dry; endostome segments 16, long, greatly exceeding the exostome teeth, folded lengthwise, cilium single, bent back behind basal membrane of endostome, between exostome teeth. Spores 15–20 μm, papillose. Figs. 8–9.

Distributed in Malesia, continental Southeast Asia, and Australia.

In Australia confined to northeast Queensland. Map 1, Fig. 29.

Habitat: M. mitratum is an epiphyte in forests above 1000 m elevation.

Notes: Details of the peristome are shown as scanning electron micrographs in Fig. 9 [see also Ramsay (1988), fig. 3f, p. 182, as M. rufum].

Studied specimens:

Queensland: Malanda, WW. Watts Q623, Q664 (NSW); Falls near Majors, Ravenshoe, WW. Watts Q657, Q660, Q662 (NSW); Mt Baldy, southwest of Atherton, 1000 m, D.H. Vitt 28054 with H.P. Ramsay 4. xi. 1981 (NSW); Mt Baldy, H. Streimann 29193 (CANB); Walter Hill Range, 26 km SE of Ravenshoe, H. Streimann 30472 (CANB); Mt Bellenden Ker, I.G. Stone 16796 (MELU); Windsor Tableland, H. Streimann 29648 (CANB); Millaa Millaa, Mrs Sparvell s.n. (BM); Kennedy Highway, Longland’s Gap State Forest, R.G. Coveny 16807 (NSW); Mt Fisher, I.G. Stone 15709 (MEL).
Fig. 8. *Macrohymenium mitratum*: a. habit of plant bearing sporophyte; b. capsule enlarged to show peristome teeth; c. branch leaves; d. perichaetial leaf; e. apical leaf cells; f. mid laminal cells; g. alar region; h. peristome—short exostome tooth (left), long endostome segment (right). Scale bars — a–d = 1 mm; e–h = 100 µm [a–h, W.W. Watts Q 623 (NSW); i–j, D.H. Vitt 28054 (NSW)].


[Etymology: generic name means 'little meiothecium' to indicate its relationship with Meiothecium].

Meiotheciella is closely related to Meiothecium but differs from the latter in having unipapillose leaf cells, serrulate to serrate margins on inner perichaetial leaves, and more significantly, a caducous peristome.

The genus Meiothecium Mitt. was restricted to members of the section Eumeiothecium Broth. by Buck (1982). We have refined the genus further by removing the species with unipapillose cells to form Meiotheciella (Tan, Schofield & Ramsay 1998). In our interpretation, Meiotheciella is monospecific.


Previous illustration: Tan, Schofield & Ramsay (1998), figs. 8–17, p. 216, figs. 18–19, p. 217.

Polyoicous. Plants mat-forming; stems slender, creeping, to 2.5 cm long, laxly branched; rhizoids in clusters scattered along main stem and primary branches, below the leaf insertion. Branches erect, 0.3–0.5 mm. Pseudoparaphyllia foliose. Leaves appressed to erect, slightly wrinkled when dry, ovate, ovate-lanceolate to lanceolate, 0.5–0.75 mm long and 0.2–0.3 mm wide near base, concave; apices obtuse to acute, at times short acuminate; margins entire to serrulate, serrulations formed by projecting marginal cells, narrowly recurved on one or both sides, becoming more recurved toward apex; costa none; laminal cells oval, rhomboidal to short fusiform, 10–15 μm, becoming oblong at middle of leaf.

Fig. 9. Scanning electron micrographs of the peristome Macrohymenium mitratulum: a. whole peristome showing size differences of exostome and endostome, apices of exostome teeth infolded, ×140; b. base of exostome tooth, outer surface, ×315; c. near apex of exostome tooth, spore also present, ×1428; d–f. exostome: d. close up of outer surface near base showing plates and ridges, ×1428; e. inner surface of upper part of tooth showing trabeculae with papillae on both surfaces, ×1428; f. inner surface near base showing large trabeculae, ×708; g–h. outer surface of endostome, g. basal region, ×1398; h. apical region, ×708; i. whole endostome from inner surface, ×126; j–l. inner surface of endostome: j. attachment of segments to high basal membrane, ×348; k. closer view showing papillose surfaces on cells of basal membrane, spore also present, ×708; l. apical region of segment showing curved surface, ×708 [W.W. Watts Q 623 (NSW)].
base, thin- to thick-walled, unipapillose both dorsally and ventrally, at times smooth or with a low papilla; *alar region* with one distinct basal row of 4–5 somewhat inflated, thin-walled, and lightly coloured alar cells, upper alar cells few. *Perigonia* small, bud-like, leaves broadly ovate, acute; *perichaetia* on stems, outer perichaetial leaves much larger than vegetative leaves, ovate to ovate-lanceolate, 1 mm long × 0.2–0.3 mm wide, nearly entire; inner perichaetial leaves oblong-lanceolate, serrulate to serrate in upper half, cells mostly oblong, smooth or unipapillose, at times prorulose. *Calyptra* cucullate, mainly smooth, roughened at distal end because of prorulose cells. *Seta* short, 3–5 mm, smooth; *capsules* erect to suberect, ovoid to short oblong, 0.50–0.75 mm long; *operculum* short conic; *peristome* single, fragile, absent in old capsules. *Spores* not seen, reportedly 20–25 μm (Fleischer, 1923). No chromosome number available. Fig. 10.

Conceptually *Meiotheciella papillosa* includes the two Old World species, namely *Meiothecium gymnostomum* M. Fleisch. and *Meiothecium papillosum* (Broth.) Broth. The above species description is based on the two syntypes of *Meiothecium gymnostomum* from Java, two New Caledonian collections of *M. papillosum* named by I. Thériot, and a recent collection from Queensland made by D.H. Norris. The Australian specimen, although small, is larger than the specimens from New Caledonia and Java.

*M. papillosa* is morphologically variable, especially in the leaf apexes, the presence or absence of a single leaf cell papilla, and the perichaetial leaf marginal serration. Seen in this light, the published description of *Meiothecium papillosum* var. *obtusifolium* Broth. & Paris does not present differences of sufficient significance to warrant a varietal recognition.

**Distribution:** Java, New Caledonia, and Australia.

In Australia the species is rare in northeast Queensland. Map 2, Fig. 29.

**Habitat:** This species grows on bark of tree trunks and branches.

**Studied Specimen:**

**Queensland:** Mt. Spec National Park, near Townsville, D.H. Norris 39869 (UC, NSW).


T: *non designatus*.

[Etymology: The generic name refers to small capsules].

**Autoicous.** *Plants* slender to coarse, forming wide and compressed tufts, green to yellow to brownish-green, +/- glossy. *Stems* creeping, irregularly-pinnately branched; *branches* arched, ascending, blunt, thick and terete to complanately leafed, short and unbranched to longer somewhat branched. *Leaves* imbricate when dry, secund, sometimes weakly plicate, +/- cucullate-concave, ovate to elongate, acute, margin entire, often recurved, branch leaves sometimes heteromorphic, the ventral leaves having longer points, ecostate; *laminal cells* usually smooth, upper cells rhombic with elliptical lumen, marginal cells longer, basal leaf cells longer and yellow at insertion; *alar region* with 2–3 swollen basal alar cells, hyaline or yellow, quadrate; supra-alar cells forming a defined group of numerous rows of sub-quadrate cells. *Perigonia* not seen. *Perichaetia* on branches, inner perichaetial leaves small, erect, acuminate, often somewhat curved, smooth or with very obscure mammillae. *Calyptra* cucullate, small, smooth, or +/- rough at apex. *Seta*
Fig. 10. *Meiotheciella papillosa*: a. habit; b. branch leaves; c. apical leaf cells; d. mid-laminal cells; e. alar region; f. perichaetium; g. capsule; [a–e, D.H. Norris 39869 (UBC); f–g, redrawn from lectotype of *M. gymnostomum*, Tan et al. (1998), fig 18, 19, p. 217]. *Meiothecium secundifolium*: h. branch leaves; i. apical leaf cells; j. mid-laminal cells; k. basal alar region; l. habit. Scale bars — a, b, f–h, l=1 mm; c–e, i–k=100 μm [h–l, I.G. Stone 15975 (MEL)].
2–3 mm rarely to 5 mm with very flat mamillae; capsules inclined, small ovoid to long elliptic or cylindrical, mouth often contracted when dry, neck short, exothecial cells semi-collenchymatous, thickened along longitudinal walls; operculum short, rostrate from a swollen conic base; peristome usually single, exostome 16, teeth lanceolate to linear-lanceolate, pallid, unistriate, densely papillose, rarely smooth, without trabeculae; endostome absent or indistinct. Spores 25–30(–40) μm, finely papillose. No chromosome number available.

Over 50 species worldwide in South America, Africa, Malesia, Pacific Islands and Australia.

In Australia four species have been recorded from northeast Queensland with *M. microcarpum* also occurring in northeastern New South Wales (Richmond River district). The report of *M. jagorii* from Australia based on *H. Streimann 45640* from Queensland, Woopen Creek Rd., 18 km WNW of Innisfail (CANB, NSW), represents a large specimen of *M. microcarpum*. Basically, *M. jagorii* differs from *M. microcarpum* in having predominantly narrowly elongate cells (not oval-oblong leaf cells) near the leaf apex. Thus, there are three species distributed in northeastern Australia from north Queensland south to northern New South Wales.

The genus is characterised by usually +/− ovate leaves with shortish rhomboidal cells; large leaves tend to become somewhat plicate; the alar cells are differentiated, somewhat inflated and coloured, but not as pronounced as in most members of the Sematophyllaceae. The capsules are erect to suberect and the peristome is described as single, exostome teeth variously spaced and papillose, endostome absent (Buck 1982).

Only one of the three sections (Section *Eumeiothecium*) described by Brotherus (1908) is represented in Australia. In this section exostome teeth are widely spaced and papillose and the calyptrae are distinctly roughened at apex.

Key to the species

1. Plants robust; leaves ovate-lanceolate to lanceolate, more than 1 mm long . 2. *M. microcarpum*

2. Leaves strongly secund when dry, orbicular to broadly ovate; setae 8.0–9.0 mm long

3. *M. secundifolium*

2. Leaves patent-erect, secund or homomallous when dry, ovate to ovate-oblong; setae less than 6 mm long . 1. *M. tenellum*


Previous illustration: Fleischer (1923) [as *M. bogoriense*], fig. 201, p. 1232.

*Autoicous.* Plants slender, green to yellowish to brownish-green, +/− glossy, in somewhat dense tufts. Stems elongate, creeping, 1–2 cm; branches short, 3–6 mm. Leaves small 0.25–0.3×0.2 mm, spreading, sometimes secund, concave, often with 2 plicae near
centre of leaf, ovate to ovate-oblong, apex minutely crenulate, margin recurved, shortly acuminate; laminal cells small, 8–10 μm smooth, rhomboid, incrassate, longer towards base; alar region differentiated with 3–4, small, rectangular, sometimes yellow alar cells, supra-alar cells numerous, small, sub-quadrate. Perichaetia borne on primary stems, perigonia on branches; inner perichaetal leaves similar to vegetative leaves but slightly larger. Seta 2–4 mm, capsules inclined, small oval to elongate, 1 mm, contracted around mouth when dry; exothecial cells irregularly rectangular, sub-collenchymatous, longitudinal walls slightly thicker; peristome reduced, single, exostome teeth 16, short (100 μm), narrow, widely separated, strongly papillose; endostome absent. Spores 10–12 μm, papillose. Fig. 11.

Distribution: Malesia and Australia.

