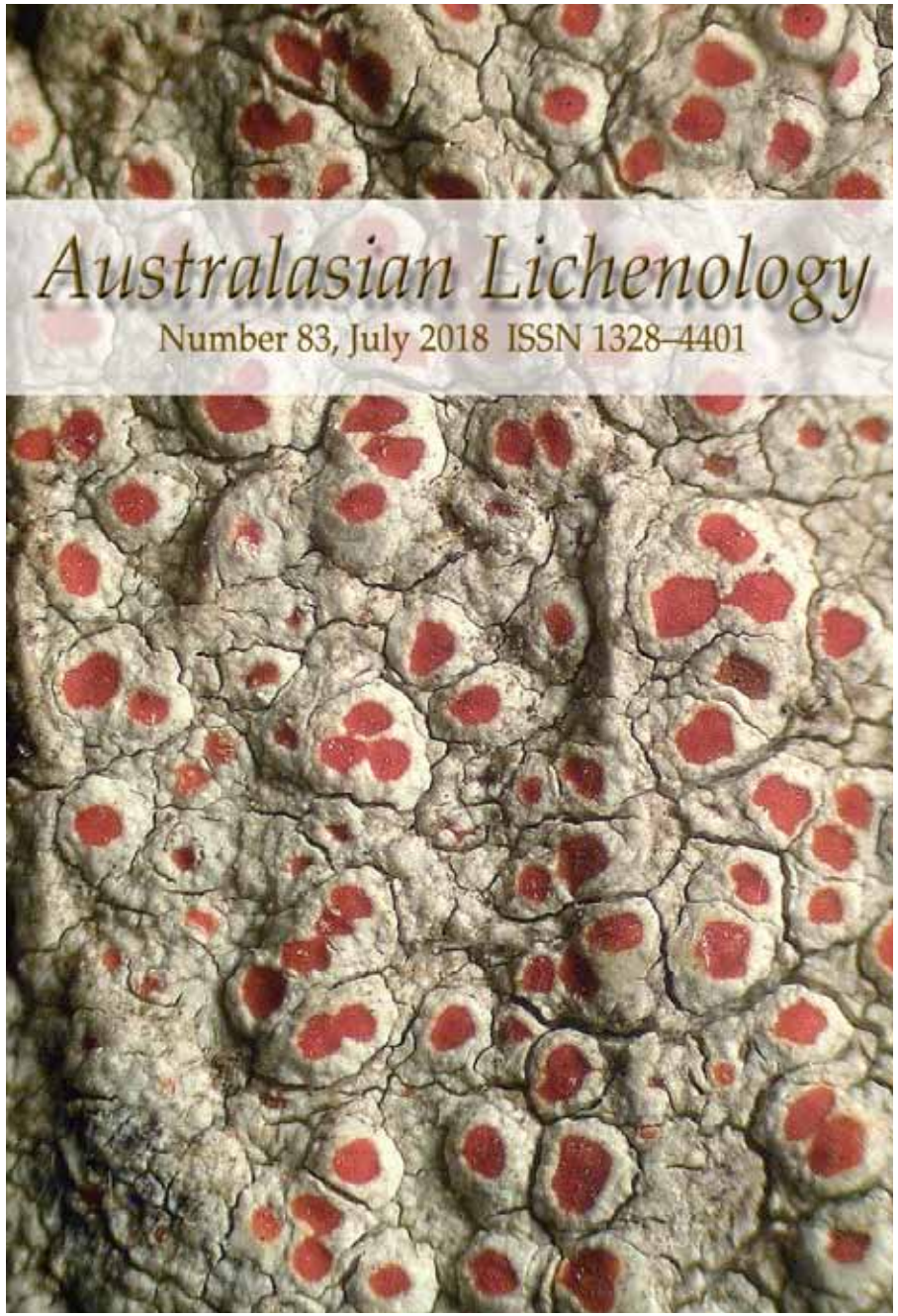

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The striking red pigments in the apothecia of species of *Haematomma* are concentrated mostly in the epihymenium above the tips of the asci. In this *Haematomma persoonii* the pigment is a tetracyclic anthraquinone called russulone. The compound has been found in the epihymenia of eight of Australia's 13 known species of the genus. *Haematomma persoonii* colonizes bark in the woodlands and forests of eastern Queensland and New South Wales in Australia. Elsewhere in the world it occurs in all of the Americas, plus several sites in Africa and the Pacific.

1 mm

CONTENTS

Two new species, a new combination and four new records of saxicolous buellioid lichens (Ascomycota, Caliciaceae) from southern South America

John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Helmut Mayrhofer
University of Graz, Institute of Biology, Division of Plant
Sciences, NAWI Graz, Holteigasse 6, 8010 Graz, Austria
e-mail: helmut.mayrhofer@uni-graz.at

Juan Manuel Rodriguez
Centro de Ecologia y Recursos Naturales Renovables,
Facultad de Ciencias Exactas, Físicas y Naturales, Universidad
Nacional de Córdoba, Av. Vélez Sarsfield 1610, Córdoba, Argentina
e-mail: juan.rodriguez@unc.edu.ar

Abstract

Amandinea puertomonttensis Elix, H.Mayrhofer & J.M.Rodr. and *Tetramelas fuegiensis* Elix, H.Mayrhofer & J.M.Rodr. are described as new to science, and the new combination *Buellia pygmaea* (Räsänen) Elix, H.Mayrhofer & J.M.Rodr. is proposed for *B. protothallina* var. *pygmaea* Räsänen. *Amandinea fuscoatratula* (Zahlbr.) Elix, *A. subplicata* (Nyl.) Øvstedal, *Buellia ocellata* (Flot.) Körb. and *B. stellulata* var. *tasmanica* Elix & Kantvilas are reported for the first time from South America.

There have been no broad-based treatments of the saxicolous representatives of *Buellia sens. lat.* in South America since that of Magnusson (1955), although incidental new records have been reported, and lists of *Buellia* species have appeared in recent checklists (Galloway & Quilhot 1998; Calvelo & Liberatore 2002). Since the publication of those checklists, the following species have been recorded from southern South America: *Amandinea nitrophila* (Zahlbr.) Elix and *A. subcervina* (Nyl.) Elix for Argentina and Chile (Calvelo & Fryday 2006; Blaha *et al.* 2016; Elix 2017), and *Buellia subalbula* (Nyl.) Müll.Arg. from Chile (Bungartz *et al.* 2011). The following three species were known previously from the region but under later synonyms: *Buellia halonia* (Ach.) Tuck. from Chile (Bungartz *et al.* 2007), *B. mamillana* (Tuck.) W.A.Weber from Argentina, Brazil, Chile and Paraguay (Bungartz *et al.* 2007) and *Tetramelas thiopolizus* (Nyl.) Giralt & Clerc from Chile and Venezuela (Giralt & Clerc 2011).

In this paper, we describe new species of *Amandinea* and *Tetramelas*, and report four new records of saxicolous buellioid lichens from southern South America.

Methods

Observations and measurements of photobiont cells, thalline and apothecial anatomy, asci, ascospores, pycnidial anatomy and conidia were made on hand-cut sections mounted in water and treated with 10% potassium hydroxide (K) and 50% nitric acid (N). Calcium oxalate was detected by treatment of thalline and apothecial sections with a 10% aqueous solution of sulfuric acid; it forms colourless, needle-shaped crystals. Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Chemical constituents were identified by thin-layer chromatography (Elix 2014) and comparison with authentic samples.

The new species

1. Amandinea puertomonttensis Elix, H.Mayrhofer & J.M.Rodr., sp. nov. Figs 1, 2
Mycobank No. **MB 826705**

Similar to *Amandinea nitrophila* (Zahlbr.) Elix, but differs in having a pustulate-sorediate upper surface and a non-inspersed subhymenium.

Type: Chile [Llanquihue Province, Los Lagos Region], Lake District, road along coast SW of Puerto Montt to Chinquinhue, *c.* 8 km behind Puerto Montt, sea level, on rock boulders at the beach, *M. Matzer & B. Pelzmann s.n.*, 27.xi.1994 (holotype – GZU).

Thallus crustose, to *c.* 60 mm wide and 0.6 mm thick, continuous to cracked and areolate, with subeffigurate margins; individual areoles irregular, angular, 0.5–1 mm wide; upper surface pale brown to rusty brown, smooth to pustulate-sorediate in part, sorediate areas becoming pulvinate to 0.5 mm high, soredia granules 25–50 µm wide, shiny or matt; prothallus black, marginal or not apparent; medulla white, lacking calcium oxalate, (H_2SO_4–), I–; photobiont cells 10–16 µm wide. *Apothecia* 0.2–0.6 mm wide, lecideine, initially immersed, then becoming adnate or sessile, dispersed or rarely crowded; disc black, epruinose, weakly concave to plane or ultimately convex; proper exciple distinct, thick, prominent but excluded in convex apothecia, in section 50–75 µm thick, the outer zone brown-black, K–, paler brown within. *Epihymenium* 10–12 µm thick, brown to dark brown, K–, N–. *Hypothecium* 120–175 µm thick, brown to brown-black, K–, N–. *Hymenium* 70–80 µm thick, colourless, not inspersed; subhymenium 20–30 µm thick, pale brown, not inspersed with granules or oil droplets; paraphyses 1.5–1.7 µm wide, simple to sparsely branched, with apices 4–6 µm wide and brown caps. Asci of the *Bacidia*-type, 8-spored. *Ascospores* initially of the *Physconia*-type, of the *Buellia*-type when mature, 1-septate, brown, ellipsoid, 14–[*15.6*]–20 × 7–[*8.3*]–10 µm, not constricted at the septum; outer spore-wall finely ornamented (microrugulate). *Pycnidia* common, pyriform, immersed, brown to black; conidia filiform, curved, 12–27 × 0.7–1 µm.
Chemistry: Thallus K–, C–, P–, UV–; no lichen substances detected.

Etymology: This species is named for the occurrence of the type specimen near Puerto Montt, Chile.

Remarks
This species is characterized by the crustose, pale brown to rusty brown, continuous to rimose-areolate thallus with subeffigurate margins, a pustulate-sorediate upper surface, lecideine, immersed then sessile apothecia, a non-amyloid medulla, 1-septate, *Physconia*- then *Buellia*-type ascospores, 14–20 × 7–10 µm, curved, filiform conidia, 12–27 µm long, and the absence of lichen substances. *Amandinea nitrophila* from New Zealand, Kerguelen, Chile and Argentina has ascospores of similar size and ontogeny (Blaha *et al.* 2016), but the thallus of that species differs in lacking subeffigurate margins and a sorediate upper surface, and in having an inspersed subhymenium and ascospores that are often dilated at the septum. *Amandinea rangitatensis* Elix & H.Mayrhofer, from New Zealand, has a sorediate upper surface, but differs in forming irregular, crateriform soralia, in having larger apothecia (to 1 mm wide) that are initially lecanorine, then biatorine and ultimately lecideine with grey-white-pruinose discs, and well as in containing atranorin (Elix & Mayrhofer 2017).

At present, the new species is known from only the type locality. Associated species include *Amandinea subplicata* (Nyl.) Øvstedal, *Carbonea phaeostoma* (Nyl.) Hertel, *Rhizocarpon reductum* Th.Fr. and *Tetramelas anisomerus* (Nyl.) Elix.

2. Tetramelas fuegiensis Elix, H.Mayrhofer & J.M.Rodr., sp. nov. Figs 3, 4
MycoBank No. **MB 826706**

Similar to *Tetramelas nelsonii* (Darb.) Elix, but differs in having larger ascospores and in containing arthothelin.

Type: Argentina, Tierra del Fuego, Dept. Ushuaia, steep slope north of Passo Garibaldi, opposite Lago Escodido, [54°41'S, 67°52'W], 400–500 m alt., wet grass, *Nothofagus* forest with large silicate rocks, on rock, *J. Poelt s.n.*, 10.i.1989 (holotype – GZU).

Thallus crustose, discontinuous, areolate, to 90 mm wide and 0.4 mm thick; areoles irregular, angular, 0.2–1 mm wide, separate, scattered or rarely crowded and contiguous; upper surface pale yellow to yellow-green or yellow-brown, dull, verrucose-roughened, epruinose; prothallus black, marginal and between areoles; medulla white, lacking calcium oxalate, (H_2SO_4–), I+ weak purple-blue; photobiont cells 8–21 µm wide. *Apothecia* 0.4–1.1 mm wide, lecideine, separate and ± round, broadly adnate to sessile; disc black, epruinose, plane to markedly convex with age; proper exciple distinct but excluded in older, convex apothecia, in section 40–55 µm thick, outer part aeruginose-black, K−, N+ reddish purple to purple-brown, dark brown within. *Hypothecium* 200−250 µm thick, dark brown to brown-black. *Epihymenium* 12–15 µm thick, dark olive-brown to aeruginose-black, K−, N+ reddish purple to purple-brown. *Hymenium* 75–110 µm thick, colourless, ± with scattered oil droplets; subhymenium 40−60 µm thick, pale to mid-brown; paraphyses 1–2 µm wide, simple to sparsely branched, with apices 4–5 µm wide and dark aeruginose caps. *Asci* of the *Bacidia*-type, 8-spored. *Ascospores* initially of the *Callispora*- or *Physconia*-types, then of the *Buellia*-type, 1-septate, brown, ellipsoid to broadly fusiform, 17–[*22.1*]–30 × 8–[*10.8*]–15 µm, becoming constricted at the septum, often curved, rarely 2- or 3-septate; outer spore-wall finely ornamented (microrugulate). *Pycnidia* immersed, punctiform; conidia bacilliform to elongate-ellipsoid, 3.5–6.5 × 1–1.2 µm.
Chemistry: Thallus K+ yellow, C+ orange, KC+ deep orange, P–, UV+ orange; containing arthothelin (major), ± atranorin (minor), 4,5-dichloronorlichexanthone (trace).