In Australia it is confined to tropical northeast Queensland. Map 3, Fig. 29.

Habitat: Epiphytic on trunks and branches.

Notes: In this species leaves are often fragile, leaving the stems almost bare. *Meiothecium brotheri* Watts, a nom. nud., is synonymous with *M. tenellum* Broth. & Paris while

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Fig. 11. *Meiothecium tenellum*: a. habit; b. stem bearing sporophyte; c. capsule; d. perigonium from branch; e. basal alar region; f. upper laminal cells; g. exothecial cells; h. spores; i. branch leaves; j. apical leaf cells; k. peristome tooth. Scale bars — a–d, i = 1 mm; e–h, j–k = 100 μm [a, d–g, i, W.W. Watts Q 230 (NSW); b–c, h, j–k, Tan 94-870 (NSW)].
specimens with the herbarium name of *M. fabronioides* Broth. (*WW Watts Q270*), from Kuranda, Queensland (NSW), also fit here.

Streimann & Curnow (1989) state that *M. tenellum* is not an Australian moss, however, specimens named as *M. brotheri* have been confirmed by us to be *M. tenellum* and additional specimens have been collected. It is distinguished from other species by the very fine plants, the small leaves and the peristome teeth widely separated and small. *Meiothecium bogoriense* from Java is also a synonym of *M. tenellum*.

**Studied Specimens:**

Queensland: German Creek Road, Richmond River, *WW Watts 2384* (NSW); Babinda Falls, The Boulders, *W.B. Schofield 79796* with M.I. Schofield (UBC, NSW); Police yard, Cairns, *WW Watts Q230* (as *M. brotheri*, NSW); Kuranda, *WW Watts Q607* [mixed with other mosses] (NSW); *Cairns, W.B. Schofield 90007* with H.P. Ramsay & I.G. Stone (UBC, NSW); Gillies Rd., between Gordonvale & Atherton, *W.A. Weber 31851* (CANB); Davidsonson Road, Curamo, *I.G. Stone 23191* (MEL); Cedar Bay Road south of Helensvale, *I.G. Stone 15823* (MELU); Rifle Creek, Mt Molloy, *H. Streimann 30660, 30663* (CANB); Mangrove boardwalk near airport, Cairns, B.C. Tan 94-870 (FIH, NSW); Botanic Gardens, Cairns, *I.G. Stone 15316* (MEL); Palmerston Highway, *I.G. Stone 15141, 15771* (MEL); Copperlode Dam Road, Cairns, *I.G. Stone 15444* (MEL).


Previous illustration: Gangulee (1980), fasc. 7, fig. 954, p. 1875.

**Autoicus.** Plants medium to robust, yellow-green, +/- glossy in low tufts. Stems creeping, divaricating, pale red, glossy, subpinnate 1–1.5 cm; branches pinnate. Leaves dense, 1–1.5 mm long., contorted or plicate when dry, otherwise suberect, narrowly ovate, apices rounded or blunt, apical cell short, laminal cells short, rhomboidal, incrassate, margins entire, slightly recurved, single plica down centre, ecostate; mid-laminal cells 45 μm × 6 μm, wider near margin; alar region with basal row of several swollen cells; upper alar cells 2–4 rows, quadrate to rectangular. Perigonia and perichaetia on branches; perichaetial leaves erect, apex acuminate. Calyptra smooth, truncate at base. Seta short, to 3.0 mm, straight or occasionally twisted to right, smooth; capsules nodding to suberect, cylindrical 1 mm × 0.5 mm, neck smooth; operculum conic, long rostrate; peristome single, exostome teeth 8, widely separated, papillose on both sides, 200 μm long, zig-zag median

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Fig. 12. *Meiothecium microcarpum*: a. plant bearing sporophyte; b. habit of plant bearing sporophyte (as *M. wattsii*); c. enlarged capsule; d. capsules showing peristome; e. branch leaves; f. leaf apical cells; g. mid-laminal cells; h. basal alar region; i. perichaetial leaf; j. exothecial cells; k. spores; l. peristome tooth. Scale bars — a-e, i = 1 mm; f-h, j-l = 100 μm [a. f-l, *H. Streimann 45640* (CANB); b-e, *WW Watts 2377* (NSW)].
Fig. 13. Scanning electron micrographs of the peristome of *Meiothecium microcarpum*: a–c. outer surface of exostome: a–b. shows large irregular papillae on exostome only, ×666; c. closer view, ×1410; d. inner surface of teeth with spores present, ×331; e. closer view of (d), ×672; f. inner surface of mid tooth, ×1332; g. inner surface showing plates and papillae, ×1380 [WW Watts 5358 (NSW)].

line; endostome not developed. Spores 20–26 μm, rough, papillose. Figs. 12–13.

Distribution: Widespread in tropical Asia including eastern India, east and west Malesia, including New Guinea, New Caledonia, Samoa and Australia.

In Australia, present in eastern Australia from north Queensland to New South Wales where it is (or was) common in the Richmond River area. Map 5, Fig. 29.

Habitat: Epiphytic on bark of *Casuarina* sp., *Araucaria* sp., and other trees.

Notes: *Meiothecium wattsii* was reported as differing from *M. microcarpum* in having shorter setae and smaller capsules. The numerous collections (over 60) of this species from Australia show that the distinctions between the two taxa are not clear cut, hence, we are proposing that they are synonymous.

*Meiothecium microcarpum* was very common in northern New South Wales in scrubby vegetation associated with sand hills, and slightly inland along the Richmond River and at Byron Bay early in the 20th Century. The obvious richness of Watts’ specimens in the 1890’s to early 1900’s contrasts strongly with the lack of collections in northern New South Wales since then, and may be significant, possibly indicating loss of habitat as a result of
land clearing for agriculture and forests for timber in that area early in the 20th century.

Studied specimens:

**Queensland:** Cape Tribulation, I.G. Stone 15914 (MELU); Finch Hatton Gorge, I.G. Stone 12370 (MELU); Russell River, Sayer 90 (as *M. microcarpum*, NSW); Kuranda, *WW Watts* Q642 (NSW); Herberton Road, *H. Streimann* 29164 (CANB).

**New South Wales:** Wardell, *WW Watts* 2377 (as *Pterogoniella wattsii*, NSW); German Creek, Richmond River, *WW Watts* 2384 (NSW); North Creek Rd., Richmond River, *WW Watts* 2806 (as *Pterogoniella wattsii*, NSW); Tintenbar Rd., 1 m from Ballina, *WW Watts* 3653 a,b,c,d (as *Pterogoniella wattsii*, NSW); German Creek, *WW Watts* 4160 (NSW); Gray’s Island, Richmond River, *WW Watts* 3053 (NSW); sand hills, E. Ballina, *WW Watts* 3358 (NSW); in scrub behind sandhills [different dates between 1898 and 1901], E. Ballina, *WW Watts* 2051, 2881, 2955, 2960, 3722, 3726, 3728, 3974, 3977, 3978, 2052(a), 4129 (NSW); towards lighthouse, *WW Watts* 3403, 3404, 3979 (NSW); tree, Newrybar by Wylies’s Creek, *WW Watts* 2246 (NSW); Newrybar, *WW Watts* 3609 (NSW); Maclean’s Ridge, *WW Watts* 1144 (NSW); Wardell, Richmond River, *WW Watts* 2366 (NSW); Wardell ferry, *WW Watts* 1810 (NSW); Uralba, Richmond River, *WW Watts* 3037 (NSW); Alstonville, Road, *WW Watts* 3519, 4147, 4047, 4048b (NSW); Wollongbar, Richmond River, *WW Watts* 3776, 3790 (NSW); Rous, Richmond River, *WW Watts* s.n. (NSW); Pimlico, Richmond River, *WW Watts* 5698 (NSW); Wardell [collections on different dates], *WW Watts* 4417, 4415, 4414, 4316 (NSW); North Creek, E. Ballina *WW Watts* 4491, 4403 (NSW); Alstonville Road, Richmond River, *WW Watts* 4440 (NSW); Rous, Richmond River, *WW Watts* 4167 (NSW); Byron Bay, *WW Watts* 4218 (NSW); three mile scrub, *WW Watts* 4220 (NSW).


T: Australia (no locality information), mixed with *Papillaria flavolimbata*, leg. Dr. Morrison 148 p.p.
[holo: Fide Dixon (1948); iso: BM].

Previous illustration: H.N. Dixon (1948), fig. 20, p. 97.

Plants small, never glossy, straw-coloured, irregularly pinnate, stems subcincinate. *Stem* and *branch leaves* similar, strongly secund, not falcate when dry, 0.8–0.9×0.4–0.5 mm, orbicular to broadly ovate, acute, slightly contracted at base, apex bluntish; margins slightly recurved when wet to revolute when dry, plane, *laminal cells* smooth, elliptic, 30 μm×6 μm, walls thick; *alar region* well developed, basal row of 3 to 4 somewhat inflated, coloured alar cells, yellow across insertion. *Perichaetia* on secondary stems or branches, perichaetal leaves narrower, elongate. *Perigonia* not seen. *Seta* smooth, straight, 9 mm; *capsules* suberect when young, urn 1.5 mm; operculum long rostrate, 1 mm; exothecial cells elongate, sub-collenchymatous. Sporophytes immature. Fig. 10.

Distribution: apparently endemic to northeast Australia. Known originally only from the type with no precise locality in Australia given. One other collection by I.G. Stone from northeast Queensland fits well and another two collections may be also this species. Map 4, Fig. 29.

Notes: The only capsules on the type specimen are immature. The absence of peristome data makes its placement in *Meiothecium* tentative until more specimens are found.

*Meiothecium subsecundifolium* is reportedly very distinct in its strongly secund leaf form. Although similar to *M. microcarpum* it differs from it in having a long seta (Dixon, 1948) and strongly secund leaves. Two other collections that may be this species are listed here but have less ovate leaves.
Studied Specimens:
Queensland: Tully, I.G. Stone 23078 (MELU); also possibly this species – Conway S.F., 16 km ENE of Proserpine, H. Streimann 374013 (CANB); Tully Falls, H. Streimann 30098 (CANB).

Trichosteleum sect Papillidiopsis Broth. in A. Engler & K. Prantl, Nat. Pflanz. 1(3): 1119 (1908);

Lecto: Papillidiopsis bruchii (Dozy & Molk.) W.R. Buck & B.C. Tan, loc. cit.

[Etymology: the generic name refers to papillose cells].

Papillidiopsis differs from Trichosteleum, which is also unipapillose, in the somewhat ranked, often strongly concave leaves with abruptly constricted apices, flagelliferous branch tips, presence of well differentiated supra-alar cells and papillae confined to upper leaf cells. In Trichosteleum the papillae are present throughout the lamina cells, often including the perichaetial laminal cells, and supra-alar cells are absent or only slightly differentiated.

Distribution: A tropical genus of seven species, Papillidiopsis, is distributed in Africa, Malesia and Sri Lanka.

Represented in Australia (Western Australia, Northern Territory) by a single species, P. ramulina.


Previous illustrations: Dozy & Molkenboer (1855–1861), figs. 240, 241; Fleischer (1923), p. 1311, fig. 211; Tan (1991), figs 6–9, p. 98.

Plants somewhat complanate when dry; stems long, creeping >2 cm, irregularly branched, branches 3–5 mm long. Branch leaves erect-spreading, somewhat falcate, ovate to ovate-oblong, 1.5–2 mm long, concave, somewhat wrinkled when dry, apices somewhat constricted, short, acute, sometimes acuminate; margins almost entire with a few teeth near the extreme apex; laminal cells linear to vermicular 45–70 µm X 5–8 µm, oval to short-oblong at the apex, thick-walled, at times incrassate, strongly to weakly unipapillose abaxially, especially on the concave part of the leaf; alar region with basal row of enlarged cells, often coloured with thin to moderately-thick walls, a few upper alar cells well differentiated, but small and thin-walled. Perichaetia on stems, perichaetial leaves differentiated, similar in size to vegetative leaves, lanceolate, somewhat flat, long-acuminate with distinct marginal serrulation throughout, alar cells absent. Perigonia not seen. Seta 1 cm or longer, smooth below, papillose above; capsules ovoid, 0.5–1 mm; peristome double, alternate, exostome and endostome similar in length; exostome teeth grooved, striate below, papillose above [Australian specimens lack sporophytes; peristome details taken from Buck & Tan (1989)]. Fig. 14.

Distribution: A widespread and variable species in the Malay Peninsula and Sarawak area of North Borneo. A variety, P. ramulina var. voluta, has been described from Sri Lanka (Tan 1991).

Notes: The first record of this species for Australia (Tan et al., 1996) is from the
Fig. 14. *Papillidiopsis ramulina*: a. habit; b. enlarged section branches; c. capsule showing peristome; d. branch leaves; e. side view of cell papillae; f. mid-laminal cells; g. leaf apical cells; h. basal alar region. Scale bars — a=2 mm; b-d=1 mm; e-h=100 μm [c, reproduced from Tan (1991), fig. 9, p. 98; a-b, d-h, H. Streimann 48190 (CANB)].
Northern Territory. Some herbarium specimens had been misidentified as *Wijkia cf. hornschuchii*. Other specimens were misidentified as *Sematophyllum jolliffii* or *S. uncinatum*. Several previously unnamed collections have been added to the list including two from the Kimberley Area in Western Australia (Tan, 1991). A recent collection by *D. Dixon 908* in May 2001 has mature capsules that agree well with the drawing in Fig. 14. Map 6, Fig. 29.

*Papillidiopsis ramulina* is a distinctive species with concave, oblong-ovate leaves, wrinkled when dry, that have a constricted sometimes slightly acuminate apex. Stems are complanate often with flagelliferous branches. Laminal cells are unipapillose abaxially on the upper part of the leaf. Australian plants are slightly larger than their Malesian counterparts. Collected first from stream banks, or shaded, damp banks near waterfalls at Kakadu National Park and Katherine Gorge, Northern Territory.

Studied specimens:

**Western Australia:** Upper reaches of Barker River, 2 km N of Mt Hart Homestead, N.W. Kimberley, *D.J. Edinger 426* (AD); Barker River Gorge, 4 km N of Mt Hart Station, *D.J. Edinger 493* (AD).

**Northern Territory:** Foot of escarpment, Nourlangie Rock near Koongarra, Kakadu National Park, *L.A. Craven 5809* (CANB, DNA); Tim Jim Falls, Kakadu National Park, *J. Russell-Smith 110* (CANB); Edith Falls, Katherine Gorge National Park, *L.A. Craven 6763* (FH); Curtain Falls, Pethersicks Rainforest, 38 km SE of Batchelor, *H. Streimann 48187, 48188, 48190, 4819.4* (CANB); Yeurlba Creek, 35 km from Katherine Gorge, *D. Lucas 55* (DNA); Crystal falls, Katherine Gorge N.P., *D. Lucas 80* (DNA); Eva Springs, upper Mary R, *D. Lucas 79* (DNA, UBC); on soil, Nitmiluk National Park, *D. Dixon 908* (DNA, JCT, NSW).


[Etymology: the generic name is derived from Latin for a small scraper, and by extension to a snail's tongue, in reference to the leaf papillae].

*Radulina* was segregated from the unipapillose *Trichosteleum* by Buck & Tan (1989). It is autoicous with abruptly long-acuminate, sharply toothed leaves and seriately papillose laminal cells with a basal row of 3–4 alar cells. Although *Radulina* may resemble *Acroprorium* in the cuspidate branch apices and concave leaves with thick-walled leaf cells, it is separated by the pluripapillose instead of smooth cells and alar cells that do not curve in towards the insertion.

The genus is confined to the palaeotropics and includes about ten species. It is distributed in Indochina, Malesia, Pacific Islands and Australia and is represented in Australia by the single species, *R. hamata*, which occurs in the Northern Territory and northeastern Queensland.


2: 486). T: Borneo, Sumatra, (syntypes: L, NY!).


Previous illustrations: Dozy and Molkenboer (1855–1861), fig. 275 (as _Hypnum hamatum_); Brotherus (1925), vol. 11, fig. 741, p. 438 (as _Trichosteleum hamatum_); Bartram (1939), pl. 25, fig. 435 (as _Trichosteleum hamatum_); Gangulee (1980), fasc. 7, fig. 979, p. 1913 (as _Trichosteleum hamatum_).

_Autoicous_. Plants variable, in dense intricate tufts or mats, pale or lurid green, slightly glossy. _Stems_ creeping, freely but irregularly pinnate, _branches_ decumbent or ascending and falcate-cuspidate, 2–3 mm long, usually hooked at tips. _Pseudoparaphyllia_ foliose. _Leaves_ crowded, falcate-secund, gradually lanceolate to ovate-lanceolate, gradually long-acuminate from a concave expanded ovate base, 1–2.2×0.5 mm, often smaller; _margins_ erect, sharply serrulate in upper half, ecostate; _laminal cells_ linear to narrowly elliptic, 30–50×5 μm, firm to thick-walled, +/− porose, strongly seriately pluripapillose with papilae uniseriate to biseriate over lumen; _alar region_ differentiated with a basal row of 2–3 enlarged, inflated, hyaline thin-walled alar cells, one row quadrate upper alar cells; across insertion cells yellow, thick-walled, in single row. _Calyptra_ cucullate, naked, roughened above. _Seta_ elongate 1–1.5 cm, slender, reddish, smooth or papillose throughout, or papillose at base of capsule or in whole upper half; _capsule_ small, ovate, inclined to horizontal, arcuate, short-cylindric with obliquely, long slender rostrum exceeding the urn length; _exothecial cells_ short-rectangular, strongly collenchymatous; _peristome_ double, exostome teeth 16, narrowly furrowed on outer surface, cross-striolate below, coarsely papillose above, trabeculate at back; _endostome_ with high basal membrane, segments keeled, perforated, roughened, about as long as teeth, cilia single, stout, coarsely roughened. _Spores_ medium sized, spherical, finely papillose. No chromosome number available. Figs. 15–16.

Widespread from India and Malesia through the Pacific Islands to Hawaii and Australia.

In Australia, _R. hamata_ is distributed in the Northern Territory (Melville Island in remnant rainforest) and in northeast Queensland from Cape Tribulation south to Cardwell and inland on the Atherton Plateau. Map 3, Fig. 30.

_Habitat_: _R. hamata_ occurs in dry coastal or upland monsoon rainforest, on trees and rotting logs on river flats and slopes of the Atherton Tableland between 100–1160 m altitude.

_Notes_: _Radulina hamata_ is a distinctive species. The slender, strongly falcate, serrulate leaves with pluripapillose laminal cells are diagnostic. These pluripapillose laminal cells give the plant a dull green appearance when fresh.

_Study specimens:_

**Northern Territory**: Melville Island, _H. Streimann_ 42434, 42505 (CANB); Tarraumbie Falls, Melville Is, _J. Russell-Smith_ 2068 with D. Lucas (DNA). Melville Island, _J. Russell-Smith_ 1299 (DNA, MEL, AD).

**Queensland**: Frenchman’s Creek, _WW. Watts_ Q383, Q362b (NSW, as var. _semimamilllosum_); Mossman Gorge, _I.G. Stone_ 15882 (MEL); Slopes of Black Mtn NW of Kuranda, _H. Streimann_ 31114 (CANB); Herbert River SW of Cardwell, _H. Streimann_ 45336 (CANB); Atherton, _B. Allen_ (NSW); Broadwater Forest Park, _H. Streimann_ 45368 (CANB); Lake Eacham, _H. Streimann_ 16899
Fig. 15. *Radulina hamata*: a. habit of plant bearing sporophytes; b. capsules with operculum (above), showing peristome (below); c. branch leaves; d. leaf apical cells; e. mid-laminal cells, papillose surface side view on left; f. basal alar region; g. exothecial cells; h. peristome—shorter endostome segment (left), larger exostome tooth (right). Scale bars—\text{a–c} = 1\text{ mm; d–h} = 100\text{ µm [W.B. Schofield 79866 (UBC, NSW)].}
Fig. 16. Scanning electron micrographs of the peristome of *Radulina hamata*: a–f. outer surface of exostome teeth: a. at transition from base to apex showing different patterning, ×1200; b. closer view of upper region with spore, ×3000; c–d. outer surface towards base of tooth, c. ×2400; d. ×9400. e. side on view of teeth showing both outer and inner surfaces, ×600; f. closer view, ×1200; g. inner view near apex showing trabeculae, ×780; h–k. endostome: h. outer view of segment near apex, ×1200; i. inner surface of segment near apex, ×1200; j. outer surface of segment near base, ×1200; k. inner surface of basal membrane, note single cilium bent inwards, ×600 [W.W. Watts Q 383 (NSW)].


[Etymology: the generic name is derived from the Greek 'rhaphē'—mature and 'rhychno'—beak, to describe the operculum.]

Autoicous, rarely dioicous. Plants slender to coarse, shiny; stems creeping, irregularly to pinnately branched, forming low tufts; branches 4–5 mm irregularly arranged. Leaves strongly flexuose, falcate-secund when dry, lanceolate, long acuminate to filiform, finely toothed to entire; ecostate; margins entire or distantly serrulate; laminal cells in upper one third of leaf towards acumen narrowly elongate-linear, 1: w ratio >8: 1, thick-walled, pitted, smooth or obscurely papillose; alar region differentiated with row of 3–4 upright cells, thin- to thick-walled, slightly to moderately large swollen cells. Perichaetia inconspicuous, on stems; perichaetal leaves oblong lanceolate, +/- abruptly acuminate; margins serrate at the acumen but otherwise subentire; ecostate, cells linear, firm to thick-walled, +/- porose, smooth to irregularly pluripapillose, alar region not differentiated but yellow across insertion; inner perichaetal leaves ovate-lanceolate, long filiform. Seta elongate, red; capsules inclined, ovoid to longish; exothecial cells usually round, strongly collenchymatous; operculum with swollen base, and needle-like rostratum; peristome double, exostome teeth 16, broad-lanceolate, cross- striate with widely extending lamellae; incurved between en-
dostome segments when dry; endostome segments 16, with basal membrane widely extending, segments same length as exostome teeth, keeled; cilia 1–2, often shorter than segments. Spores moderately large. No chromosome number available.

The correct nomenclature is as above as Bescherelle’s original publication was invalid. The species name was validated by Jaeger, and the generic name by M. Fleischer (information kindly supplied by B. O’Shea). There has been much disagreement about the status and generic concept of *Rhaphidorrhynchium* vis-à-vis *Sematophyllum* and other related genera. Brotherus (1925) assigned those species with strongly falcate-secund leaves to *Rhaphidorrhynchium* and those with erect to flexuose leaves to *Sematophyllum*. This has not met with general approval as related species may sometimes be placed in separate genera. Dixon (1929), Sainsbury (1955) and Scott & Stone (1976), combined both taxa into *Sematophyllum* when dealing with Australasian species as have Buck & Tan (1989) for the Philippines.