Etymology: This species is named for the occurrence of the type specimen in Tierra del Fuego.

Remarks
Phylogenetic studies have confirmed that the genus *Tetramelas* Norman constitutes a well-founded segregate of *Buellia sens. lat.* (Helms *et al.* 2003; Nordin & Tibell 2005). Diagnostic characters include the presence of xanthones (arthothelin or 6-*O*-methylarthothelin) and commonly curved, 1–3-septate ascospores with pointed apices and *Callispora*-type thickenings in early ontogeny. *Tetramelas fuegiensis* exhibits all of those characteristics. In many respects, it resembles *T. nelsonii*, from the South Shetland Islands and continental Antarctica (Lamb 1968; Øvstedal & Lewis Smith 2001; Elix 2018). Both lichens are characterized by the presence of an aeruginose, N+ purple epihymenium and similar ascospores (which can become 2- or 3-septate), conidia and apothecial anatomy including similar reactions of the hypothecium and epihymenium. *Tetramelas nelsonii* differs from *T. fuegiensis* in containing 6-*O*-methylarthothelin (major or minor) and 4,5,dichloro-6-*O*-methylnorlichexanthone (minor or trace) and rarely accessory atranorin.

At present, the new species is known from only Tierra del Fuego. Associated species include *Acarospora* sp., *Amandinea subplicata* (Nyl.) Øvstedal, *Lecidella* sp. and *Rhizocarpon geographicum* (L.) DC.

SPECIMEN EXAMINED
Argentina: ● Tierra del Fuego, Dept. Río Grande, N-margin of the Andes, Cerro Chenen, E of Hacienda Chenen, rocky NE-facing hillside (above abandoned cabana), 200–230 m alt., on rock, *J. Poelt s.n.*, 8.i.1989 (GZU).

New combination

Buellia pygmaea (Räsänen) Elix, H.Mayrhofer & J.M.Rodr., comb. nov. Fig. 5
MycoBank number: **MB 826707**
Buellia protothallina var. *pygmaea* Räsänen, *Annales Botanici Societatis Zoologicae Botanicae Fennicae "Vanamo"* **2** (1), 31 (1932)
Type: Chile, Fuegia media, Lago Deseado, [54°23'S, 68°41'W], *H. Roivainen 704*, 5.i.1929 (H – holotype, not seen).

Thallus crustose, to 50 mm wide and 0.1 mm thick, continuous, areolate, the areoles aggregated or dispersed and delimited by a black prothallus; individual areoles irregular, angular, 0.1–0.4 mm wide; upper surface whitish or yellow-white, smooth; prothallus black, prominent, marginal and between areoles; medulla white, lacking calcium oxalate (H_2SO_4–), I+ purple-blue; photobiont cells 7–17 µm diam. *Apothecia* 0.1–0.3 mm wide, lecideine, immersed in the thallus or between the areoles, isolated or crowded, round or distorted by mutual pressure; disc black, epruinose, weakly concave then plane, initially with a necrotic thalline veil; proper exciple thin, persistent, slightly raised above disc, in section 25–40 µm thick; outer zone brown-black to greenish black, K–, N+ purple-brown; inner zone brown. *Epihymenium* 8–12 µm thick, aeruginose to greenish black, K+ blue-green, N+ purple. *Hypothecium* 100–125 µm thick, with deep red-brown to brown-black, K+ yellow then red crystals, N+ orange-brown. *Hymenium* 50–60 µm thick, colourless, not inspersed; subhymenium 15–25 µm thick, pale brown, inspersed with oil droplets; paraphyses 1.7–2 µm wide, moderately branched, capitate, with apices 3–4 µm wide; caps aeruginose. *Asci* of the *Bacidia*-type, with 8 or fewer spores. *Ascospores* 1-septate, brown, ellipsoid to subspherical, 8–[*10.5*]–12 × 5–[*7.2*]–8 µm, not constricted at the septum; outer spore-wall microrugulate to rugulate. *Pycnidia* common, pyriform, immersed, brown to black; conidia bacilliform, 4.5–6.5 × 0.7–1.2 µm.
Chemistry: Thallus K+ yellow then red, C–, PD+ orange-red, UV–; containing norstictic acid (major), connorstictic acid (minor), atranorin (trace or absent).

Remarks
This species closely resembles *B. aethalea* (Ach.) Th.Fr., which is also present in southern South America (Calvelo & Liberatore 2002). Both contain norstictic acid, have immersed to weakly adnate, lecideine apothecia with epruinose discs, aeruginose, N+ purple epihymenia, 1-septate, *Buellia*-type ascospores and bacilliform conidia. However, *B. aethalea* lacks an inspersed subhymenium and has larger ascospores 11–[*15.5*]–21 × 7–[*9.2*]–12 µm, which become constricted at the septum with age, and more elongate, bacilliform conidia, 5.5–8.5 µm long (Elix 2011).

SPECIMENS EXAMINED
Argentina: ● Tierra del Fuego, Dept. Ushuaia, Montes Martial near Ushuaia [54°46'S, 68°29'W], above Acrosilla, 700–1000 m alt., on silica rock among alpine heath, moor and stunted woodland, *J. Poelt s.n.*, 17.i.1989 (GZU) [two specimens].

New records for South America

1. Amandinea fuscoatratula (Zahlbr.) Elix, *Australas. Lichenol.* **77**, 39 (2015)
This species was previously known from New Zealand and Tasmania (Blaha *et al.* 2016). It is characterized by the crustose, rimose-areolate, pale to dark grey or grey-brown thallus, the initially immersed then broadly adnate to sessile apothecia, the non-amyloid medulla, non-inspersed subhymenium, 1-septate, *Physconia*- then *Buellia*-type ascospores, 11–16 × 5–10 µm, curved, filiform conidia, 15–25 µm long, and the absence of lichen substances. A detailed description and illustrations are given in Blaha *et al.* (2016).

SPECIMENS EXAMINED
Argentina: ● Tierra del Fuego, Dept. Ushuaia, Estancia Moat, *c.* 4 km W of Pampa de los Indios, 0–30 m alt., *Nothofagus betuloides* forest, on coastal rock, *J. Poelt s.n.*, 12.i.1989 (GZU).
Chile: ● Chiloé, E coast, Chadmo, N of Quellón, beach area of village, sea level, on coastal rocks, *M. Matzer & B. Pelzmann*, 24.xi.1994 (GZU) [two collections].

2. Amandinea subplicata (Nyl.) Øvstedal, *in* D.O. Øvstedal & R.I. Lewis-Smith, *Lichens of Antarctica and South Georgia. A guide to their identification and ecology*: 87 (2001) Figs 6, 7
Lecidea subplicata Nyl., *in* Crombie, *J. Bot. (London)* **15**, 190 (1877).
Buellia subplicata (Nyl.) Müll.Arg., *Bot. Jahrb. Syst.* **5**, 138 (1884).

Type: Îles Kerguelen, Swain's Bay, on coastal rock, *A.E. Eaton* [Venus Transit Expedition] (BM 000671130! – lectotype here designated, selected from three syntypes present in BM with identical locality information).

Thallus crustose, forming patches to *c.* 30 mm wide, endolithic and not apparent, or epilithic, discontinuous, thin, membranaceous to rimose-areolate, white or pale grey; prothallus black, marginal or absent; medulla white, lacking calcium oxalate (H_2SO_4–), I–; photobiont cells 7–17 µm wide. *Apothecia* 0.3–0.7 mm wide, lecideine, broadly adnate to sessile, scattered or crowded, rounded or distorted through mutual pressure; disc black, epruinose, weakly concave to gyrose-distorted; proper exciple distinct, thin, persistent, raised above the disc, in section 40–360 µm thick, with the outer zone dark brown to black-brown, K–, brown within. *Epihymenium* 12–15 µm thick, dark brown, K–, N–. *Hypothecium* 170–250 µm thick, dark brown to black-brown, K–, N–. *Hymenium* 60–90 µm thick, colourless, not inspersed with oil droplets; subhymenium 15–20 µm thick, pale brown, not inspersed with granules or oil droplets; paraphyses 1.2–2 µm wide, simple to moderately branched; apices 4–6 µm wide and with dark brown caps. *Asci* of the *Bacidia*-type, 8-spored. *Ascospores* of the *Physconia*- then *Buellia*-type, 1-septate, brown, ellipsoid, 13–[*16.1*]–20 × 7–[*8.7*]–10 µm, sometimes curved, older spores rarely constricted at septum; outer spore wall microrugulate to rugulate. *Pycnidia* immersed, black; conidia filiform, curved, 15–22 × 0.7–1 µm.
Chemistry: Thallus K–, P–, C–, UV–; no lichen substances detected by TLC.

This species was previously known from the Kerguelen Islands, Prince Edward Island, Marion Island and South Georgia (Øvstedal & Lewis Smith 2001). It is characterized by an endolithic or inconspicuous, off-white to pale grey, crustose thallus lacking lichen substances, a non-amyloid medulla that lacks calcium oxalate, adnate to sessile, lecideine apothecia, 0.3–0.7 mm wide, often with gyrose-distorted discs, a brown, N– epihymenium, broad, ellipsoid *Physconia*-then *Buellia*-type ascospores, 13–20 × 7–10 µm, which are rarely constricted at the septum, having a rugulate to microrugulate outer wall, and curved, filiform conidia, 15–22 µm long.

SPECIMENS EXAMINED
Australia: *Macquarie Island*: ● Gadgets Gully, *c.* 2.4 km S of ANARE Station, 54°30'S, 158°55'E, 60 m alt., on rock with E aspect, *R.B. Filson 6358C & P. Atkinson*, 18.iii.1964 (MEL).
Chile: ● [Llanquihue Province, Los Lagos Region], Lake District, road along coast SW of Puerto Montt to Chinquinhue, *c.* 8 km behind Puerto Montt, sea level, on rock boulders at the beach, *M. Matzer & B. Pelzmann s.n.*, 27.xi.1994 (GZU) [2 specimens].

3. Buellia ocellata (Flot.) Körb., *Syst. Lich. Germ.* 224 (1855)
This species is known from Europe, North America, Macaronesia, Asia and Africa (Coppins *et al.* 2009), south-eastern Australia (McCarthy 2018) and New Zealand (Elix *et al.* 2015). It is characterized by an areolate to subsquamulose, yellowish to grey thallus, the areoles typically aggregated into small patches 1–2 cm wide, the presence of arthothelin (C+ orange), immersed apothecia occurring singly in each areole, an aeruginose, N+ red-violet epihymenium, a greenish lower hymenium, *Buellia*-type ascospores, 12–22 × 6.5–12 µm, and bacilliform conidia, 4–6 × 0.8–1 µm. A detailed description is given in Coppins *et al.* (2009).

SPECIMENS EXAMINED
Argentina: ● Tierra del Fuego, Dept. Río Grande, disturbed, grazed fuegian steppe N of Río Grande, 5–10 m alt., on rock, *J. Poelt s.n.*, 3.i.1989 (GZU); ● Tierra del Fuego, Dept. Río Grande, old *Nothofagus antarctica* forest, *c.* 7 km SE of Estancia Río Apen, 100–150 m alt., on rock, *J. Poelt s.n.*, 7.i.1989 (GZU).
Ecuador: ● Andes, [Cordillera Occidental], Chimborazo, below the refuge, 4800 m alt., on rock, *H. Huss s.n.*, 27.viii.1980 (GZU).

4. Buellia stellulata var. **tasmanica** Elix & Kantvilas, *Australas. Lichenol.* **73**, 32 (2013)
This taxon was previously known from Australia and New Zealand (Elix & Kantvilas 2013; Elix *et al.* 2017). Morphologically, it is identical to *Buellia stellulata* (Taylor) Mudd var. *stellulata*, but it can be readily distinguished chemically because the latter contains additional 2'-*O*-methylperlatolic acid (major) and confluentic acid (minor). A detailed description is given in Elix & Kantvilas (2013).

SPECIMEN EXAMINED
Chile: ● Prov. de Concepción, Cerro el Pompon, rockfalls on the coast at the mouth of the Río Bio-Bio, on rock, *O. Matthei & J. Poelt s.n.*, 26.vii.1979 (GZU).