Our study shows that *Rhaphidorrhynchium* and *Sematophyllum* can be morphologically distinct in Australia. *Rhaphidorrhynchium* has strongly flexuose or falcate-secund leaves, and *Sematophyllum* has appressed to erect-spreading leaves that may be secund or flexuose at most, but not strongly falcate when dry. However, it is the laminal cells in the upper one third of the leaf, especially in the long leaf acumen, that are the important distinguishing feature. These cells are narrowly elongate to linear (l:w ratio > 7:1) in *Rhaphidorrhynchium*, but rhomboid, oval-oblong, fusiform to short-elongate (l:w ratio < 7:1) in *Sematophyllum* (except for *S. subhumile* which has elongate-linear cells with l:w ratio 7–10:1 but leaves are straight, not falcate-secund). The exothecial cells in *Rhaphidorrhynchium* are strongly collenchymatous but in *Sematophyllum* they are sub-collenchymatous with thickened longitudinal walls. Although laminal cells of *Rhaphidorrhynchium* were described as smooth in literature, many species which were treated traditionally in this genus, such as those from Australasia, infrequently develop a low single papilla on some laminal cells. Because of the unipapillose leaf cells, *Rhaphidorrhynchium*, in our opinion, is more closely related to *Warburgiella* than to *Sematophyllum*. It differs from *Warburgiella* in having strongly collenchymatous exothecial cells and non-sheathing inner perichaetial leaves.

The genus *Rhaphidorrhynchium* has a Gondwanan distribution with a number of species scattered throughout Australasia, South America and Africa, extending northward in Asia reaching Malesia and India. Only one species, *R. amoenum*, with one variety, and several heterotypic synonyms, is accepted for the Australian moss flora. *Rhaphidorrhynchium leucocytus* is transferred to *Warburgiella* on account of shared similarities in the perichaetial leaf morphology and exothecial cells.

1. **Rhaphidorrhynchium amoenum** (Hedw.) M. Fleisch., Musci Fl. von Buitenzorg 1249 (1923).


Stereodon leporrhynchus (Brid.) Brid., Bryol.Univ. 2: 824 (1827), comb. inval.; Hypnum leporrhynchum Brid., nom. illeg. incl. H. cyparioides Brid., fide Index Muscorum and Dixon (1923).


Hypnum cyparioides Brid. ex P. Beauv. was reduced to a synonym of R. amoenum by Dixon (1929). Numerous collections of Hypnum cyparioides from Tasmania collected by Stuart and Gunn in Herbarium of W. Wilson at BM support this synonymy.

We could not locate the type of Hypnum callidioides at B or BM but an isotype has
Fig. 17. *Rhaphidorrhynchium amoenum*: a. habit of var. *amoenum*, plant bearing sporophyte; b. sporophyte with perichaetal leaves at base; c. young sporophyte with calyptra; d. calyptra enlarged with young sporophyte inside; e. habit of plant of var. *congruens* bearing sporophyte, note perichaetal leaves not acuminate; f. capsule of (e); g. branch leaves of (a); h. apical leaf cells; i. mid-lamina cells; j. basal alar region; k. perichaetal leaf of (a); l. exothecial cells; m. peristome–endostome segment (left), exostome tooth (right); n. side view of apex of exostome tooth, note trabeculae. Scale bars — a–g, k=1 mm; h–j, l–n=100 μm [a–d, g–j, 1–n, var. *amoenum*, R.A. Bastow s.n., 9. xi. 1901 (HO); k, A.C. Beauglehole 14105 (MEL); e–f, var. *congruens*, W.A. Weymouth 2900 (HO)].
been found in MEL which is *R. amoenum*. There are three specimens of *H. callidioides* at BM collected by F. Mueller from Austral Felix and La Trobe River, Victoria, they are all *R. amoenum*. Our proposed synonymy between the two taxa is further supported by the detailed illustration prepared by F. von Mueller (1864) for *H. callidioides* which shows clearly that it is conspecific with *R. amoenum*.

Many collections named as *R. amoenum* are in reality species of *Warburgiella*, so specimens need to be studied with care.

**Studied Specimens:**
- **Queensland**: logging road to Mt. Lewis from Kennedy Road, B.C. Tan, 94-75, with E.A. Brown & R.G. Coveny (NSW, FH).
- **New South Wales**: Bago State Forest SSW of Batlow, H. Sfreimann 35052 (CANB, HO); Yarrangobilly, *W. W. Watts* 8613, 8623, 8814, 8646, 8633, 8859 (NSW, as *R. callidioides*).
- **Australian Capital Territory**: Tidbinbilla, R.G. Coveny s.n. (NSW).
- **Victoria**: Grampians, G.K. Thomson s.n. (MEL); Mt Wombelano Falls, Kinglake National Park, *A.W. Thies* FN 1480 G (MEL); Gembrook, *R.A. Bastow* 90 (MEL); Mt Donna Buang, *A.W. Thies* FN 1502D (MEL); Wombat Creek, *J.H. Willis* s.n. (MEL); near Warburton, *J.H. Willis* s.n. (MEL); Wilsons Promontory, *J.H. Willis* s.n. (MEL); Lakes N.P., G.K. Thomson s.n. (MEL); Kallista, *H.T. Clifford* s.n. (MEL); Mt Ellery, *J.H. Willis* s.n. (MEL); Grampians, *J.H. Willis* s.n. (MEL); Victoria Range, G.K. Thomson s.n. (MEL); Mt Eccles, A.C. Beauglehole 3070 (MEL); Seales Cove, F. Mueller 168 (MEL); East Gippsland, C. Walter s.n. (MEL); Dandenongs, F. Mueller s.n. (MEL).
- **Tasmania**: Mt Wellington, A.V. Ratkowski A 1728 (HO); The Springs, Mt Wellington, *W.A. Weymouth* 169 (HO); Cradle Mtn, A.V. Ratkowski H426 (HO); Margaret Pass, S.J. Jarman 156627 (HO); Safety Cove, *J.H. Willis* s.n. (MEL); Port Davey, *M. Davis* 12166F (MEL); Bathurst Harbour, *M. Davis* 1420C (MEL); Flinders Is., *J.S. Whinray* s.n. (MEL); Deal Is., Bass Strait, *J.S. Whinray* s.n. (MEL); Mt Rurneay, R.A. Bastow 199 (MEL).


Previous illustration: none.

Compared to *R. amoenum*, the type of *Hypnum congruens* is larger in plant size. The species is similar to *R. amoenum* in nearly all gametophytic and sporophytic details except in the perichaetal leaves. In *R. amoenum*, the perichaetal leaf apices are gradually long acuminate to piliferous and strongly denticulate distally, whereas the perichaetal leaf apices of *H. congruens* are shortly acute and nearly entire. We have very few specimens of *H. congruens* and could not interpret the taxonomic significance of these morphological differences. Because *H. congruens* has collenchymatous exothecal cells, the taxon is being treated here as a variety of *R. amoenum* that exhibits a different perichaetal leaf morphology.

**Additional studied specimen:**
- **Tasmania**: No locality given, *W.A. Weymouth* 2900 (HO).


[Etymology: The generic name is derived from the Greek 'trichos' or hair and 'steleon' handle, possibly referring to the long rostrate operculum].

Autoicous. Plants slender to moderately robust forming extensive dull, yellow-green to brownish-green tufts or mats. Stems creeping, irregularly branched, branches solitary or with scattered branchlets, sometimes obscurely complanate-foliolate. *Pseudoparaphyllia* foliisose. Rhizoids red, short, smooth, in tufts on main stem. Leaves erect-spreading to slightly falcate-secund, ovate-lanceolate to lanceolate, acute to gradually or abruptly acuminate-subulate, concave; margins subentire or more often serrulate above, sometimes recurved; ecostate; upper laminal cells linear, sometimes shorter in extreme apex, unipapillose over lumina at least in upper 2/3-3/4 of leaf, usually thick-walled and porose, more so towards insertion; alar region with basal row of greatly enlarged and inflated, oblong, thin to firm-walled, often coloured alar cells, supra alar cells few if any. Perichaeta on stems. Perichaetal leaves erect, mostly lanceolate, acuminate, margins often serrate particularly near apex, ecostate; upper cells linear above, laxly rectangular below, often papillose; alar region well developed, basal alar cells enlarged and inflated. Calyptra cucullate, naked, smooth or roughened above. Seta slender, short, curved at apex, often papillose above, occasionally smooth; capsules small, horizontal to pendant, asymmetric; exothecial cells strongly collenchymatous, often bulging; annulus none; operculum slenderly long-rostrate; peristome double, exostome teeth 16, with zig-zag centre line or a median furrow on front, cross-striolate below, coarsely papillose above, projecting trabeculae at back; endostome with high basal membrane, papillose, segments keeled, perforated, cilia usually single. Spores small, papillose. No chromosome number available.

As proposed by Buck & Tan (1989), *Trichosteleum* now includes only those species that have erect, flexuose leaves with elongate leaf cells that are unipapillose over the lumen, alar cells that are enlarged and inflated but rather thin-walled, and exothecial cells collenchymatous. Unlike other taxa with unipapillose cells only in vegetative leaves (*Acanthorrhynchium, Papillidiopsis*), in *Trichosteleum* the cells of both vegetative and perichaetial leaves are unipapillose. In addition the exothecial cells are often strongly mammillose in *Trichosteleum*.

The leaf shape variation in *Trichosteleum* is similar to that in *Sematophyllum* but with unipapillose cells on most of the leaf, whereas *Sematophyllum* has smooth leaf cells. A few species of *Acroporium* may share unipapillose leaf cells with *Trichosteleum*, but in *Acroporium* the leaf cell papillae tend to express themselves weakly in the upper 1/3 of the leaf and the tips of the alar cells curve distinctly inwards towards the stem, whereas in *Trichosteleum*, the leaf cell papillae are strongly developed, except in *T. subfalcatum* and *T. wattsii*, and the alar cells are always straight. *Acanthorrhynchium* also has unipapillose
cells but has short laminal cells, filamentous pseudoparaphyllia, presence of an annulus, conic short rostrate operculum, and non-collenchymatous exothecial cells, which separate it from other genera including *Trichosteleum*.

*Trichosteleum* and *Taxithelium* are sometimes confused with each other because of the often complanate-spreading habit but *Trichosteleum* has unipapillose cells, and a long rostrate operculum, while *Taxithelium* has seriately papillose cells, a short apiculate operculum and often has binate teeth on the leaf margin. *Trichosteleum* can also be confused with *Rhaphidorrhynchium* sharing the same unipapillose leaf cells, but the leaves of the latter are strongly falcate-secund and the laminal cells are elongate-linear throughout whereas the leaves of *Trichosteleum* are mostly straight or flexuose, at most weakly falcate, and the leaf cells are mostly oblong to oblong-elongate near the leaf apex.

*Trichosteleum*, with about 60 species, is distributed in the old world tropics, including Malesia, extending to wet tropical northeastern Australia. The genus is now known to include 4 species in Australia of which 2 are endemic. A number of Australian taxa previously placed in *Sematophyllum* or *Rhaphidorrhynchium*, such as *Sematophyllum wattsii* and *Rhaphidorrhynchium subfalcatum*, have been found to have unipapillose cells and transferred to *Trichosteleum* (Tan et al., 1998). A number of Australian collections named as *Sematophyllum saproxylophilum* (Miull. Hal.) M. Fleisch. fit into various *Trichosteleum* species. Although *S. saproxylophilum* has been transferred to *Trichosteleum* (Tan et al., 1998) none of the Australian specimens fit this species concept and it is therefore excluded from Australia.