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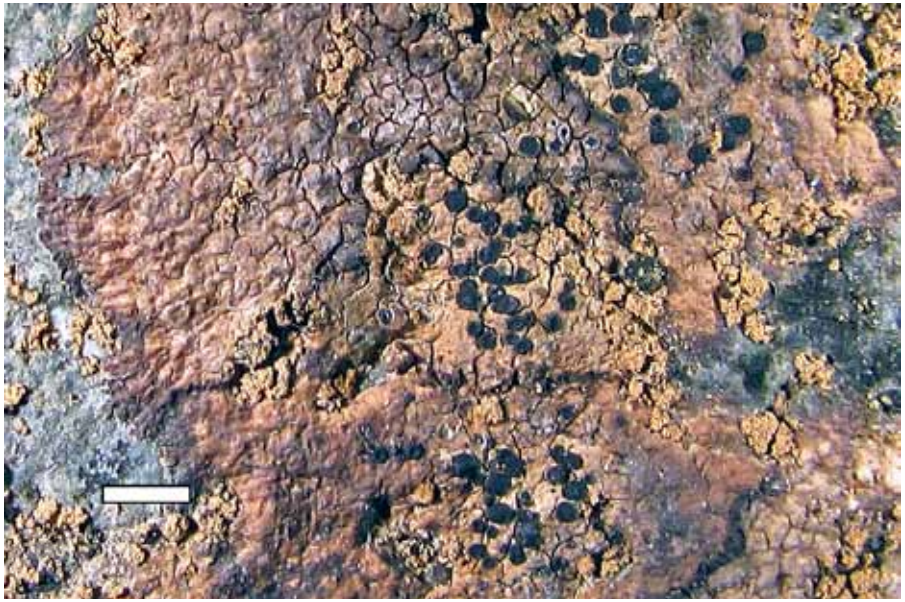

Fig, 1. *Amandinea puertomonttensis* (holotype in GZU). Scale = 2 mm.

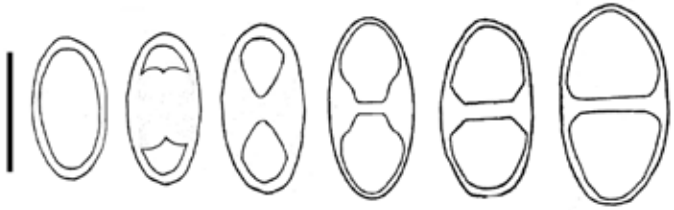

Fig. 2. Ascospore ontogeny of *A. puertomonttensis*. Scale = 10 µm.

Fig. 3. *Tetramelas fuegiensis* (holotype in GZU). Scale = 1 mm.

Fig. 4. Ascospore ontogeny of *T. fuegiensis*. Scale = 10 µm.

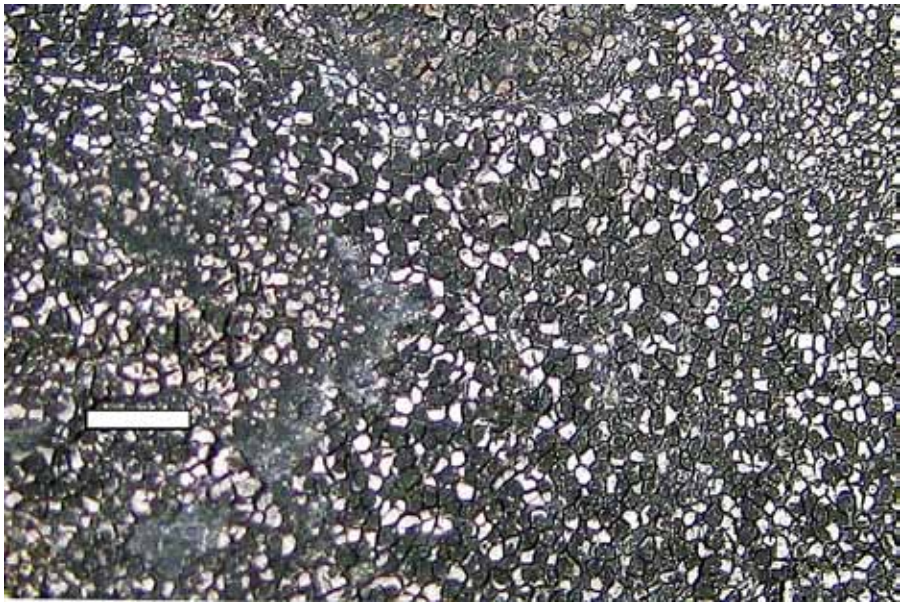

Fig. 5. *Buellia pygmaea* (*J. Poelt s.n.*, 17.i.1989 in GZU). Scale = 1 mm.

Fig. 6. *Amandinea subplicata* (*M. Matzer & B. Pelzmann*, 27.xi.1994 in GZU). Scale = 1 mm.

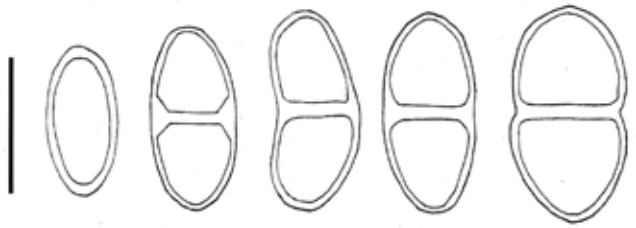

Fig. 7. Ascospore ontogeny of *A. subplicata*. Scale = 10 µm.

Sclerophyton puncticulatum sp. nov. (lichenized Ascomycota, Opegraphaceae) from New South Wales, Australia

Patrick M. McCarthy
64 Broadsmith St, Scullin, A.C.T. 2614, Australia
email: pmcc2614@hotmail.com

John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Abstract

Sclerophyton puncticulatum P.M.McCarthy & Elix (lichenized Ascomycota, Opegraphaceae) is described from bark in montane rainforest in northern New South Wales, Australia. Some older reports from Australia of other *Sclerophyton* species are re-assessed.

Sclerophyton Eschw. (Opegraphaceae) includes 14 species known from bark and lignum in rainforest throughout the tropics and subtropics and in coastal shrub communities at low latitudes on the Pacific coasts of North, Central and South America (Sparrius 2004). In this paper, a new species is reported from montane rainforest in northern New South Wales. Meanwhile, only two of the five species previously reported from Australia can confidently be assigned to *Sclerophyton*.

The genus has come under scrutiny by Ertz & Tehler (2011), who found it to be paraphyletic. Consequently, future studies and the availability of additional collections might see *S. puncticulatum* transferred elsewhere, possibly to *Fulvophyton* Ertz & Tehler (Roccellographaceae).

Methods

Observations and measurements of photobiont cells, thalline and ascomatal anatomy, asci, ascospores, pycnidial anatomy and conidia were made on hand-cut sections mounted in water and treated with 10% potassium hydroxide (K). Calcium oxalate was detected by treatment of thalline and pseudostromatal sections with a 10% aqueous solution of sulfuric acid; it forms colourless, needle-shaped crystals. Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Chemical constituents were identified by thin-layer chromatography (Elix 2014) and comparison with authentic samples.

Sclerophyton puncticulatum P.M.McCarthy & Elix, **sp. nov.** Fig. 1
MycoBank No.: **MB 825500**

Characterized by the combination of the thin, off-white to greenish white, richly rimose, corticolous thallus containing psoromic acid (major), gyrophoric acid (minor) and calcium oxalate; puncticulate, brown-black ascomata, 60–80(–100) µm wide above, and fully immersed in thalline pseudostromata that are simple and rounded to elongate or sparingly to richly branched and dendroid; a brown-black hypothecium; asci of the *Opegrapha*-type; sparingly branched and anastomosing paraphysoids; colourless, elongate-fusiform, 3-septate ascospores, 35–51 × 3–4.5 µm, thick-walled and lacking a perispore; and curved-filiform conidia, 10–18 × *c.* 0.5 µm.

Type: Australia, New South Wales, Northern Tablelands, Gibraltar Range, Washpool Natl Park, 78 km E of Glen Innes, 29°28'10"S, 152°21'01"E, 895 m alt., on bark of sapling in mixed rainforest with scattered *Eucalyptus*, *J.A. Elix 37294*, 2.v.2005 (holotype – CANB).

Thallus corticolous, crustose, determinate, forming colonies to 5 cm wide, off-white to greenish white, richly rimose, but not areolate, esorediate; surface dull to slightly glossy, minutely and irregularly uneven or verruculose, to 60–100 µm thick (100–150 µm thick in pseudostromata; see below), not unambiguously corticate, but with an upper, hyaline, alga-free layer 12–16(–20) µm thick, composed of closely interwoven, short-celled hyphae 2–2.5 µm wide. *Algae Trentepohlia*, forming a continuous layer to *c.* 80 µm thick, inspersed with clusters of plate-like calcium oxalate crystals (H_2SO_4+); cells ellipsoid, 9–14 × 8–12 µm, solitary or in very short filaments; interstitial hyphae short-celled, 2–2.5 µm wide. *Medulla* to *c.* 50 µm thick, lacking or with sparse calcium oxalate crystals, composed of loosely arranged hyphae 1.5–2.5(–3) µm wide. *Prothallus* fimbriate, effuse, white to greyish black. *Ascomata* numerous, brown-black above, punctiform, rounded or ellipsoid and 60–80(–100) µm wide, often merging laterally to form short, unbranched 'lirellae' 0.1–0.3 mm long, fully immersed in the pseudostromata; disc epruinose, plane or very slightly convex; margin scarcely distinguishable from the disc in surface view; sectioned ascomata occasionally precipitating crystals in K (see *Chemistry*). *Pseudostromata* anatomically ± identical to the vegetative thallus, simple and rounded to elongate or sparingly to richly branched and dendroid, weakly to moderately convex, densely inspersed with clusters of plate-like calcium oxalate crystals (H_2SO_4+). *Proper excipulum* (thin section) medium to dark olive-brown or brown-black above, 25–40 µm thick and spreading slightly laterally (darker externally), pale to medium brown at the sides and 10–15 µm thick, medium to dark brown or brown-black at the base and 10–15 µm thick; cells periclinal laterally and at the base, 8–15 × 2–3 µm, anticlinal and divergent apically. *Hypothecium* brown-black, 25–40 µm thick, merging laterally with the excipulum and contiguous with the substratum, KI–, K– or precipitating orange-red crystals. *Hymenium* 70–100 µm wide, 90–150 µm deep, not inspersed with granules or oil globules, KI+ blue; subhymenium hyaline to pale brown, 15–25 µm thick. *Epihymenium* poorly defined, 5–10 µm thick, pale brown, K–. *Paraphysoids* loosely to moderately conglutinate in the hymenial gel, separating further in K, 1.3–2(–2.5) µm thick, sparingly branched and anastomosing, long-celled, the septa not constricted; apices not or only very slighty swollen, hyaline to pale brown. *Asci* 8-spored, *Opegrapha*-type, narrowly clavate to cylindroclavate, thin-walled, 60–76 × 12–16 µm; apex rounded, with a tholus 2–3 µm thick, with or without a low-conical ocular chamber to 2 µm wide which is often, but not always, encircled by a minute amyloid ring; ascoplasma orange-brown in KI. *Ascospores* colourless, more or less in a single fascicle in the ascus, persistently 3-septate, elongate-fusiform, straight or slightly to rather strongly curved, commonly tapering more gradually towards the distal end, not constricted at the septa, (35–)42(–51) × (3–)4(–4.5) µm [*n* = 50]; apices rounded or subacute; cells of ± equal size throughout spore ontogeny (microcephalic); spore wall to *c.* 0.8 µm thick, usually noticeably thicker than the septa; perispore not visible in water, K, I or KI; contents clear. *Pycnidia* numerous, solitary, completely immersed in the thallus, 60–80 µm wide; apex punctiform, medium to dark brown; internal wall hyaline to pale brown (thin section), 4–6 µm thick, with a simple conidiogenous layer; conidiogenous hyphae 8–12 × 0.7–1 µm. *Conidia* simple, filiform, usually slightly curved, occasionally almost arcuate, 10–16(–18) × *c.* 0.5 µm. *Chemistry:* Thallus and pseudostromata K–, C–, KC–, PD+ yellow, UV–; containing psoromic acid (major) and gyrophoric acid (minor) by TLC; H_2SO_4+, containing calcium oxalate; in sectioned ascomata the hypothecium occasionally precipitating orange-red crystals, a potassium salt of a quinone derived from the base-catalyzed oxidation of norstictic acid.

Etymology: The epithet *puncticulatum* refers to the outwardly dot-like ascomata of the new species.

Remarks

In terms of morphology, the placement of this species in *Sclerophyton* is supported by the melanized hypothecium that merges laterally with the excipulum and is contiguous with the substratum, and rather thick-walled ascospores (Sparrius 2004). Macrocephalic ascospores were also cited as being diagnostic for the genus (Sparrius 2004). Thus, formation of the medial first septum is followed by second and third divisions close to the middle of the spore, so that the end cells remain considerably larger until they too are reduced in size with the formation of addition septa. However, since the ascospores of *S. puncticulatum* are persistently 3-septate, they are effectively microcephalic. Ascospore shape in *S. puncticulatum* remains

somewhat anomalous, being elongate-fusiform rather than narrowly ellipsoid (Sparrius 2004).

Sclerophyton conspicuum A.W.Archer was described from bark at two localities near Darwin, Northern Territory (Archer 2003). Sparrius (2004) suggested "according to the description and illustration probably a species of *Lecanographa* (*L. aff. lyncea*)". However, an examination of the holotype (*H.Streimann 48684*, CANB) and paratype (*J.A.Elix 22603*, CANB) confirmed an excipulum that is carbonized apically and laterally, the ascomatal base being hyaline and open, suggesting a species of *Opegrapha*. Archer & Elix (2003) reported *S. circumscriptum* (Taylor) Zahlbr. from Lord Howe Island and *S. rostratum* Egea & Torrente from the Northern Territory. The former has been re-identified as *Enterographa subgelatinosa* (Stirt.) Redinger by Sipman (2018) based on a duplicate in B which matches the two CANB specimens (*J.A.Elix 42291*, *42310*). The report of *S. rostratum* is surprising, as the Australian specimen (*J.A.Elix 22607*, not "22606" as published; CANB) bears little resemblance to the species described and illustrated by Egea & Torrente (1995) from Baja California, Mexico; it is referable to *Enterographa subserialis* (Nyl.) Redinger.

Consequently, in addition to *S. puncticulatum*, two species of *Sclerophyton* are accepted in the Australian lichen flora, *viz.* the pantropical *S. elegan*s Eschw., which was reported by Archer (2006) from south-eastern Qld, and the pantropical *S. seriale* (Ach.) Sparrius, from the Northern Territory and north-eastern Queensland (Sparrius 2004). The former has richly branched, lirelliform ascomata and ellipsoid ascospores 12–17 × 3.2–5.5 µm, the upper cell enlarged (Sparrius 2004), while *S. seriale* has a glossy, pale grey-brown thallus, whitish pseudostromata, and ellipsoid-fusiform, 3-septate ascospores 14–22 × 3–6 µm (Sparrius 2004).

The new species is known from only the type locality in northern New South Wales, Australia.

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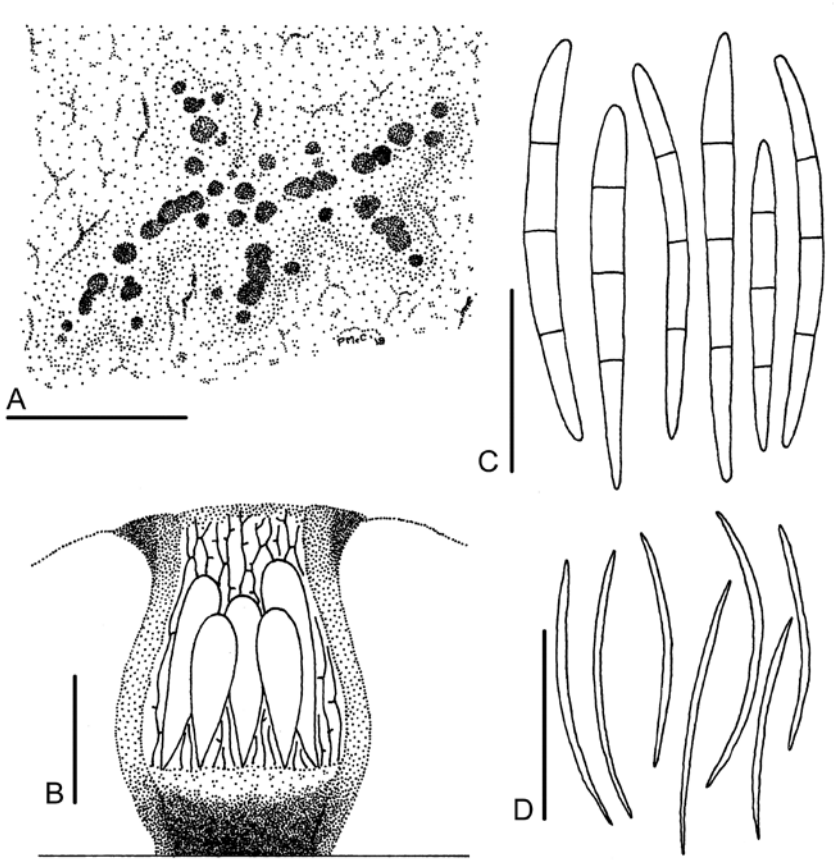

Figure 1. *Sclerophyton puncticulatum* (holotype). A, Habit of thallus and a branched pseudostroma, with punctiform ascomatal apices; B, Sectioned ascoma (semi-schematic); C, Ascospores; D, Conidia. Scales: A = 1 mm; B = 50 µm; C = 20 µm; D = 10 µm.

Agonimia abscondita sp. nov. (lichenized Ascomycota, Verrucariaceae) from New South Wales, Australia

Patrick M. McCarthy
64 Broadsmith St, Scullin, A.C.T. 2614, Australia
e-mail: pmcc2614@hotmail.com

John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Abstract

Agonimia abscondita P.M.McCarthy & Elix (lichenized Ascomycota, Verrucariaceae) is described from bark and corticolous bryophytes in cool-temperate rainforest in south-eastern New South Wales, Australia. It has a thin, greenish, microlobulate thallus, immersed perithecia, 0.25–0.45 mm wide, with a concave to plane apex, long periphyses, (1–)4-spored asci and pale yellowish brown, muriform ascospores, 45–95 × 17–32 µm.

Agonimia Zahlbr. (Verrucariaceae), a genus of *c.* 24 species, is most diverse at northern temperate latitudes, growing on soil, bark and rock and on bryophytes already occupying those substrata. It is characterized by the crustose, squamulose or minutely lobulate thallus, usually with a cortex of papillate cells, simple, perithecioid ascomata with a layered excipular anatomy, 1–8-spored asci, and hyaline to pale brown, muriform ascospores (Sérusiaux *et al.* 1999; Orange & Purvis 2009; Guzow-Krzemińska *et al.* 2012; Orange 2013; Hafellner 2014). In this paper, a new corticolous and bryophilous species is described from cool-temperate rainforest in south-eastern New South Wales.

Methods

Observations and measurements of photobiont cells, thalline and ascomatal anatomy, asci and ascospores were made on hand-cut sections mounted in water. Asci were also observed in Lugol's Iodine (I), with and without pretreatment with potassium hydroxide (K).

Agonimia abscondita P.M.McCarthy & Elix, sp. nov. Fig. 1
MycoBank No.: **MB 826862**

Thallus corticolous and bryophilous, microlobulate, medium olive-green, 40–80(–120) µm thick; lobules prostrate, richly branched, 0.08–0.2(–0.25) mm long, 40–80(–100) µm wide, to 40 µm thick, matted and obscured in older parts of the thallus; cortex of periclinal, sparingly papillose hyphae or a discontinuous layer of globose, hyaline, papillose cells 9–21 µm wide. Ascomata perithecia, almost completely immersed in the thallus, 0.25–0.45 mm wide, 0.25–0.4 mm tall, subglobose to obpyriform or broadly ovoid, lacking an involucrellum; apex plane to concave. Excipulum layered, predominantly brown-black, 45–65 µm thick. Periphyses 50–120(–150) × 1–1.5 µm. Asci (1–)4-spored, 105–225 × 25–42 µm. Ascospores muriform, pale yellowish brown, 45–95 × 17–32 µm.

Type: Australia, New South Wales, Southern Tablelands, Morton National Park, slopes of Barrengarry Mtn, 6 km ESE of Fitzroy Falls, 34°41'07"S, 150°29'53"E, alt. 480 m, on bark and corticolous bryophytes at base of tree in dense, cool-temperate rainforest, *J.A.Elix 45622*, 16.ix.2008 (holotype — CANB).

Thallus corticolous and overgrowing corticolous bryophytes, continuous and forming colonies several centimetres wide, dull medium olive-green, 40–80(–120) µm thick, lacking soredia and isidia, microlobulate. *Lobules* most clearly distinguishable near the thallus margin, prostrate, 0.08–0.2(–0.25) mm long, 40–80(–100) µm wide, ± smooth, richly and irregularly branched and imbricate, somewhat flattened and up to 40 µm thick, with lateral, subglobose projections 20–30 µm wide resembling goniocysts. Older, thicker parts of the thallus crust-like, the lobes becoming tightly contiguous or more markedly overlapping and appearing matted, layered in section, most losing their discrete outline, although the thallus surface retaining a very fine, irregular pattern of faint grooves. *Photobiont cells* dominating the thallus, dark green, unicellular, ± globose, thin- to thick-walled, 5–10(–12) µm wide; interstitial mycobiont cells paraplectenchymatous, angular, thin-walled, 3–4(–5) µm wide. *Cortex* often indistinct, especially around newly developing lobes where it forms a single layer of periclinal hyphae 2–2.5 µm wide, the cells smooth-walled or with sparse, convex, conical or tuberculate papillae *c.* 1 µm tall and wide. Older parts of the thallus with a cortex-like layer of globose, hyaline cells 9–15(–21) µm wide which can form an almost continuous layer or appear more scattered but in the same plane, these cells thick-walled (the wall 1.5–3 µm thick), each with numerous, low-convex to conical papillae *c.* 3 µm wide and 2 µm tall. Lobes attached to the substratum by long, hyaline rhizohyphae that are long-celled, thin-walled, sparingly branched and 1–2 (–2.5) µm wide. *Prothallus* not apparent. *Ascomata* perithecia, sparse, solitary, 2/3-immersed to almost completely immersed in the thallus and in the spongy outer layers of the substratum, inconspicuous when immature and mature, later often breaking open and then visible as the gaping, black, hollow shell of the excipulum, 0.25–0.4(–0.45) mm wide, 0.25–0.35(–0.4) mm tall [n = 10, too destructive of the specimen to measure more], subglobose to obpyriform or broadly ovoid; apex concave to plane, 0.15–0.25(–0.3) mm wide, ± concolorous with the thallus or medium to dark brown, often with a narrow, smooth, raised rim; ostiole usually rather conspicuous, initially pale greyish brown, finally visible as a pore 20–30 µm wide. *Involucrellum* absent. *Excipulum* layered, 50–75 µm thick at and directly below the apex, 45–65 µm thick at the sides and base, with a brown-black, paraplectenchymatous, outer layer 30–45 µm thick at the sides and base, subtended by paler brown to hyaline cells of similar size and shape; inner excipular cells hyaline, elongate-periclinal, forming a layer 10–15 µm thick; laterally, the innermost cells with periphysis-like filaments projecting into the hymenium, these 15–30 × 1–1.5 µm, short-celled, sinuous, branched and sparingly anastomosing; in section the excipular apex with a palisade of hyaline to brown, anticlinal hyphae 15–25 µm long and 1.5–3 µm wide. *Subhymenium* plane to concave, hyaline, 10–20 µm thick. *Paraphyses* absent. *Periphyses* simple or very sparingly branched near the base, 50–120(–150) × 1–1.5 µm, long-celled, with narrow lumina. *Hymenial gel* I+ pale blue, slowly turning red-brown or purple-brown, KI+ pale blue-violet. *Asci* (1–)4-spored, narrowly to broadly clavate, 105–175(–225) × 25–42 µm [n = 15], the apex lacking an ocular chamber; ascoplasma I+ orange-brown, KI–. *Ascospores* irregularly biseriate or overlapping-uniseriate in the ascus, muriform, pale yellowish brown, broadly ellipsoid, elongate-ellipsoid, oblong or oblong-fusiform, occasionally soleiform, ± straight, the surface smooth to irregularly undulate, with rounded or somewhat pointed ends, (45–)72(–95) × (17–)25(–32) µm [n = 60; 37 in 4-spored asci, 8 in 3-spored asci, 4 in 2-spored asci, 1 in a monosporous ascus, 10 uncertain]; wall *c.* 1 µm thick, lacking an epispore; locules thin-walled, angular, 3–5(–6) µm wide, (3–)4–5(–6)-sided in optical section, the contents clear or minutely granulose. *Pycnidia* not seen.

Etymology: The epithet *abscondita* (L., hidden, concealed) alludes to the largely immersed ascomata and their very inconspicuous apical parts.

Remarks

Other species of *Agonimia* have either 1–2-spored or mainly 8-spored asci; *A. abscondita* is the first to exhibit predominantly 4-spored asci. Among other microlobulate taxa, *A. pacifica* (H.Harada) Diederich, from Korea, Japan, China, Taiwan, Papua New Guinea, Costa Rica and Brazil, has squamules with proliferating lobules to 50 µm wide, an almost uniformly dark-pigmented excipulum, shorter and thicker periphyses and mostly monosporous asci (Harada 1993; Aptroot *et al.* 1997). *Agonimia flabelliformis* Halda, Czarnota & Guzow-Krzemińska, from Great Britain and Central Europe, has a minutely flabelliform-squamulose to coralloid thallus, prominent, black perithecia to 0.25 mm wide and ascospores 23–35 × 11–15 µm in 8-spored asci (Guzow-Krzemińska *et al.* 2012). Lastly, the corticolous *A. tenuiloba* Aptroot &

M.Cáceres, from Amazonian Brazil, has superficial, grey perithecia with an excipulum to 100 µm thick and shorter ascospores, 30–50(–76) × 20–35 µm, in bisporous asci (Aptroot & Cáceres 2013).