Key to the species

1. Leaf cells strongly papillose ............................................. 2
1. Leaf cells weakly papillose ............................................ 3
   2. Leaf margins strongly serrulate to serrate throughout; leaves flat; lamina cells 12–14: 1
       ................................................................. 2. *T. ruficaule*
   2. Leaf margins weakly serrate or serrulate in the upper half; leaves concave; lamina cells 15–20: 1
       ................................................................. 1. *T. boschii*
3. Leaves mostly falcate, especially the perichaetial and distal branch leaves, clearly falcate-flexuose ................................................................. 3. *T. subfalcatum*
3. Leaves mostly straight, erect spreading, distal branch leaves and perichaetial leaves very rarely falcate-flexuose .................................................. 4. *T. wattsii*


Previous illustrations: Dozy & Molkenboer (1844), Pl. 275. (as *Hypnum boschii*); Bartram (1939), pl. 26, fig. 440; Gangulee (1980), fascicle 7, fig. 977, p. 1910.

*Autoicous.* Plants slender to moderately large, in dense, tangled, loose tufts, yellowish-green, slightly glossy. Main stems elongate, creeping, dark brown, irregularly pinnate; branches laxly ascending, erect, 0.5–2 cm long, complanate. Leaves ovate-lanceolate, concave, gradually or often abruptly long-acuminate to 1.3–2.0×0.5 mm, ecostate; leaf margins more or less reflexed and slightly undulate above, serrulate in upper half; laminal cells
linear-rhomboid, thin-walled, 42–80×0.3–0.4 μm, unipapillose with large conic papilla over lumen on dorsal side, smooth towards base, alar region with basal row of 2–3 large, inflated, coloured alar cells, upper alar cells few. Perigonia and perichaetia on stems and branches; perichaetial leaves oblong lanceolate, long acuminate to filiform, serratate above; cells strongly unipapillose. Seta 8–14 mm long, curved and papillose at tip, smooth below; capsules small, horizontal or pendulous, exothecial cells smooth to mammillose, col-lenchymatous; operculum conic, long rostrum 2–3 times as long as urn; peristome red-brown, gradually finely acuminate, inflexed above, 0.3 mm long, mid-line distinct; endostome yellowish, broadly ovate, basal half keeled, apex finely pointed, perforate; basal membrane short, ciliatum single, shorter than segment. Spores 18 μm, spherical, smooth. Fig. 18.

Distribution: Widely distributed in India, Malesia, Hong Kong, Fiji and Australia. The species was first recorded for Australia by Tan et al. (1996) in northeast Queensland where it is rare and restricted. Map 1, Fig. 31.

Habitat: Epiphytic on dead wood and on bark.

Notes: Trichosteleum boschii is easy to identify among the Australian congeners. It is the only species that has strongly papillose leaf cells and also strongly concave leaves. The leaf apex is somewhat abruptly short acuminate which distinguishes it from the broadly acute leaves of T. ruficaule and the slenderly acuminate to filiform leaves of T. subfalcatum and T. wattsii. The last two taxa also have low leaf cell papillae. It has some similarity to Acanthorrhynchium papillatum which differs in having narrowly acuminate leaf apices, serrate margins, short cells, and a short conic operculum.

Studied Specimens:
Queensland: Track to Kennedy Falls, W.B. Schofield 90362 with I.G. Stone & M.I. Schofield (NSW, UBC); Mossman Gorge, W.B. Schofield 90077 with I.G. Stone & M.I. Schofield (NSW, UBC); Woopen Creek, I.G. Stone 15055 (MEL), H. Streimann 57010, 57370 (CANB); Stoney Creek, Cardwell, I.G. Stone 18718, 18745 (MEL).


**Autoicos.** Plants dull to somewhat glossy, spreading, closely pinnately branched, forming complanately-foliate greenish mats, sometimes slightly secund at tips, tips tapering. Stems creeping, branches regularly arranged, 3–5 mm long. Leaves erect-spreadin, oblong-elliptic to lanceolate or narrowly ovate, subulate, contracted at base, margins entire at base, narrowly recurved, sharply serrate to apex, ecostate. Laminal cells long narrow, linear, 40×3 μm, walls thick, strongly unipapillose over lumen, particularly in upper 1/2–3/4 leaf cells; alar region well developed; basal row of 2–3 alar cells, large, coloured, thin-walled, inflated, elongate, 90×15 μm, upper alar cells, 2, distorted subquadrate, cells across insertion coloured, thick-walled. Filamentous gemmae, unbranched, sometimes present in
Fig. 18. *Trichosteleum boschii*: a. habit of plant bearing sporophyte; b. capsule with operculum; c. capsule showing peristome; d. branch leaves; e. leaf apical cells; f. mid-lamina cells; g. side view of papillae; h. basal alar cells; i. perichaetial leaf; j. apex of (i) enlarged; k. more ovate leaves from another specimen; l. leaf of (k) enlarged to show papillose surfaces; m. exothecial cells; n. peristome—wide endostome segment folded (left), narrower exostome tooth (right). Scale bars — a, d, j–l = 1 mm; b–c, e–i, m–n = 100 µm [a–h, m–n, W.B. Schofield 90362 (NSW); i–l, H. Streimann 57010 (CANB)].
leaf axils. *Perichaetium* on main stem, perigonia on side branches, perichaetial leaves unipapillose with dense marginal serrulation. *Seta* 7–8 mm, straight, smooth; *capsules* narrowly obovate, contracted around mouth, 1×0.5 mm, neck cells mamillate; operculum conic, long rostrate; *peristome* details not recorded. *Spores* 10–15 μm. Fig. 19.

*Trichoesteleum ruficaule* is widespread in Indo-Malesia including the Philippines and Pacific region, as well as in NE Australia.

In Australia *T. elegantulum*, which is a synonym of *T. ruficaule* (Tan et al., 1996), has been recorded only from northeast Queensland. Map 2, Fig. 31.

Habitat: on tree branches in rainforest.

Notes: Dwarf male plants have been reported for the type specimens of *T. ruficaule* and also in a collection from Borneo (Tan, 1991). The strongly serrate leaf margins coupled with unipapillose leaf cells and collenchymatous exothecial cells are distinctive for the species. However, it has been described under many synonyms in the Indo-Pacific region including *T. elegantulum* in Australia. Capsules are very rare on Australian collections.

Studied Specimens:

**Queensland:** Cooro logging area near Innisfail, *H. Streimann* 299988 (CANB); Frenchman’s Creek, Cairns district, *W.W. Watts* Q382 (H-BR, MEL, NSW); Windsor Tableland, *P. Hynes* 8B (BRI); Mossman Gorge, *B.C. Tan* 94-703 with E.A. Brown & R.G. Coveny (FH, NSW), *I.G. Stone* 158567 (MEL); Kirrama, *I.G. Stone* 17005 (MEL); Old Leo Creek Mine, Mellwrath Range, 27 km NE of Coen, *H. Streimann* 56761 (CANB); Mowbray R., Mrs Sparvell s.n. (Flecker 4948 (as *Sematophyllum saproxylophilum*, BRI); Cape Tribulation, *I.G. Stone* 18015, 18016, 18017c, 18025, 18026 (MEL); Mt Bartle Frere, *I.G. Stone* 18884 (MEL); Hichinbrook Is., *I.G. Stone* 14914 (MEL).


Previous illustration: none.

Plants small to robust, creeping, forming pale yellow-green mats. *Stems* red, 1–3 cm, irregularly branched, *branches* 3–5 mm. *Leaves* falcate to falcate-secund, narrowly lanceolate to oblong, slightly narrowed to base, 0.5×0.25 mm, gradually narrowed to long attenuate filiform point, margin nearly entire, plane, serrulate distally, with a few widely spaced short teeth near apex; *laminal cells* narrow, elongate with pointed ends, smooth, often with a low papilla over the cell lumen, 90×6 μm; *alar region* well developed with basal row of 4–5 coloured, swollen, thick-walled cells; upper alar cells 1–2. *Perichaeta* on stems, perichaetial leaves large, oblong-lanceolate, slenderly filiform, apices serrulate; *perigonia*
Fig. 19. *Trichosteleum ruficaule*: a. three leaves; b. apex of leaf showing marginal serration; c. apex of perichaetal leaf showing marginal serration; d. perichaetium; e. leaf apical cells; f. mid laminal cells; g. alar region; h. filamentous gemma; i. enlarged cells of gemma; j. habit bearing sporophyte; k. capsules, with operculum (above), showing peristome teeth (below). Scale bars — a, d, h–k = 1 mm; b, c, e–g = 100 μm [a–d, h–k (as *T. elegantulum*), W.W. Watts Q382 (NSW); e–g., H. Streimann 29988 (CANB)].
Fig. 20. *Trichosteleum subfalcatum*: a. habit of plant bearing sporophytes; b1, b2, branch leaves; c. apical leaf cells; d. mid-laminal cells; e. basal alar region; f. perichaetial leaves; g. apex of perichaetial leaf; h. capsule with operculum; i. exothecial cells; j. peristome-endostome segment (left), exostome tooth (right); k. apex of exostome tooth, note trabeculae; l. spores. Scale bars — a, b1, b2, f, h = 1 mm; c-e, h-i = 100 μm [a-i, isoleclo: W.W. Watts LHI122; j-l, syntype W.W. Watts LHI 134 (NSW)].
not seen. *Seta* smooth, <1.0 cm; *capsules* suberect to nodding, ovate, 0.6×0.5 mm, wall mammillate, exothecial cells clearly collenchymatous; operculum long rostrate; *peristome* double, exostome teeth 16, strongly papillose, striate, median longitudinal groove, trabeculate on inner surface; endostome segments 16, papillose, basal membrane high, papillose, cilia not seen. *Spores* 10–15 μm. Figs. 20, 21.

Distribution: an Australian endemic, distributed in Queensland and New South Wales including Lord Howe Island, also on Norfolk Island. Map 3, Fig. 31.

Habitat: epiphytic on stems and branches.

Notes: *Trichosteleum subfalcatum* is a variable species. Plants can be small or robust. The narrowly oblong-lanceolate leaves are clearly falcate, at times flexuose, but never strongly falcate-secund as in species of *Rhaphidorrhynchiun*. The present species approximates *T. wattsii* in leaf outline and cell areolation but differs in having larger leaves, many of which are clearly falcate with long acuminate apices, not straight or erect as in the case of *T. wattsii*. Its relationship with *T. wattsii* needs further study when additional specimens of both species are available for a critical comparison. However, the following features are

![Fig. 21. Scanning electron micrographs of the peristome of *Trichosteleum subfalcatum*: a. outer surface of exostome showing plates and lapillae, also trabeculae on inner surface, ×720; b. outer surface showing apices of exostome teeth alternating with endostome segment, ×1440; c. junction between cells of the apex and the base of an exostome tooth showing differences in pattern, ×1440; d. close up of base of exostome tooth showing all surfaces papillose, ×3600; e. inner surface of exostome tooth showing trabeculae, ×720; f. inner surface of basal membrane at base of endostome segment, ×1440 [W.W. Watts LHI 131 (NSW)].](image)
distinguishing for *T. subfalcatum* based on comparison of types: leaves larger and long acuminate, exothecial cells collenchymatous, spores smaller, perichaetal leaves serrarulate; filamentous gemmae have not been located.