Two species of *Agonimia* are already known from Australia, but both are readily distinguishable from the new species. The almost cosmopolitan and mainly calcicolous *A. tristicula* (Nyl.) Zahlbr., in south-eastern New South Wales and Lord Howe Island, has a squamulose thallus that is scarcely microlobulate, black, rugose-plicate perithecia, (1–)2-spored asci and ascospores 65–135 × 30–50 µm (McCarthy 2001). Another widely distributed species, *A. opuntiella* (Buschardt & Poelt) Vězda, has distinctive squamules to 2 mm wide which are covered with minute, hyaline hairs, as well as bisporous asci; it has been reported from south-eastern Queensland by Aptroot (2011).

The new species is known only from the type locality in cool-temperate rainforest in the Southern Tablelands, New South Wales. Associated lichen species include *Bacidia* sp. and *Lepraria squamatica* Elix.

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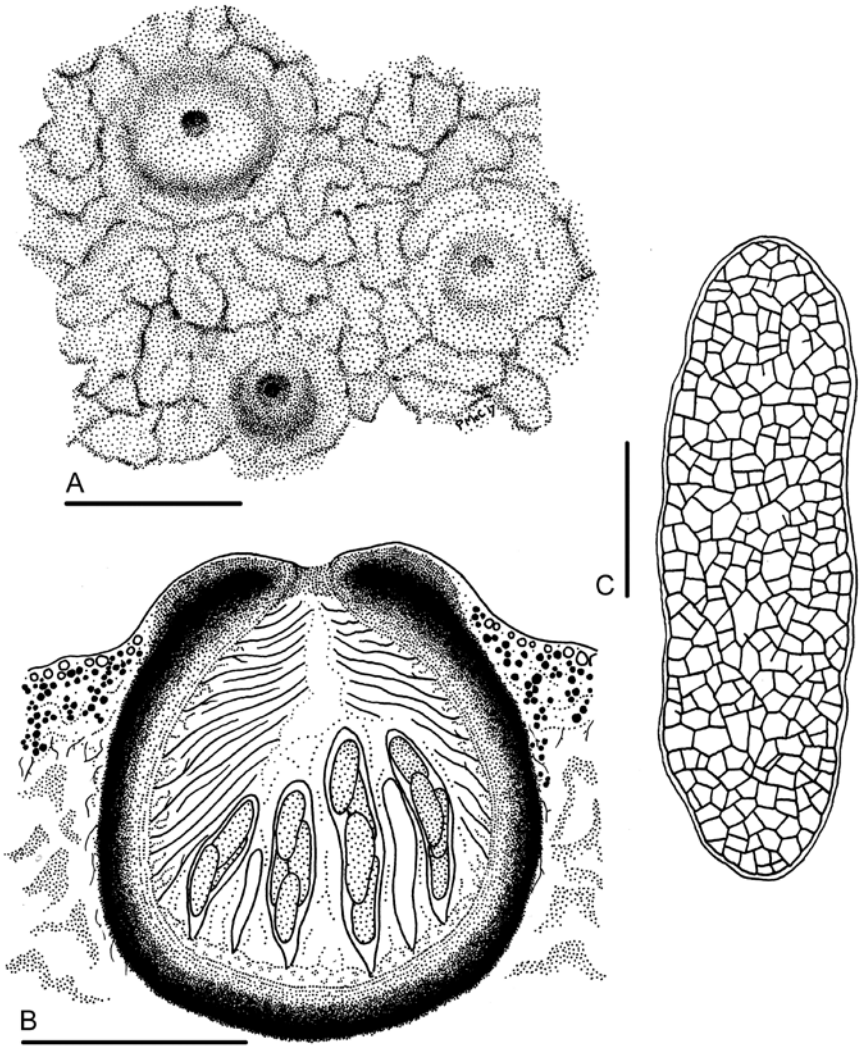

Figure 1. *Agonimia abscondita* (holotype). **A**, Habit of thallus and ascomatal apices; **B**, Sectioned ascoma, with adjacent thallus and substratum (semi-schematic); **C**, Ascospore. Scales: A, B = 0.2 mm; C = 20 µm.

A new species of *Rinodina* (Physciaceae, Ascomycota) from eastern Australia

Helmut Mayrhofer
University of Graz, Institute of Biology, Division of Plant Sciences, NAWI Graz, Holteigasse 6, 8010 Graz, Austria
e-mail: helmut.mayrhofer@uni-graz.at

John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Abstract
Rinodina michaelae H.Mayrhofer & Elix, characterized by the presence of 6-*O*-methylarthothelin and zeorin, is described as new to science from Queensland and New South Wales, Australia.

The saxicolous species of *Rinodina* (Ach.) S.F.Gray in Australia are relatively well known following the initial treatment by Mayrhofer (1984), further additions by Mayrhofer *et al.* (1990), Matzer & Mayrhofer (1994), Matzer *et al.* (1998) and Trinkaus *et al.* (1999), and the more recent revisions by Kaschik (2006) and Elix (2011). In this paper we describe a new saxicolous species of *Rinodina* from Queensland and New South Wales.

Methods
Observations and measurements of photobiont cells, thallus and apothecium anatomy, asci and ascospores were made on hand-cut sections mounted in water and 10% KOH (K). Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Medullary sections were treated with 10% sulfuric acid (H_2SO_4), and apothecial sections with 50% nitric acid (N).

The new species

Rinodina michaelae H.Mayrhofer & Elix, sp. nov. Figs 1, 2
MycoBank number: **MB 825243**

Similar to *Rinodina fijiensis* Elix & Giralt, but differs in having a brown to dark brown hypothecium, larger ascospores, and in containing 6-*O*-methylarthothelin.

Type: Australia, Queensland, Kerry, Duck Creek Road, near Lamington National Park close to O'Reilly's Mountain Resort, 28°10'S, 153°04'E, 850–950 m alt., on basalt, *H. Mayrhofer 11478, E. Hierzer & R.W. Rogers*, 18.viii.1993 (GZU – holotype).

Thallus to 40 mm wide, crustose, continuous and rimose to areolate-subsquamulose; individual areoles 0.1–0.5 mm wide, to 0.15 mm thick, scattered or contiguous, concave to plane; upper surface matt, smooth to verruculose, esorediate, grey-white to cream or pale yellow-brown; prothallus marginal, white or absent; medulla white, lacking calcium oxalate (H_2SO_4–), I–; photobiont cells 7–12 µm diam. *Apothecia* 0.2–0.7 mm wide, scattered, lecanorine, immersed at first, then broadly adnate but rarely sessile and basally constricted; disc pale brown to brown-black, epruinose, plane to weakly convex; thalline margin thick and raised above the disc at first, becoming thinner and excluded in convex apothecia. *Proper excipulum* indistinct, in section 70–80 µm thick, outer zone dark brown, K–, N–; inner zone paler brown. *Epihymenium* 10–15 µm thick, brown to dark brown, K–, N–. *Hypothecium* 150–240 µm thick, dark brown to brown-black, K+ yellow solution, N–. *Hymenium* 70–80 µm thick, colourless; subhymenium 40–50 µm thick, yellow-brown; paraphyses 1.5–2.5 µm wide, simple to branched, capitate, with apices 3–3.5 µm wide and brown caps, not inspersed with oil droplets; asci of the *Lecanora*-type, 2–7-spored or rarely 8-spored. *Ascospores* transitioning from *Serotina*- to *Dirinaria*-, *Physcia*-, *Pachysporaria*- or *Buellia*-type, 1-septate, brown, broadly ellipsoid, 20–[*23.9*]–28 × 12–[*13.9*]–18 µm, not constricted at the septum, often with paler spore-ends, rarely becoming fusiform with age; ontogeny of type-B; outer spore-wall smooth. *Pycnidia* pyriform, immersed, brown to brown-black; conidia bacilliform, 3.5–5 × 1 µm.
Chemistry: Thallus K+ pale yellow, C+ orange, P–, UV+ orange; containing zeorin (major), 6-*O*-methylarthothelin (major), arthothelin (trace), 4,5-dichloro-6-*O*-methylnorlichexanthone (trace), 2,4,5-trichlorolichexanthone (trace).

Etymology: The species is named in honour of Dr. Michaela Kaschik (neé Lambauer) for her contribution to our knowledge of the saxicolous species of *Rinodina* in Australia.

Remarks
The new species is characterized by the crustose, rimose-areolate to subsquamulose, grey-white to cream or pale yellow-brown, saxicolous thallus containing zeorin and 6-*O*-methylarthothelin, immersed to broadly adnate, lecanorine apothecia, 0.2–0.7 mm wide, asci with 2–7(–8) spores, non-inspersed paraphyses, 1-septate ascospores that transition from *Serotina*- to *Dirinaria*-, *Physcia*-, *Pachysporaria*- or *Buellia*-type, 20–28 × 12–18 µm, and the straight, bacilliform conidia, 3.5–5 × 1 µm. Morphologically, it closely resembles *R. fijiensis* from the Fiji Islands, in that both have crustose, areolate to subsquamulose thalli that lack vegetative propagules, and similar immersed to subimmersed, lecanorine apothecia that become adnate at maturity (Elix & Giralt 2015). However, *R. fijiensis* differs in having a colourless hypothecium, smaller *Pachysporaria*-type ascospores, 15–21 × 8–12 µm, and in containing atranorin, zeorin and arthothelin. Anatomically, the new species resembles *R. sheardii* Tønsberg, a corticolous lichen from North America. Like *R. michaelae, R. sheardii* has a brown to dark brown hypothecium, similar-sized ascospores that transition from *Pachysporaria*- to *Physcia*-, *Mischoblastia*- to *Milvina*-type with apparent type-B ontogeny (Sheard 2010). The two taxa are also chemically similar, but *R. sheardii* contains the xanthones thiomelin and zeorin, rather than 6-*O*-methylarthothelin and zeorin. Two other saxicolous *Rinodina* species in Australia contain zeorin and xanthones, namely *R. thiomela* (Nyl.) Müll.Arg., and *R. xanthomelana* Müll.Arg., but both species differ from *R. michaelae* in having colourless hypothecia and prominent oil paraphyses in the hymenium, and they also contain thiomelin and satellites rather than 6-*O*-methylarthothelin.

At present, the new species is known from hinterland regions of New South Wales and southern Queensland. Associated species include *Heterodermia speciosa* (Wulfen) Trevis., *Lepra subventosa* (Malme) I.Schmitt & Lumbsch var. *subventosa* and *Pertusaria xanthoplaca* Müll.Arg.

SPECIMENS EXAMINED
Queensland: ● Type locality, on basalt, *H. Mayrhofer 11485a, E. Hierzer & R.W. Rogers*, 18.viii.1993 (GZU), *H. Mayrhofer 11485b, E. Hierzer & R.W. Rogers*, 18.viii.1993 (CANB). *New South Wales*: ● Royal National Park, 0.5 km N of Garie Beach, 34°09'59"S, 151°04'03"E, 50 m alt., on E-exposed sandstone rocks in open *Eucalyptus* forest, *M. Lambauer 0120*, 28.x.2003 (GZU).

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Figure 1. *Rinodina michaelae* (holotype in GZU). Scale = 1 mm.

Figure 2. Ascospore ontogeny of *R. michaelae*. Scale = 10 µm.

A key to the buellioid lichens (Ascomycota, Caliciaceae) in New Zealand

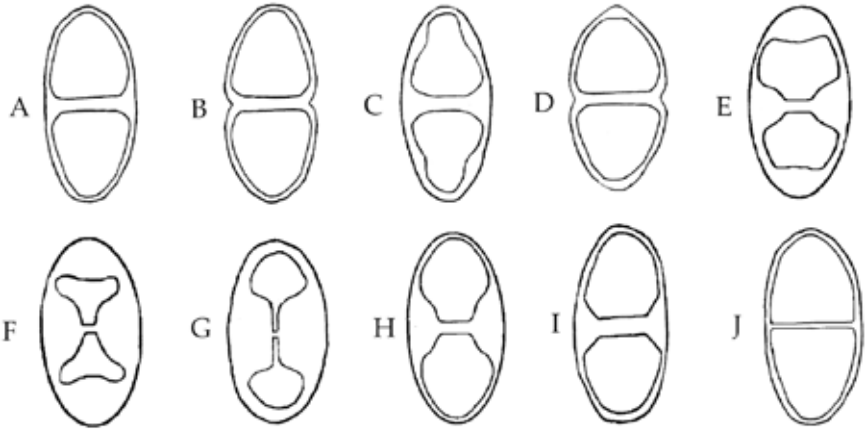
John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Abstract

A key to the 106 taxa of buellioid lichens in New Zealand is provided. *Amandinea hnatiukii* Elix is reported for the first time from New Zealand

This paper continues our investigation of *Buellia*-like lichens in New Zealand, and follows from the previous accounts of *Buellia* and related genera (Elix 2015, 2016, 2017a, 2017b; Elix *et al.* 2015, 2017a, 2017b; Elix & Kantvilas 2016; Elix & Knight 2017; Elix & Mayrhofer 2016, 2017, 2018) and our additions and revisions to *Amandinea* (Blaha *et al.* 2016; Mayrhofer *et al.* 2016). Here, I provide a key to the 106 species and infraspecific taxa of buellioid lichens currently known from New Zealand. *Amandinea hnatiukii* Elix is reported for the first time from New Zealand.

Keys to buellioid lichens in New Zealand



Types of ascospore. A = *Buellia*-type; B = *Buellia*-type (constricted); C = *Callispora*-type; D = *Cratiria*-type; E = *Dirinaria*-type; F = *Mischoblastia*-type; G = *Orcularia*-type; H, I = *Physconia*-type; J = *Rinodinella*-type.

Key A. Species growing on bark, wood, soil or other lichens; lacking lichen substances [K–, C–, KC–, P–, UV–, TLC–]
Key B. Species growing on bark, wood, soil, grass, bryophytes or other lichens; containing lichen substances [positive test with one or more of K, C, KC, PD, UV, TLC]
Key C. Species growing on rock; lacking lichen substances [K–, C–, KC–, PD–, UV–, TLC–]
Key D. Species growing on rock; containing lichen substances [positive test with one or more of K, C, KC, PD, UV, TLC]

***** These species have been reported for New Zealand and are included in the key, although no authentic material has been seen by the author.
These species have only been reported for New Zealand's subantarctic islands.

Key A

1 Thallus growing on bark or wood 2
1: Thallus growing on soil or other lichens 14

2 Ascospores 3-septate or submuriform ..... **Diplotomma alboatrum**
2: Ascospores 1-septate 3

3 Ascospores *Orcularia*-type; conidia filiform, curved 4
3: Ascospores *Physconia*-or *Buellia*-type; conidia various 6

4 Ascospores initially *Orcularia*-type, then *Physconia*-type, 20–28 µm long ..... **Amandinea dudleyensis#**
4: Ascospores persistently *Orcularia*-type, 13–22 µm long 5

5 Ascospores 10–[*13.5*]–16 × 5–[*6.8*]–8.5 µm ..... **Orcularia elixii**
5: Ascospores 11–[*15.5*]–22 × 6.5–[*8.0*]–10 µm ..... **Orcularia insperata**

6 Ascospores persistently *Buellia*-type 7
6: Ascospores initially *Physconia*-type, then *Buellia*-type 8

7 Ascospores 12–15 × 5–8 µm; conidia filiform, curved, 12–18 µm long ..... **Amandinea punctata**
7: Ascospores 16–30 × 7–12 µm; conidia bacilliform, straight, 5–6 µm long ..... **Baculifera macromera**

8 Apothecia initially lecanorine, then biatorine or lecideine; conidia filiform, curved, 16–30 um long 9
8: Apothecia lecideine throughout 10

9 Ascospores 14–21 × 6–9 µm; juvenile ascospore locules spherical ... **Amandinea ornata**
9: Ascospores 10–17 × 5–8 µm; juvenile ascospore locules lachrymiform (tear-shaped) .... **Amandinea ropinii**

10 Epihymenium green to greenish black, K+ greenish, N+ purple-black or grey-black; conidia bacilliform, straight, 5–9 µm long ..... **Baculifera xylophila**
10: Epihymenium brown, K–, N–; conidia curved, filiform, 16–30 µm long 11

11 Ascospores 17–25 × 7–12 µm ..... **Amandinea pillagaensis**
11: Ascospores 11–20 × 5–8 µm 12

12 Thallus on wood; ascospores 13–20 µm long ..... **Amandinea lignicola** var. **australis**
12: Thallus on bark or wood; ascospores 11–16 µm long 13

13 Subhymenium inspersed; locules of juvenile ascospores spherical ..... **Amandinea porulosa**
13: Subhymenium not inspersed; locules of juvenile ascospores clavate ..... **Amandinea extenuata**

14 Thallus growing on soil; ascospores 10–15 × 5–7 µm ..... **Buellia suttonensis**
14: Thallus growing on other lichens 15

15 Ascospores 1-septate; growing on *Caloplaca* sp. 16
15: Ascospores 3-septate or submuriform 17

16 Ascospores *Physconia*-type, then *Buellia*-type, 12–16 µm long; conidia bacilliform, straight, 4–5 µm long ..... **Buellia subadjuncta**
16: Ascospores *Buellia*-type, 14–18 µm long; conidia filiform, curved, 16–20 µm long ..... **Amandinea adjuncta***

17 Ascospores 3-septate, 8–12 × 4–5 µm; on *Thelotrema* sp.; Auckland Is ..... **Buellia thelotremicola#**
17: Ascospores submuriform, 13–20 × 7–10 µm; on *Caloplaca* sp. or *Xanthoria elegans* ... **Diplotomma nivale***

Key B
1 Thallus growing on bark or wood 2
1: Thallus growing on grass, soil, bryophytes or other lichens 13

2 Ascospores 1–3-septate or submuriform 3
2: Ascospores 1-septate 4

3 Ascospores submuriform; thallus sorediate, K+ red; norstictic acid present ..... **Buellia griseovirens***
3: Ascospores 1–3-septate; thallus not sorediate, K+ yellow; atranorin present ..... **Buellia billewersii**

4 Thallus K+ red; norstictic acid present 5
4: Thallus K–; norstictic acid absent 6

5 Hymenium densely inspersed with oil droplets; ascospores 26–34 µm long ..... **Buellia subcrassata**
5: Hymenium not inspersed with oil droplets; ascospores 12–18 µm long ..... **Baculifera entochlora**

6 Upper surface yellow or yellow-grey; thallus C+ orange, UV+ orange; xanthones present .. 7
6: Upper surface whitish, grey to grey-brown; thallus C–, UV–; xanthones absent 10

7 Asci 16-spored; ascospores 9–12 × 4–5.5 µm ..... **Amandinea melaxanthella**
7: Asci 8-spored 8

8 Ascospores 11–14 × 4.5–6 µm; arthothelin and thuringione present ..... **Amandinea diorista** var. **hypopelidna**
8: Ascospores 12–18 × 6–8 µm; thiophanic acid present 9

9 Thallus sorediate ..... **Gassicurtia jamesii**
9: Thallus not sorediate ..... **Gassicurtia gallowayi**

10 Hymenium not inspersed with oil droplets; ascospores *Buellia*-type, 13–17 × 5–7 µm .. **Baculifera micromera**
10: Hymenium densely inspersed with oil droplets; ascospores *Callispora*-type 11

11 Asci 3–4-spored ..... **Buellia tetrapla***
11: Asci usually 8-spored 12

12 Ascospores with strong subapical wall-thickenings; diploicin present. ..... **Buellia demutans***
12: Ascospores with weak subapical wall-thickenings; diploicin absent ..... **Buellia disciformis**

13 Thallus bright yellow; growing on Pannariaceae; Campbell Is . **Buellia campbelliana#**
13: Thallus brown or pale yellow; growing on soil, grass or bryophytes 14

14 Thallus K+ yellow, UV–; atranorin present; ascospores 13–17 × 6–9 µm ..... **Tetramelas kopuwaianus**
14: Thallus K–, UV+ orange; 6-*O*-methylarthothelin present; ascospores 14–32 × 5–13 µm 15

15 Ascospores 14–25 × 5–7.5 µm ..... **Tetramelas confusus**
15: Ascospores 23–32 × 8–13 µm ..... **Tetramelas insignis**

Key C
1 Ascospores 3-septate or submuriform; on limestone 2
1: Ascospores 1-septate; on limestone or siliceous rocks 3

2 Ascospores submuriform ..... **Diplotomma alboatrum**
2: Ascospores 3-septate ..... **Diplotomma venustum***

3 Upper surface granular-sorediate ..... **Buellia amandineaeformis**
3: Upper surface not sorediate 4

4 Thallus growing on limestone ..... **Buellia albula**
4: Thallus growing on siliceous rocks 5

5 Thallus subsquamulose to squamulose 6
5: Thallus crustose 7

6 Thallus initially lichenicolous; ascospores 10–15 µm long; conidia bacilliform, 3–5 µm long ..... **Monerolechia badia**
6: Thallus never lichenicolous; ascospores 12–18 µm long; conidia curved, filiform, 20–30 µm long ..... **Amandinea isabellina**

7 Thallus epilithic 8
7: Thallus endolithic, not apparent or with a few scattered, thalline flecks 33

8 Epihymenium aeruginose, N+ violet; on montane rocks ..... **Buellia epiaeruginosa**
8: Epihymenium brown, N– or N+ greenish black then orange-brown 9

9 Ascospores with marked medial wall-thickenings, *Orcularia* to *Physconia*-type 10
9: Ascospores without medial wall-thickenings, or with weak medial wall-thickenings during spore ontogeny, *Physconia*-then *Buellia*-type 13

10 Apothecia to 1 mm diam., often pruinose 11
10: Apothecia to 0.6 mm diam., not pruinose 12

11 Ascospores 17–23 × 10–14 µm; subhymenium not inspersed; ± variolaric acid ..... **Amandinea decedens**
11: Ascospores 14–18 × 6–9 µm; subhymenium inspersed; ± SV-1 ..... **Amandinea variabilis**

12 Apothecia immersed; thallus cream-coloured to pale brown, weakly verrucose; ascospores 7.5–10 µm wide ..... **Amandinea otagensis**
12: Apothecia broadly adnate; thallus dirty white to grey-brown, rimose-areolate; ascospores 6–8 µm wide ..... **Amandinea pelidna**

13 On montane rocks 14
13: On coastal and lowland rocks 15

14 Medulla I+ blue; ascospores 15–26 × 8–14 µm..... **Amandinea austroconiops**
14: Medulla I–; ascospores 14–20 × 7–10 µm ..... **Amandinea isabellina**

15 Ascospores without medial wall-thickenings; ascospores 9–15 × 4–9 µm 16
15: Ascospores with weak medial wall-thickening during spore ontogeny, but soon reduced 20

16 Conidia bacilliform, straight, 3–6 µm long..... 17
16: Conidia filiform, curved, 12–30 µm long..... 19

17 Thallus lacking calcium oxalate [H_2SO_4–]..... **Buellia suttonensis**
17: Thallus containing calcium oxalate [H_2SO_4+]..... 18

18 Thallus thick, corticate, continuous ..... **Buellia cranwelliae**
18: Thallus of scattered ecorticate areoles..... **Buellia poolensis**

19 Mature ascospores not constricted at the septum; prothallus usually absent; conidia 12–18 µm long ..... **Amandinea punctata**
19: Mature ascospores constricted at the septum; prothallus broad, marginal; conidia 20–30 µm long ..... **Amandinea prothallinata**

20 Ascospores 15–30 × 7–14 µm 21
20: Ascospores 10–16 × 5–9 µm 28

21 Medulla I+ blue; ascospores 15–26 × 8–14 µm..... **Amandinea austroconiops**
21: Medulla I–; ascospores 15–22 × 8–12 µm 22

22 Conidia bacilliform, straight, 6–10 µm long; prothallus thick, black, dominant.....
..... **Buellia prothallina**[#]
22: Conidia curved, filiform, 14–30 µm long; prothallus thin or absent 23

23 Mature ascospores not or only rarely constricted 24
23: Mature ascospores commonly constricted at the septum 25

24 Thallus rimose-areolate; ascospores 14–[*16.3*]–20 × 7–[*8.7*]–12 µm; subhymenium inspersed ..... **Amandinea nitrophila**
24: Thallus chinky; ascospores 15–[*17.9*]–22 × 8–[*9.8*]–13 µm; subhymenium not inspersed
..... **Amandinea subcervina**

25 Apothecial discs weakly grey-pruinose; subhymenium inspersed .....
..... **Amandinea hnatiuki**[#]
25: Apothecial discs epruinose; subhymenium not inspersed 26

26 Thallus bullate-areolate to sublobate; apothecia broadly adnate; hypothecium brown....
..... **Amandinea coniops**
26: Thallus finely fissured or granular; apothecia immersed; hypothecium hyaline..... 27

27 Medulla containing calcium oxalate, H_2SO_4+; upper surface granular .....
..... **Amandinea antipodensis**[#]
27: Medulla lacking calcium oxalate, H_2SO_4–; upper surface finely fissured .....
..... **Amandinea hypopallida**[#]

28 Ascospores 12–16 × 6–9 µm, elongate-ellipsoidal..... 29
28: Ascospores 10–13 × 5–7 µm, broadly ellipsoidal 30

29 Mature ascospores often constricted at the septum; thallus thick, warty; prothallus absent; apothecia to 1.5 mm wide ..... **Amandinea litoralis**
29: Mature ascospores not or very rarely constricted; thallus thin, rimose-areolate; prothallus often black and prominent; apothecia to 0.8 mm wide..... **Amandinea fuscoatratula**

30 Ascospores constricted at the septum; apothecial disc epruinose; thallus lacking orange pigment ..... **Amandinea australasica**
30: Ascospores not constricted; apothecial disc ± pruinose; thallus with or without orange pigment 31