Dixon (1941) described *T. pallidum* based on a 1922 collection of *Sherrin* from Duma Creek, Ravenshoe. Although we were unable to see the type preserved at BM (iso: E), the description would indicate it to be a synonym of *T. subfalcatum*. Several specimens from northeast Queensland, Lord Howe Island and Norfolk Island, named as *T. pallidum*, fall within our concept of *T. subfalcatum*.

**Studied Specimens:**

**Queensland:** Dallachy Creek, Cardwell, I.G. Stone 16431 (MEL, as *T. pallidum*); Cape York Peninsula, L.J. Brass 19873, 20152 (FH, as *Sematophyllum saproxylophilum*); Mt. Lewis area, along Kennedy Road, Tan 94-766A with Brown & Coveny (FH, NSW); Wright Creek, Lake Eacham, Streimann 16899 (UBC, CANB); Conway State Forest, Proserpine, Streimann 37344 (CANB); Upper Mowbray R., Mrs Sparvell (CANB); Finch Hatton Gorge, Eungella Ra., D. Verdon 5262 (CANB); Conway S.F. 18 km ENE of Proserpine, H. Streimann 27517, 27522, 27525, 27529 (CANB); Cardwell, Dallachy Creek, I.G. Stone 16451 (MELU); Kennedy, I.G. Stone 18574 (MEL); Windsor Tableland, I.G. Stone 16119 (MEL); Pine Creek near Cairns, I.G. Stone 17988 (MEL); O'Reillys, 25 Sept 1983, I.G. Stone 21597 (MEL); Mt Mackay, I.G. Stone 22504 (MEL); Cape Tribulation, I.G. Stone 18176 (MEL).

**New South Wales:** Blue Mountains, W.B. Schofield 81158 (UBC); Blue Mts, Wentworth Falls, B.C. Tan 94-823 (NSW); Lawson, B.C. Tan 94-825, 94-826, with A.E. Brown & R.G. Coveny (FH, NSW); Kurrajong Heights, C.T. Musson 4534 (as Acanthocladium sericeum Broth., nom. nud.) (NSW); Mt. Wilson, between Cathedral of Ferns and Zircon Creek, B.C. Tan 94-841, with P.M. Selkirk & A.J. Downing (FH, NSW).

**Lord Howe Island:** northern end of North Beach, R.D. Hoogland 8711 (CANB, MEL, as *T. pallidum*); Mt Gower, *WW*. Watts 364a, 370, 400 (syntypes, NSW); Intermediate Hill, *WW*. Watts 135 (syntype, NSW); Creek above Johnson’s, *WW*. Watts 122 (lectotype NSW); Gully back of Henderson’s, *WW*. Watts 131 (syntype, NSW).

**Norfolk Island:** King Fern Gully, Mt Pitt Reserve, H. Streimann 34533 (CANB, as *T. pallidum*).


Previous illustration: none.
Plants creeping with few short branches. Stems pale orange; branches to 7 mm, often complanate. Leaves weakly secund or erect ascending, ovate-lanceolate to narrowly lanceolate-linear, 1–2 × 0.3 mm near base, apex acuminate, weakly toothed above; margin entire, weakly recurved; laminal cells faintly unipapillose, elongate-linear 60–90×6 μm, apical cells shorter, 4–5:1; alar region with basal row of 1–3 very large thin-walled cells, supraalar cells 1–4, rhomboid; branching, papillose, filiform gemmae sometimes present. Perigonia not seen; perichaetia on stems, outer perichaetial leaves short acuminate, inner perichaetial leaves long acuminate with smooth margins. Seta long, 1.6–1.8 cm, smooth; capsules small 0.6 mm long, sub-erect to inclined, mammilllose; exothecial cells semi-collenchymatous; operculum long rostrate, curved; peristome double, exostome teeth 16, to 300 μm long, with long acuminate apex, papillose, striate on outer face, trabeculate on inner surface; endostome 16, segments arising from high basal membrane, lightly papillose, ciliatum single, shorter than segments. Spores 18–20 μm. Figs. 22, 23.

Trichosteleum wattsii is a relatively small plant with erect, narrowly lanceolate leaves measuring to 2 mm long. The type of Hypnum glaucoviride Hampe represents plants with longer leaves. Smaller plants sometimes can be mistaken for Sematophyllum subhumile, but this species has ovate-lanceolate to oblong-lanceolate leaves with smooth laminal cells. Undoubtedly, its relationship is with T. subfalcatulum which has somewhat falcate to flexuose leaves. However, there are differences that distinguish between them. T. wattsii has smaller, less acuminate leaves, its exothecial cells are semi-collenchymatous, not collenchymatous, perichaetial leaves have smooth margins, and it occasionally has branching, filiform gemmae.

Distribution: an Australian endemic found in Queensland, New South Wales and Victoria where it is rare. Map 4, Fig. 31.

Habitat: On fallen logs in coastal heath and along riverine forest.

Notes: T. wattsii was once common in scrub and coastal heath on fallen logs in the Richmond and Brunswick River area in the late 19th century when W.W. Watts collected large numbers of specimens. Although sought, it has not been collected in that area since that time. A search should be made to determine whether it is still present in the area. Most of the specimens at NSW were originally published as T. micropyxis, hom. illeg., later republished as T. wattsii.

Studied Specimens:

Queensland: Frenchmans Creek, WW Watts s.n. (MEL); Upper Mowbray R., Mrs Sparvell s.n. [Flecker 4949 ex QRS] (CANB); Lockhart R., Settlement Rd, H. Streimann 56626 (CANB); Tozers Gap, Iron Range National Park, 30 km SW Cape Weymouth, H. Streimann 56424 (CANB); Cooroo logging area, 16 km WN of Innisfail, H. Streimann 29989 (CANB); The Gap, Enoggera Creek, S.T. Blake 22985 (BRI); Scrappys Creek, Hinchinbrook Is., E. Stephens s.n. (BRI); Binna Burra, I.G. Stone 12936 (MEL); Cardwell, I.G. Stone 16278 (MEL); Mt Bellenden Ker, I.G. Stone 15570 (MEL); Stoney Creek, Cardwell I.G. Stone 18684 (MEL); Dunk Is., D.G. Catcheside 76.112 (AD); Kennedy Falls, I.G. Stone 24413 (MEL); Downey Creek, I.G. Stone 24177 (MEL); Seaview R., I.G. Stone 21302 (MEL); Kirrama, I.G. Stone 18369 (MEL); Cape Tribulation, I.G. Stone 18017 (MEL).

New South Wales: Double Bay, Sydney, T. Whitelegge (NSW); Rous, Richmond River, WW Watts 1357 (NSW, MEL), WW Watts 647 (NSW); Brooloo, Richmond River, WW Watts 1239 (NSW); Myocum, Brunswick R., WW Watts 1525 (NSW, MEL), 1680, 3815, 3820 (NSW); Marshal-
Fig. 22. *Trichosteleum wattsii*: a. habit of plant bearing sporophyte; b. branch leaves of *T. wattsii*; c. branch leaves of *Hypnum glaucoviride*; d. leaf apical cells of b; e. mid-laminar cells of b; f. basal alar region of b; g. leaf apical leaves of c; h. mid-laminar cells of c; i. basal alar region of c; j. perichaetial leaves; k. apex of perichaetial leaf; l. capsule with operculum; m. exothecial cells; n. peristome: endostome segment (left), exostome tooth (right); o. spores; p. branched gemma arising from the stem; q. enlarged gemma. Scale bars — a–c, j–l, o, p=1 mm; d–i, m–o, q=100 μm [a–b, d–f, j–k, m–o (W.W. Watts 617, holotype of *T. wattsii*, BM); c, g–l, Dallachy (MEL 32743 as *Hypnum glaucoviride*); l, p–q, I.G. Stone 21424 (MEL)].
1's Falls track, Richmond R., WW Watts 617 (type, NSW, MEL); Marshalls Falls, Richmond R., WW Watts 2033 (NSW); Alstonville, Richmond R., WW Watts s.n. (MEL); Marshall's Falls, Alstonville WW Watts 606, 3489, 3490 (NSW); Spring Hill, Richmond R., WW Watts 1124 (NSW); Brooklet, WW Watts 1269 (NSW); East Ballina, WW Watts 1036 (NSW); scrub at Ballina, WW Watts 783, 4458 (NSW); Tintenbar, WW Watts 1223, 351 (NSW); Fernleigh, WW Watts 1882 (NSW); Maxwell's scrub, Richmond R., WW Watts 892 (NSW); Foot of Mt Lindsay, W Forsyth 899 (NSW); Alstonville Road, WW Watts 475, 4962 (NSW); Wardell-Ballina Rd, WW Watts 695 (NSW); Uralba, WW Watts 1787, 4492 (NSW); Prospect track, Richmond River, WW Watts 1372 (NSW); Federal to Mullimbimby, WW Watts 2123 (NSW); Wollongbar, WW Watts 2390 (NSW); Possum Shoot, WW Watts 3877, 3881 (NSW); Myocum, WW Watts 3934 (NSW); Park Gray's Island, Richmond River, WW Watts 4230 (NSW); Ballina, WW Watts 4419 (NSW); Wardell Rd, WW Watts 5034 (NSW); Head, Wilson's Creek, Richmond River, WW Watts 5215 (NSW).

Victoria: Mt Drummer, 17 Feb 1965, J.H. Willis s.n. (MEL); Mt Boobyalla, R. Filson 7041 (MEL).

Excluded taxon: 
Trichosteleum kerianum Broth. = Taxithelium kerianum (Broth.) Broth.


[Etymology: The generic name is in recognition of the work of Otto Warburg a german plant collector].

Autoicous. Plants small, in dense, glossy yellowish-green mats. Stems creeping, elongate, irregularly pinnate to bipinnately branched. Branches to 2 cm, with short, erect-divergent cuspidate branch tips. Pseudoparaphyllia foliose. Stem and branch leaves similar, strongly falcate-secund to circinate, lanceolate to ovate-lanceolate, with expanded, sheathing leaf base, often abruptly long acuminate, acumen sometimes twisted; margins sharply serrate to nearly entire above, entire below, plane but sometimes appearing involute from the strong concavity, ecostate; laminal cells elongate to narrow-linear, prorulose to smooth, sometimes unpapillose; alar region often coloured, single basal row of 3 large, swollen, thick-walled, elongate alar cells; one row of 3 subquadrate small supra-alar cells. Perigonia and perichaetial leaves borne on separate branches; inner perichaetial leaves large, with expanded

Fig. 23. Scanning electron micrographs of the peristome of Trichosteleum wattsii: a-d. outer surface of exostome, a. towards apex of tooth, shows large papillae confined to ridges, ×1380; b. transition zone between apex and base of tooth, ×1380; c. basal region showing patterning of ridges and papilla, ×1410; d. closer view, ×3342; e-h. inner surface of exostome: e. curved tooth shows trabeulae on inner face, ×690; f. apical area, ×1320; g. triangular trabeulae above covered in small papillae, shorter and more rectangular below, ×660; h. trabeule smooth towards base of tooth, ×1320; i-l. outer surface of endostome: i. base, bare of papillae, ×660; j. higher up shows smooth surface, ×1410; k. higher up shows papilllose surface, ×714; l. several segments, ×714; m-p. inner surface of endostome: m. towards apex showing concave papilllose surface, ×1410; n. basal membrane and bases of segments; note cilia bent backwards behind membrane, ×324; o. close up of basal membrane, spores visible, ×714; p. closer view shows papilllose basal membrane cells, cilia and spores visible, ×1308 [WW Watts 1357 (NSW)].
base clasping the branch and vaginula, often abruptly cuspidate, without differentiated alar cells. *Calyptra* large, campanulate (mitrate) sheathing the whole capsule or cucullate, smooth, base deeply laciniate to entire. *Seta* slender, elongate, curved at apex, smooth or papillose above; *capsules* horizontal to inclined, cylindric, neck with stomata, contracted under mouth when dry, smooth, exothecial cells rectangular with thickened longitudinal walls, at times semi-collenchymatous; operculum obliquely long rostrate; *peristome* double, exostome of 16 lanceolate teeth, subulate, densely cross-striolate below, coarsely papillose above with a deep median furrow, well developed trabeculae on inner surface; endostome segments same length as exostome teeth, keeled, slit and perforated, hyaline, smooth, from a high basal membrane, cilia usually 2, well developed, nodose. *Spores* finely papillose. No chromosome number available.