31 Thallus absent or discontinuous, verruculose to granulose, white to pale orange; prothallus absent; thallus containing orange pigment..... **Amandinea vitellina**
31: Thallus rimose-areolate, continuous, grey to brown or dark brown; prothallus often present; thallus with or without orange pigment 32

32 Thallus brown or dark brown; prothallus often dark and prominent; disc epruinose; thallus lacking orange pigment ..... **Amandinea brunneola**
32: Thallus white to pale grey; prothallus grey-white or not apparent; disc often grey-white-pruinose; thallus containing orange pigment ..... **Amandinea julianeae**

33 Ascospores 12–16 × 5–10 µm 34
33: Ascospores 8–14 × 3.5–7 µm 35

34 Ascospores persistently *Buellia*-type, 5–[*6.6*]–8 µm wide ..... **Amandinea punctata**
34: Ascospores *Physconia*- then *Buellia*-type, 6–[*7.9*]–10 µm wide. .. **Amandinea discreta**

35 Thallus containing calcium oxalate [H_2SO_4+] 36
35: Thallus lacking calcium oxalate [H_2SO_4–] 37

36 Ascospores 10–[*12.0*]–15 µm long..... **Buellia poolensis**
36: Ascospores 8–[*10.5*]–13 µm long..... **Buellia austroabstracta**

37 Ascospores 3.5–[*4.6*]–6 µm wide, not constricted..... **Buellia abstracta**
37: Ascospores 5–[*6.2*]–8 µm wide, constricted or not..... 38

38 Ascospores not constricted; conidia curved, filiform, 15–25 µm long.....
..... **Amandinea vitellina**
38: Ascospores often constricted; conidia straight, bacilliform, 3–6.5 µm long.....
..... **Buellia suttonensis**

Key D
1 Ascospores 1–3-septate or submuriform 2
1: Ascospores 1-septate 7

2 Epihymenium brown, N–..... 3
2: Epihymenium aeruginose, N+ violet..... 5

3 Ascospores submuriform; thallus whitish..... **Diplotomma chlorophaeum**
3: Ascospores usually 1-septate, rarely 2–3-septate; thallus bright yellow..... 4

4 Ascospores 13–[*17.1*]–22 × 6–[*8.5*]–11 µm ..... **Tetramelas concinnus**
4: Ascospores 19–[*23.1*]–30 × 7–[*10.3*]–13 µm ..... **Tetramelas allisoniae**

5 Ascospores 3-septate; thallus K+ yellow, C+ red; alectorialic acid present; montane ..... **Buellia alectorialica**
5: Ascospores submuriform; thallus K–, C+ orange; isoarthothelin present; coastal..... 6

6 Ascospores 15–[*19.5*]–25 × 10–[*11.8*]–15 µm ..... **Buellia papanui**
6: Ascospores 13–[*16.2*]–19 × 7–[*9.1*]–10.3 µm..... **Buellia aeruginosa**

7 Thallus K+ red; norstictic acid present 8
7: Thallus K–, K+ yellow or K+ pale orange-red; norstictic acid absent..... 21

8 Thallus growing on limestone..... **Buellia albula**
8: Thallus growing on siliceous rocks 9

9 Thallus endolithic and not apparent or consisting of fragmentary white flecks 10
9: Thallus epilithic, more substantial..... 11

10 Thallus lacking calcium oxalate (H_2SO_4–)..... **Buellia northallina**
10: Thallus containing calcium oxalate (H_2SO_4+)..... **Buellia ferax**

11 Epihymenium aeruginose, N+ violet or purple-brown 12
11: Epihymenium brown, N–..... 17

12 Medulla containing calcium oxalate, H_2SO_4+..... 13
12: Medulla lacking calcium oxalate, H_2SO_4–..... 14

13 Apothecial discs epruinose ..... **Rinodinella fertilis**
13: Apothecial discs white-pruinose..... **Buellia kantvilasii**

14 Apothecia remaining immersed; atranorin absent ..... **Buellia aethalea**
14: Apothecia superficial at maturity; atranorin present or absent..... 15

15 Subhymenium inspersed; atranorin absent ..... **Buellia patearoana**
15: Subhymenium not inspersed; atranorin present..... 16

16 Ascospores 12–20 × 6–10 µm, commonly constricted at the septum ..... **Buellia homophylia**
16: Ascospores 10–16 × 5–8 µm, rarely constricted ..... **Buellia spuria** var. **amblyogona**

17 Apothecia initially lecanorine or cryptolecanorine; ascospores *Buellia*-type..... **Buellia haywardii**
17: Apothecia lecideine 18

18 Ascospores *Buellia*-type 19
18: Ascospores *Callispora*- then *Buellia*-type..... 20

19 Mature apothecia immersed; ascospores 14–20 × 6–8 µm; atranorin present..... **Buellia austroalpina**
19: Mature apothecia superficial; ascospores 10–16 × 5–7 µm; atranorin absent..... **Buellia tuapekensis**

20 Ascospores 15–[*18.4*]–20 × 7–[*9.3*]–12 µm; atranorin absent; montane ..... **Buellia maungatuensis**
20: Ascospores 15–[*21.3*]–25 × 8–[*10.8*]–13 µm; atranorin present; coastal ..... **Buellia akatorensis**

21 Thallus K+ yellow, UV–; atranorin 22
21: Thallus K– or K+ pale orange-red; atranorin absent or present as traces only 35

22 Thallus placodioid, bullate-areolate or squamulose..... 23
22: Thallus crustose 25

23 Thallus bullate-areolate to squamulose; xantholepinone A present..... **Endohyalina arachniformis**
23: Thallus placodioid; xantholepinone A absent..... 24

24 Buellolide and canseolide present..... **Diploicia canescens** subsp. **australasica**
24: Buellolide and canseolide absent..... **Diploicia canescens** subsp. **canescens**

25 Thallus sorediate; apothecia cryptolecanorine, with pruinose discs..... **Amandinea rangitatensis**
25: Thallus esorediate; apothecia lecideine, with epruinose discs 26

26 Ascospores 18–32 × 8–16 µm 27
26: Ascospores 10–23 × 5–11 µm 28

27 Conidia filiform, curved, 18–31 µm long ..... **Amandinea subbadioatra**
27: Conidia bacilliform, 4.5–7 µm long ..... **Buellia seppeltii**

28 Ascospores 10–16 × 5–8 µm 29
28: Ascospores 15–23 × 7–11 µm 33

29 Excipulum and hypothecium K+ intense purple..... **Buellia hypopurpurea**
29: Excipulum and hypothecium K–. 30

30 Thallus C+ orange, UV+ orange; xanthones present..... **Buellia subarenaria**
30: Thallus C–, UV–; xanthones absent 31

31 Thallus PD+ orange; stictic acid present ..... **Buellia spuria** var. **spuria**
31: Thallus PD+ pale yellow; stictic acid absent..... 32

32 2'-*O*-Methylperlatolic and confluentic acids absent .... **Buellia stellulata** var. **tasmanica**
32: 2'-*O*-Methylperlatolic, ± confluentic acids present ..... **Buellia stellulata** var. **stellulata**

33 Medulla lacking calcium oxalate, H_2SO_4–; Kermadec Is. ..... **Buellia insularicola**
33: Medulla containing calcium oxalate, H_2SO_4+ 34

34 Upper surface epruinose; hafellic acid present ..... **Buellia fallax**
34: Upper surface pruinose; porphyrilic acid present..... **Buellia porphyrilica**

35 Thallus K+ pale orange-red; hypostictic acid present..... 36
35: Thallus K–; hypostictic acid absent..... 37

36 Apothecial discs grey-white-pruinose; conidia bacilliform ..... **Buellia hypostictella**
36: Apothecial discs epruinose; conidia filiform ..... **Amandinea hypostictica**

37 Thallus C+ red, UV–; gyrophoric and ± 5-*O*-methylhiascic acids present..... **Buellia poimenae**
37: Thallus C+ orange or C–, UV+ or UV–; gyrophoric and 5-*O*-methylhiascic acids absent 38

38 Ascospores *Dirinaria*-type 39
38: Ascospores *Buellia*-type or *Physconia*-type 40

39 Thallus autonomous; hymenium densely inspersed with oil droplets; prothallus black, marginal; diploicin and xantholepinone A present ..... **Endohyalina arachniformis**
39: Thallus lichenicolous on *Lecanora* sp.; hymenium not inspersed; diploicin present, xantholepinone A absent. ..... **Endohyalina insularis**

40 Thallus C+ orange, UV+ orange; xanthones present 41
40: Thallus C–, UV–; variolaric acid present. 52

41 Upper surface pustulate-sorediate in part; apothecia immersed, cryptolecanorine ..... **Buellia malcolmii**
41: Upper surface esorediate; apothecia adnate to sessile, lecideine 42

42 Medulla containing calcium oxalate, H_2SO_4+ 43
42: Medulla lacking calcium oxalate, H_2SO_4– 45

43 Epihymenium N+ violet; arthothelin present; on siliceous rocks ..... **Buellia halonioides**
43: Epihymenium brown, N–; arthothelin present or absent; on limestone or siliceous rocks 44

44 Ascospores 16–24 × 9–14 µm; arthothelin present; on limestone ..... **Buellia georgei**
44: Ascospores 11–20 × 6–10 µm; 2,5,7-trichloro-3-*O*-methylnorlichexanthone present; on siliceous rocks ..... **Buellia alutacea**

45 Medulla I+ blue-violet 46
45: Medulla I– 49

46 Epihymenium aeruginose, N+ violet 47
46: Epihymenium brown, N– 48

47 Ascospores 10–[*13.8*]–18 µm long; 6-*O*-methylarthothelin present .. **Buellia macveanii**
47: Ascospores 10–[*12.4*]–14 µm long; arthothelin present ..... **Buellia sharpiana**

48 Ascospores 13–[*17.1*]–22 × 6–[*8.5*]–11 µm ..... **Tetramelas concinnus**
48: Ascospores 19–[*23.1*]–30 × 7–[*10.3*]–13 µm ..... **Tetramelas allisoniae**

49 Ascospores *Buellia*-type; discs epruinose; subhymenium greenish 50
49: Ascospores *Physconia*-type; discs often pruinose; subhymenium pale brown 51

50 Ascospores 11–[*12.4*]–15 × 5–[*5.8*]–7 µm ..... **Buellia straminea**
50: Ascospores 12–[*15.1*]–20 × 7–[*9.3*]–11 µm ..... **Buellia ocellata**

51 Thallus rimose-areolate; epihymenium N+ violet; arthothelin present ... **Buellia halonia**
51: Thallus verrucose-areolate; areoles convex; epihymenium brown, N–; 2,5,7-trichloro-3-*O*-methylnorlichexanthone present ..... **Buellia subarenaria**

52 Medulla I+ blue; ascospores *Physconia*- then *Buellia*-type, 14–18 × 7–10 µm ..... **Amandinea okainensis**
52: Medulla I–; ascospores *Orcularia*- then *Physconia*-type, 17–23 × 10–14 µm ..... **Amandinea decedens**

New record for New Zealand

Amandinea hnatiukii Elix, *Australas. Lichenol.* **81**, 6 (2017)

This species was previously known from Macquarie Island (Elix 2017a). It is characterized by the crustose, rimose to rimose-areolate, off-white to pale grey thallus, the inspersed subhymenium, ± white- to pale grey-pruinose discs, the *Physconia*- then *Buellia*-type ascospores, 15–[*18.4*]–25 × 8–[*9.5*]–12 µm, that are dilated at the septum in early ontogeny but become constricted at the septum with age and have a microrugulate outer wall, curved, filiform conidia, 16–25 × 0.7–1 µm, and by the lack of lichen substances. Illustrations and a detailed description are provided in Elix (2017a).

SPECIMENS EXAMINED

New Zealand: *Campbell Island*: ● N side of base of Courrejolles Peninsula, on ledges of mollymawk rookery, *H.A. Imshaug 46302*, 30.xii.1969 (MSC); ● W side of Monument Harbour, on rocks along shore, *H.A. Imshaug 46694 pr.p.*, 8.i.1970 (MSC).

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Pannaria pyxinoides comb. nov., an overlooked lichen species from northern New Zealand

Arve Elvebakk
Tromsø University Museum, University of Tromsø – the Arctic University of Norway, PO Box 5060 Langnes, N-9037 Tromsø, Norway
e-mail: arve.elvebakk@uit.no

Abstract: The name *Psoroma pyxinoides*, which has been considered to be a synonym of *Pannaria sphinctrina*, is shown here to represent a distinct species, differing from *P. sphinctrina* by thallus characters and in spore and pycnidium morphology. Those characters indicate a relationship with *Pannaria allorhiza.* Like the latter species, *P. pyxinoides* is endemic to northern New Zealand, and is at present known from 11 localities.

Introduction

Tripartite foliose *Pannaria* species are especially adapted to austral forests. Their biodiversity is far from completely known, particularly in New Zealand, which seems to be the centre of speciation. When Elvebakk & Elix (2017) described two new species, they also presented the highly diverse secondary chemistry of the group, and accepted 24 species. Most of those species had been accommodated in *Psoroma* prior to the studies by Jørgensen (2001) and Elvebakk & Galloway (2003).