About ten species are distributed in tropical Africa, Malesia, Oceania and New Caledonia. Three species are accepted for Australia. *Warburgiella leptorrhynchoiides* [syn. *W. subleptorrhynchoiides* (M. Fleisch.) M. Fleisch.] is confirmed in this study to be present in Queensland and northeastern New South Wales. *Warburgiella leucocytta* and *W macrospora* are two Australasian taxa added to this genus by Tan, Schofield & Ramsay (1998).

The report of *W. cupressinoides* in Bartram (1952) from Cape York Peninsula (*L.J. Brass 20056, 18281, FH*) is a misinterpretation of *W. subleptorrhynchoiides* [= *W. leptorrhynchoiides*]. The listing of *Warburgiella leptorrhyncha* (A. Jaeger) Broth. for Tasmania in Streimann & Curnow (1989) is also an error incorrectly attributed to Brotherus (1925). No mention of this species was made in the recent moss checklist of Tasmania prepared by Dalton, Seppelt & Buchanan (1991). The species was reported only for Africa in Brotherus (1925) and in Index Muscorum.

The genus *Warburgiella* occurs on tree trunks in closed and subtropical or tropical forests. The character of a mitrate to campanulate calyptra traditionally used to define *Warburgiella* as a genus is barely consistent. In some cases the mitrate calyptra splits up on one side and appears to be cucullate. Buck & Tan (1989) prefer to define the genus on the basis of its strongly circinate leaves with abruptly long toothed apices and somewhat thick-walled alar cells. The semi-collenchymatous exothecial cells and the sometimes prorulose to unipapillose laminal cells further separate it from many other Sematophyllaceous genera. Unipapillose species of *Warburgiella* can be separated from *Trichosteleum* by the calyptra and falcate-secund leaves with a serrate acumen, and semi-collenchymatous exothecial cells. From equally circinate-leaved members of *Rhaphidorrhynchium*, *Warburgiella* can be separated by the semi-collenchymatous exothecial cells, and the sheathing inner perichaetial leaves with a somewhat abruptly acuminate or contracted cuspidate apex. The perichaetial leaves of *Rhaphidorrhynchium* are non-sheathing, gradually long acuminate to filiform. It is on this basis that we have transferred *Rhaphidorrhynchium leucocytta* and *Sematophyllum macrospora* to *Warburgiella*.

**Key to species**

1. Most stem and branch leaves abruptly cuspidate or long acuminate to filiform with an expanded and involute leaf base .......................................................... 3. *W. leptorrhynchoiides*
2. Stem and branch leaves gradually not abruptly long acuminate and without an expanded, invo-
lute leaf base

2. Leaves strongly falcate related to the long, slender and curved apices; apical leaf cells of vegetative and perichaetial leaves elongate-linear; spores small, 10–15 μm in diameter . . . .

H. P. RAMSAY ET AL.: The family Sematophyllaceae in Australia. 255


Previous illustration: F. von Mueller (1864), pl. 15 [as Hypnum trachychaeton].

Autoicous. Plants in matted tufts on bark, pale-green to pale yellow-brown, +/− glossy. Stems to 4 cm, creeping, interwoven, subpinnately and densely branched; branches to 2 cm long, almost straight, +/- cuspidate from the penicillate apical leaves. Leaves narrow, long and tapering, strongly falcate-secund, 1.0–1.4×0.2–0.3 mm; margins plane or narrowly recurved at middle, entire or slightly denticulate in leaf acumen; laminal cells very narrow 50–75×4–5 μm, weakly unipapillose, apical cells elongate-linear; alar region with single row 3–4 inflated cells; upper alar cells few, 1–2. Perigonia not seen; perichaetia on stems, perichaetal leaves ovate-oblong, acuminate to abruptly short-cuspidate, apices strongly toothed. Seta 1–2 cm long, rather stout if short, slightly rugulose in upper part, red, twisted to right; capsules 1.25–1.5 mm long, horizontal or pendulous, oblong or elliptic, angular ridge around base; exothecial cells with unevenly thickened longitudinal walls; annulus lacking; operculum conic, long rostrate, rostrum needle-like, as long as capsule; peristome double, exostome teeth 16, to 250 μm long, ovate-lanceolate, broad at base, crossstriolate, median groove, with acuminate, papillose apex, trabeculate on inner surface, endostome segments from a broad, short basal membrane, segments 16, broad, ovate-lanceolate, as long as exostome teeth, cilium single, shorter than segments or teeth. Spores 10–15 μm, uneven in size but not bimodal. Fig. 24.

Distribution: South America, New Zealand and Australia.

In Australia (Queensland, New South Wales, Victoria, Tasmania), the species is com-
Fig. 24. *Warburgiella leucocyta*: a. habit of plant bearing sporophyte; b. capsule with operculum; c. capsule showing peristome teeth; d. spore e. branch leaves, f. apical leaf cells; g. mid-laminal cells; h. basal alar region; i. peristome: basal membrane with endostome segment and cilium (left), exostome tooth (right); j. exothecial cells; k. side view of apex of peristome tooth showing trabeculae. Scale bars — a–c, e = 1 mm; d, f–k = 100 µm [W.A. Weymouth 941 (HO)].
monest in southern temperate regions. Map 4, Fig. 30.

Habitat: Occurs on logs in fern gullies and rainforest. Rare in NSW and QLD.

Notes: Dixon (1929) synonymized Sematophyllum leucocytus and Rhaphidorrhynchium cerviculatum; this was accepted by Streimann and Curnow (1989). Sainsbury (1955) commented that the vegetative plants of \textit{S. leucocytus} are not always easy to separate from \textit{Rhaphidorrhynchium amoenum}. However, the exothecial cells of \textit{S. leucocytus} were observed to be semi-collenchymatous with extremely incrassate longitudinal walls and thin transverse walls (Sainsbury 1955; Scott & Stone 1976). Here we follow Scott and Stone (1976) in recognizing the semi-collenchymatous exothecial cells of \textit{S. leucocytus} (syn. \textit{R. cerviculatum}) as an important diagnostic character separating it from \textit{Rhaphidorrhynchium amoenum}. The latter has strongly collenchymatous exothecial cells. Scott and Stone (1976) further commented on the peculiar capsule base of \textit{S. leucocytus} which they described as like “a collapsed apophysis and an angular ridge around the very base”. This same capsule base is also present in \textit{W. leptorrhynchoides}. In fact, we think that these differences seen in the perichaetal leaf and exothecial cells of \textit{Sematophyllum leucocytus} warrant a transfer of this species to \textit{Warburgiella}. In addition the seta is rugulose rather than smooth in this species.

Studied Specimens:

\textbf{Queensland:} Mt Bellenden Ker, \textit{W.B. Schofield} 90249 (NSW); Bellenden Ker Range, \textit{I.G. Stone} 24604, 24624 (MEL); Mt Bellenden Ker, \textit{I.G. Stone} 17960, 19763, 155489 (MEL); Damper Creek, Cardwell, \textit{I.G. Stone} 16277, 16274 (MEL).

\textbf{New South Wales:} Pretty Point, Mt Kosciuszko, \textit{J.H. Maiden} & \textit{W Forsyth} 208 (NSW); Mt Wilson, \textit{W.W. Watts} 10369 (NSW).

\textbf{Victoria:} Gembrook, \textit{M. Tindale} s.n. (MEL); Masons Falls, Kingslake N.P., \textit{A.W. Thies} \textit{FN 1565Y} (MEL); Learmonth Ck, Glenelg, \textit{A.C. Beaglehole} 1383 (MEL); Mt Baw Baw, 1892, \textit{C. French Jr.} s.n. (MEL, as \textit{S. cerviculatum}); Otway Ra., \textit{A.C. Beaglehole} 9080 (MEL); Errinundra-Bonang S.F., \textit{A.W. Thies} \textit{FN 1472K} (MEL); Mt Ellery, \textit{J.H. Willis} s.n. (MEL); Yarra R., \textit{F. Mueller} s.n. (MEL); Warrandyte, \textit{E.T. Dakin} s.n. (MEL); Warburton, \textit{Mrs Kerbey} 39, \textit{W.W. Watts} \textit{V921} (NSW); Coolgadie Swamp, \textit{A.C. Beaglehole} 4469 (MEL); Hopetoun Falls, Otway ranges, \textit{A.C. Beaglehole} 16298 (MEL); Turton’s Pass, \textit{H.T. Clifford} s.n. (MEL).

\textbf{Tasmania:} Archer, s.n. (BM, as \textit{Rhaphistegium cerviculatum}); Mt Wellington, \textit{R.A. Bastow} 360 (NSW), 35 (MEL), \textit{W.A. Weymouth} 2900 (HO), 370 (NSW); King Is., \textit{I.D. Cameron} (MEL); Fern Tree, \textit{D.A.} & \textit{A.V. Ratkowsky} \textit{B319} (MEL); Cascades, \textit{R.A. Bastow} s.n. (MEL); Upper Meander, \textit{L. Rodway} s.n. (HO); Wellards Track, Tasman Peninsula, \textit{W.A. Weymouth} 1213 (HO); Fawkes Rivulet, \textit{W.A. Weymouth} 941 (HO); Newmans Creek, Tasman Peninsula, \textit{W.A. Weymouth} 172 (HO); Waratah, \textit{L. Rodway} s.n. (HO); Willards Rivulet, Tasman Peninsula, \textit{W.A. Weymouth} 1967A (HO); near Hobart \textit{W.W. Watts} 312, 313; Mt. Field N.P., \textit{J.H. Maiden} s.n. (NSW); Gordon Rd., \textit{I.G. Stone} 3027 (MELU); Cradle Mtn National Park, \textit{D.H. Norris} 28005 (UBC); Mt King William, \textit{S.J. Jarman} 1648 (HO); Mole Creek, \textit{G. Kantvilas} 64 (HO).


Previous illustration: none.

Autoicous. Plants slender, in dense flat glossy mats, yellow-brown, bronze or yellow-green. Stems creeping; irregularly pinnately branched; branches upright, 2–3 mm, apex straight, curved or weakly falcate. Leaves falcate-secund, narrowly ovate to lanceolate, acuminate, tapering towards narrow apex, 1×0.25 mm, margins slightly recurved on one or both sides, serrate above; laminal cells long narrow, 50–70×2–3 μm, lowly unipapillose, apical leaf cells oblong to elongate, 20–30×2–3 μm; alar region with 2–4 slightly enlarged basal alar cells, thin-walled +/− coloured, supra-alar cells few, quadrate to irregular; flagelliferous shoots sometimes on ends of branches. Perichaetia on stems, outer perichaetial leaves narrow short cuspidate, inner ones long acuminate, apex smooth to slightly serrulate. Seta short, <1.0 cm, smooth; capsules erect, 1–1.5 mm long, subcylindrical, elliptic or ovoid, tapered towards mouth when dry; operculum conic, curved rostrate; exothecial cells semi-collenchymatous; peristome double, exostome teeth 16, 250–300 μm long, narrow, lanceolate, apex subpiliform, papillose, hyaline border, dorsal trabeculae projecting laterally, long trabeculae on inner face, cross-striolate on dorsal surface, median groove; endostome segments 16, lightly papillose, basal membrane medium height, cilia absent or rudimentary. Spores large, strongly papillose, 15–30 μm. Fig. 25.

Distribution: New Zealand and Australia.
In Australia distributed in the southern temperate regions of Queensland (rare), New South Wales (rare), Victoria, Tasmania (rare). Map 5, Fig. 30.

Habitat: Epiphytic on trees and logs in temperate or montane forests.

Notes: Sainsbury (1955) synonymized his New Zealand endemic, Sematophyllum macrosporum Dixon & Sainsbury, with the Javan species, Rhaphidorrhynchium subcylindricum (Broth. ex M. Fleisch.) M. Fleisch., and distinguished Sematophyllum subcylindricum (Broth. ex M. Fleisch.) Sainsbury from Rhaphidorrhynchium amoenum and Warburgiella leucocyta by its recurved leaf margins and large spores. Subsequently, Clifford and Willis (1952) and Scott and Stone (1976) reported Sematophyllum subcylindricum from Victoria and Tasmania. We studied the types of both S. subcylindricum and S. macrosporum and concluded that the two taxa are not conspecific. The type specimens of Rhaphidorrhynchium subcylindricum preserved at FH are much larger plants with longer and more slender leaf acumens than S. macrosporum. Unlike R. subcylindricum, the leaves of S. macrosporum have shorter cells and the leaf margins are only slightly recurved, often on one side only. In addition, the exothecial cells of S. macrosporum are not truly collenchymatous, whereas those of R. subcylindricum are strongly collenchymatous (see illustration in Fleischer, 1923). All Australian records of R. subcylindricum or Sematophyllum subcylindricum should be corrected to Sematophyllum macrosporum which we accept in this treatment as a species of Warburgiella.

Because of its semi-collenchymatous exothecial cells, Warburgiella macrospora can
Fig. 25. *Warburgiella macrospora*: a. leaves; b. leaf apical cells; c. mid-laminal cells; d. alar region; e. leaves f. branch with flagelliform shoot; g. perichaetium; h. apex of perichaetal leaf; i. habit of plant bearing sporophyte; j. capsule with operculum; k. capsule showing peristome teeth; l. exothecial cells; m. peristome: endostome segment (left), exostome tooth (right); n. spores. Scale bars — a, e–g, i–k = 1 mm; b–d, h, l–n = 100 μm [a–d, type, e–f, I.G. Stone 18133 (MEL); i–k. I.G. Stone s.n., Mt. Donna Buang, 13. ix. 1970 (MEL); g–h, l–n, Rodway s.n. 1912 (HO)].
not be considered a species of Trichosteleum, nor Rhaphidorrhynchium, both genera are characterized by strongly collenchymatous exothecial cells within the family circumscription. Warburgiella macrospora differs from Rhaphidorrhynchium amoenum in having shorter leaf acumens and semi-collenchymatous exothecial cells.

Warburgiella macrospora is related to W. leucocya. The two taxa share the same infrequently developed low papillose leaf cells and the semi-collenchymatous exothecial cells. Warburgiella macrospora differs from W. leucocya in having oblong to elongate apical leaf cells, shorter setae (ca. 1 cm long), more erect capsules, larger and strongly papillose spores (15–25 μm in diameter), and more importantly, in having a narrowed, short cuspidate or acuminate, and serrulate perichaetial leaf apex. The apical leaf cells of W. leucocya are elongate-linear and the perichaetial leaves have abruptly long cuspidate and strongly toothed apex. Spores are smaller, 10–15 mm in diameter.

The type of the New Zealand endemic, Rhaphidostegium dallii, kept at BM, lacks sporophytes. The leaf areolation shows that it is conspecific with W. macrospora, although the leaf acumens are shorter and less falcate than the typical W. macrospora. Nevertheless, the description of Rhaphidostegium dallii in the protologue (Brotherus, 1900) matches well the original description of Sematophyllum macrosporum (Sainsbury, 1945). We have seen a specimen collected from Sydney by Rev. R. Collie at NSW named Rhaphidorrhynchium sydneyense Dixon, which also closely approximates the type of Rhaphidostegium dallii, a taxon which we interpret as representing merely a variation of W. macrospora with shorter and less curved leaf acumens. Hence, we cannot agree, therefore, with the herbarium annotation of A. Fife at BM dated July of 1992, which states that Rhaphidostegium dallii is a rather robust form of Rhaphidorrhynchium amoenum.

**Studied Specimens:**

**Queensland:** Mt Bellenden Ker, I.G. Stone 16936 (MEL); Kennedy National Park, I.G. Stone 18787 (MEL).

**New South Wales:** Deep Creek, Batlow, WW. Watts 7976 (NSW); Cambewarra, W. Forsyth s.n. (NSW, as Rhaphidostegium dallii).

**Victoria:** Mt. Donna Buang, 4.5 km NNW of Warburton, H. Streimann 36252, 36233 (CANB, UBC); Turtons Pass, H.T. Clifford s.n. (MEL); Mt Cope, Bogong National Park, A.C. Beauglehole 15560 (MEL); Bunyip Ck., F. Mueller s.n. (MEL); Mt Donna Buang Rd, 20 km from Healesville, R.D. Seppelt 4557 (HO); Mt Donna Buang, I.G. Stone s.n. (MEL); H. Streimann 36252, 36233 (CANB, UBC); Lorne, McRoberts, WW. Watts V 452 (MEL); Head of Yarra R., A.G. Campbell s.n. [WW. Watts V 894] (MEL); Grampians, Australian Bryological Group (MEL); Yackandandah, J.H. Willis s.n. (MEL); Mt Thackarey, C. Beauglehole 30351 (MEL).

**Tasmania:** Florentine Rd & Robinson Rd, S.J. Jarman 1284 (HO); NE of Dundas Tramway, A.E. Orchard 3664 (HO); Mt Wellington, R.D. Seppelt 11460 (HO); Willards Rivulet, Tasman’s Peninsula, W.A. Weymouth 1967B (HO); Bower track, Mt Wellington, R.D. Seppelt 011439 (as Sematophyllum subcylindricum, HO).


Fig. 26. *Warburgiella leptorrhynchoidea*: a–b. leaves; c. leaf apical cells; d. mid-laminal cells; e. alar region; f. perichaetium; g. apex of perichaetal leaf; h. habit of plant bearing sporophytes; i. capsule with operculum; j. capsule showing peristome; k. exothecial cells; l. peristome–endostome segment (left), exostome tooth (right); m. spores. Scale bars — a, b, f, h–j = 1 mm; c–e, g, k–m = 100 μm [a, h–i, D.H. Vitt 27990 (NSW); b–e, j, m, H.P. Ramsay R1075 (NSW); f–g, k–l, W.B. Schofield 90432 (NSW)].
rotet (NY).


Previous illustration: Fleischer (1923), vol. 4, p. 1251, fig. 203 [as *W. subleptorrhynchoides*].

**Polyoicous.** Plants creeping, irregularly pinnate to bipinnate, greenish to yellow-green, forming mats. *Stems* creeping, long to 2 cm. *Branches* upright to spreading, 4–5 mm long. *Leaves* falcate or falcate-secund, narrow oblong to lanceolate, 0.5–1 mm long × 0.3 mm wide, abruptly narrowed to a long serrulate acumen; *laminal cells* rhomboidal 45–72 μm long × 5–6 μm wide, often unipapillose over lumen, apical cells long, *alar region* with basal row of 2–3 large alar cells, orange, elliptical, thick-walled over 100 μm long × 15 μm wide; supra-alar cells few, thick-walled. *Perigonia* on branches; *perichaetia* on stems, perichaetial leaves long narrow, acuminate, apex serrulate. *Seta* orange, 1.5–2 cm long, smooth; *capsules* 1.3 mm long, exothecial cells semi-collenchymatous; *peristome* double, exostome teeth 16, papillose above, cross-striolate below, median groove, trabeculate on inner face, papillose on outer and inner surface; endostome segments 16, surface with scattered papillae, basal membrane high, cilium single, shorter than teeth or segments.

**Spores** 11–15 μm, papillose. No chromosome number available. Figs. 26, 27.

**Distribution:** India, Malesia including New Guinea, and Australia.

The species was recorded for Australia by Streimann & Touw (1981) from Queensland and Ramsay (1984) from northeastern New South Wales. Recent studies give the distribution as Queensland and New South Wales. Map 6, Fig. 30.

**Habitat:** on stems and branches of trees in rainforest.

**Notes:** Touw (1992) placed *W. subleptorrhynchoides* into synonymy with *W. leptorrhynchoides*. Previously Fleischer (1923) placed them close together, although he retained them as two separate species. We have accepted Touw's interpretation that they represent a single taxon.

*Warburgiella leptorrhynchoides* has often been confused with *W. cupressinoides* Müll. Hal. ex Broth. The latter has a mitrate or campanulate calyptra and strongly toothed, falcate leaf acumen. The report of *W. cupressinoides* from Australia by Bartram (1952) is based on specimens of *W. leptorrhynchoides*.

**Specimens:**

**Queensland:** Mt Bellenden Ker, South Peak, H. Streimann 27339 (CANB, L, NICH, H, NY); Josephine Falls, Mt Bartle Frere, W.B. Schofield 79747 with M.I. Schofield (NSW, UBC); Plane track, Mt Bellenden Ker, I.G. Stone 16869 (MELU), 16797 (MELU); Creek walk, Mt Bellenden Ker, I.G. Stone 16869 (MEL).

Fig. 27. Scanning electron micrographs of the peristome of *Warburgiella leptorrhynchoides*: a. face view of peristome, note the exostome teeth incurred between the endostome segments, ×190; b. curled over exostome tooth showing inner trabeculae and outer papillose surface, ×700; c. side view of tooth nearer base, ×800; d. basal region of tooth showing attachment to capsule mouth, ×1000; e. apex of tooth showing papillose surface, endostome segments shown behind, ×300; f. outer surface of endostome shows high basal membrane and segments, ×500; g. outer surface segments, ×1200; h. papillose inner surface of basal membrane, note cilium folded backwards, ×1000. [I.G. Stone 16869 (MEL)].

Stone 16806 (MELU); Centre Peak, Mt Bellenden Ker, J.G. Stone 1690 (MELU); Atherton Forest Reserve No 194, B. de Winter 988 (NSW); Mt Bellenden Ker, south Peak, H. Streimann 27416, 27327, 27329 (CANB); Barron State Forest, Herberton Range, H. Streimann 27222 (CANB, L, NICH, H); Upper Coomera River, Mc Pherson Range, H. Streimann 338 (CANB).

New South Wales: Gibbergunyah, NNE of Lismore, H. Streimann 315 (CANB).

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H. P. RAMSAY ET AL.: The family Sematophyllaceae in Australia. 2

Fig. 31. Distribution maps for Trichosteleum. 1. Trichosteleum boschii, 2. Trichosteleum ruficaule, 3. Trichosteleum subfalcatum, 4. Trichosteleum wattsii.

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