Psoroma pyxinoides Nyl. is a name given to a species that has been treated as a synonym of *Pannaria sphinctrina* Mont. ex Tuck. in all recent studies, e.g. by Jørgensen (2003) and Galloway (2007). It was described from New Zealand by Nylander (1888), with the brief specimen information "Corticola (Kn.)." The label information on the lectotype *C. Knight 62* (H-NYL 30804) is "Nova Zelandia, 1867". Galloway (1985) made the lectotypification, and stated that its location was probably Wellington.

When the present author studied herbarium material of the *Pannaria sphinctrina* complex, some collections were found to deviate by having thin and strongly adnate lobes, and their colour was much paler than the dark chestnut-brown characteristic of old specimens of *P. sphinctrina*. The lectotype of *Psoroma pyxinoides* proved to have the same appearance, illustrating that the epithet had been aptly chosen, in that the habit of the type specimen resembles a *Pyxine* species in overall appearance, except for the pale brown apothecial discs and the presence of cephalodia.

Our revisions have now defined the *P. sphinctrina* complex as one primarily apotheciate species, *P. sphinctrina* itself, another rare, deviating and apparently extinct, fertile Chilean species (Elvebakk 2012), and four new species characterized by the presence of various types of vegetative propagules (Elvebakk 2013). The aim of the present study was to investigate whether *Psoroma pyxinoides* could be maintained as a synonym of *Pannaria sphinctrina,* whether it should be accommodated as a further primarily apotheciate member of this complex, or if it has other affinities. Because the old description is incomplete (although it included the key phrase "subcrustaceo-adnato"), a new description is provided here.

Material and methods

This paper is based on material from the herbaria AK, B, H-NYL, TROM, W and WELT. In total, 15 collections of *Pannaria pyxinoides* from 11 localities were found and examined, and most analyzed by TLC. In microscope sections, iodine reactions were tested by adding IKI to mounts pretreated with KOH. Perispore structures were studied in water mounts and restricted to spores liberated from their asci, and detailed drawings of a total of 50 spores were made and included with the specimens. Thin-layer chromatography of acetone extracts followed standardized procedures and used solvents A and C (Orange *et al.* 2010). Nomenclature of ascospore structures follows Nordin (1997). The localities cited are indicated within the present political boundaries of New Zealand.

Pannaria pyxinoides (Nyl.) Elvebakk, comb. nov. Figs 1–4
MycoBank number: **MB 824968**

Basionym: *Psoroma pyxinoides* Nyl., *Lich. Nov. Zel.: 53* (1888). Type: New Zealand, *sine loco* (probably Wellington). *C. Knight 62*, H-NYL 30804, lectotype!; lectotypified by Galloway 1985: 482; W 1919-12621, isolectotype!

Thallus foliose, corticolous, forming adnate rosettes 2–7 cm diam. *Lobes* 100–150 µm thick, 0.5–1 mm wide and up to 15 mm long, convex to flat, margins entire; monopodially to subdichotomously or irregularly and often weakly branched, resulting in lobes with parallel orientation, coalescing centrally where thin and adnate secondary lobules frequently develop. *Upper surface* smooth, weakly glossy, uneven in older parts; when alive, pale greyish green when dry, lettuce-green when moist, turning pale ochraceous or weakly brownish after long-term storage. *Upper cortex* 20–30 µm thick, plectenchymatous, lumina 5–8 µm wide, walls 1.5–2 µm thick. *Photobiont layer* 20–30 µm thick, of either cf. *Myrmecia* or cf. *Trebouxia* cells, globose to subglobose, 2–6 µm diam. *Medulla* lax, 60–80 µm thick, pale brown-pigmented on the exposed, ecorticate and erhizinate lower part. Hypothallus/prothallus not observed. *Cephalodia* common, pulvinate to placodioid, 0.5–2 mm diam.; cyanobiont *Nostoc*, cells deep green, globose to irregularly ellipsoid, 3–7 µm diam., organized within glomerules, without visible chain structures. *Apothecia* common, substipitate,1–2.5 mm diam.; disc pale reddish brown, mostly flat, without concentric rings or thalline granules; thalline excipulum *c.* 0.2 mm wide, finely striate-crenulate with striae 0.1–0.15 mm broad. *Epithecium* pale brown, 20–30 µm thick; hymenium *c.* 90–100 µm thick, IKI+ deep blue; hypothecium pale brown, 50–60 µm thick. *Asci* clavate, 70–80 × 15 µm, no IKI+ internal structures seen, with 8 ascospores. *Ascospores* entire, regularly ellipsoid to ovoid, ends broadly obtuse, short- to elongate-ellipsoid, 12–15 × 6–9 µm; *perispores* seen as a few scattered low verrucae on some spores, and without apical extensions, but mostly not visible apart from very small verrucae, 0.5–1 µm wide on immature spores. *Pycnidia* common in some specimens, elevated and verrucose, 0.1–0.25 × 0.1–0.25 µm, ostiole brown, spermatia bacilliform, 2.5 × 0.5 µm.
Chemistry: containing vicanicin.

Remarks

The species differs from *Pannaria sphinctrina* in having more adnate and thinner lobes, which are often more parallel-oriented, and by verrucose pycnidia and smaller spores. Perispores are usually not visible on mature spores, although sometimes a few low verrucae are present, and the large apical extensions characteristic of *P. sphinctrina* are always absent. Immature spores have verrucae, but they are much smaller than those observed in *P. sphinctrina.* Old herbarium specimens do not become dark chesntnut-brown in colour as do those of *P. sphinctrina*.

ADDITIONAL SPECIMENS STUDIED:
Auckland Region: ● Great Barrier Island, 2 km E of Port Fitzroy, 6–700 m southwards from Aotea Road along the Coopers Castle Track, 36°09'45"S, 175°22'45"E, 280 m alt., on trunk of *Syzygium maire*, *A. Elvebakk 16:066; 16:069,* 21.ii.2016 (TROM); ● Ruahine summit, 36°20'S, 175°31'E, 395–400 m alt., on bark, semi-open forest, *B.W. Hayward*, 4–10.i.1984 (AK 182668); ● Tryphena, Needles Track, 36°17'S, 175°29'E, 170–190 m alt., semi-open forest, *B.W. Hayward*, i.1984 (AK 178239); ● Little Barrier (Hauturu) Island (36°11'57"S, 175°04'53"E), *B.W. Hayward*, viii.1984 (AK 175465), *B.W. Hayward* 9.v.1990 (AK 247025); ● ridge north of Te Hue Stream, Track 5, 36°11'S, 175°04'E, 300 m alt., on bark of kauri in mature forest, *A.E. Wright 10064*, 10.v.1990 (AK 193519); ● Hauraki Gulf, Awaroa Stream, *J.E. Braggins 84/155b*, 4.xi.1985 (AK 280149). *Waikato Region*: ● Coromandel Ecological Region, Colville Ecological District, Mount Maungatawhiri, near Whitianga, 36°47'S, 175°44'E, 240 m alt., on bark in bush, *B.W. & G.C. Hayward H44.230*, viii.1974 (AK 154596). *Northland Region*: ● Hokianga Co., Waipoua State Forest, Ohae headwaters, 35°37'S, 173°29'E, 250 m alt., mixed forest, *B.W. & G.C. Hayward,* 6.i.1987 (AK 181577); ● 1 km N

of Mitimiti, on banks of Taikarawa Stream, Warawara Forest, 35°25'20"N, 173°16'20" E, along river and on banks, on fallen tree, *P.J. Brownsey*, 26.iv.1990 (W L-3197); ● *W.A. Nelson*, 26.iv.1991 (W L-3188); ● Okahu, Herekino Forest, end of Larner Road, 1 km past quarry, track to Okahu Stream, 35°10'S, 173°16'E, 80 m alt., forest of nikau, kohekohe, kahikatea, taraire, puriri; on nikau near stream edge, *W.A. Nelson* 28.iv.1990 (W L-3171).

Conclusions

The characters cited above clearly show that *P. pyxinoides* is a distinct species and not conspecific with *P. sphinctrina,* even though the two species have the same major secondary chemistry. Most collections in the *P. sphinctrina* complex have perispores with tall and *c.* 2.5 µm wide verrucae, frequently in addition to larger nodulose apical extensions. The verrucae of *P. pyxinoides* are much smaller, 0.5–1 µm, and are absent when spores mature. The size and shape of the spores are actually more similar to *P. allorhiza* (Nyl.) Elvebakk & Galloway and *P. araneosa* (C.Bab.) Hue, both now being studied by the present author.

Pycnidia have been little studied in the Pannariaceae, and have been overlooked in my previous studies of the *P. sphinctrina* complex. However, they are distinct and verrucose with dark ostioles in some of the collections of *P. pyxinoides*. As such they show a strong resemblance to the large pycnidia present in *P. allorhiza*, to be described in a forthcoming paper.

Whereas all of these species are deep lettuce-green when observed moist in the field, the colour of old herbarium collections of *P. pyxinoides* is pale, ochraceous-brown, rather than deep chestnut-brown like species in the *P. sphinctrina* group. The reasons for these colours are not well understood; however, Elvebakk (2007) suggested that they derive from compounds released after the death of the chlorobionts. Interestingly, the cells of the chlorobionts of *P. pyxinoides, P. allorhiza* and *P. araneosa* are all much smaller than those in other species of tripartite foliose *Pannaria* species. Most cells are smaller than 5 µm wide, both in strains determined as cf. *Myrmecia* here, and in a contrasting collection where the shape of the chloroplasts indicates it belongs to *Trebouxia*. Perhaps the chlorobionts have narrow climatic demands that contribute to the northern New Zealand distributions of these lichens.

Most of the specimens studied here are from Little and Great Barrier Islands. In addition, there is a collection from the Coromandel Peninsula, and the species is known from the Herekino, Waipoua and Warawara forests in northern parts of Northland. If the lectotype really originates from the Wellington area, that would be the southernmost locality known for the species. In cases where ecological information is available, it shows that *P. pyxinoides* occurs in forests from 170 to 400 m altitude. Our present knowledge indicates that it is a northern New Zealand endemic. It was found in only a single site during the present author's field work on Great Barrier Island, and only in the highest locality visited, so it might be more common at slightly higher altitudes. The Knight collection made in 1867 and published by Nylander (1888) is the only reliable report of the species made previously. Zahlbruckner (1941) reported an Allison collection of *P. pyxinoides* from 500 m on the Volcanic Plateau, but that collection could not be located.

A molecular study of the northern tripartite, foliose *Pannaria* species might confirm the relationships proposed here based on morphological and anatomical characters. In the meantime, *P. pyxinoides* is considered to be a relative of *P. allorhiza* and not *P. sphinctrina*.

Acknowledgements

I am indebted to the herbaria cited for permission to study material in their collections, and to borrow part of it. The New Zealand Department of Conservation kindly granted me a collection permit, and H. Rämä and M. Karlstad, both of Tromsø University Museum, University of Tromsø, performed some TLC analyses and took a photograph, respectively. John A. Elix (Canberra) kindly commented on the manuscript.

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Fig. 1. The holotype of *Psoroma pyxinoides*.

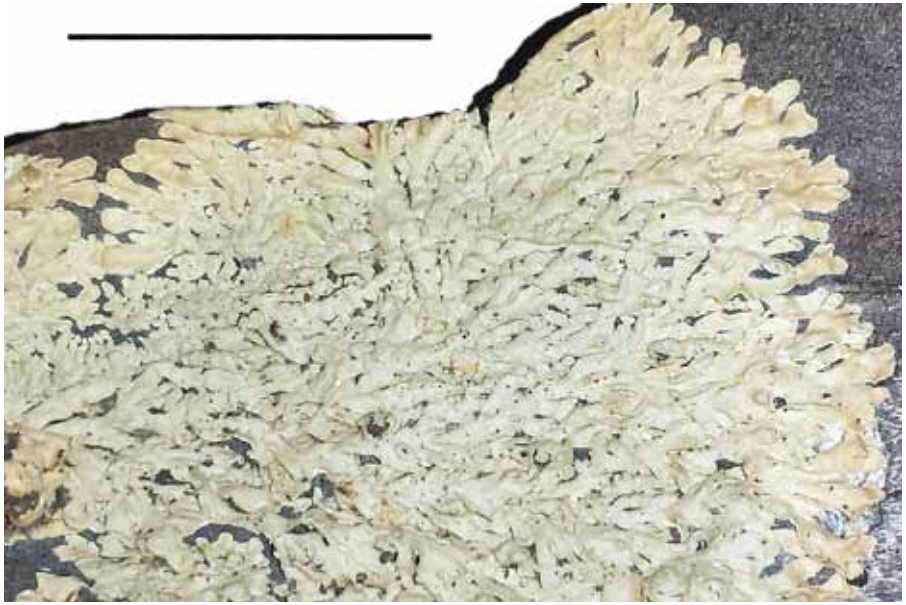

Fig. 2. *Pannaria pyxinoides*. The specimen *Wright 10064*. Scale bar = 10 mm.

Fig. 3. *Pannaria pyxinoides*. The 5-cm-wide specimen *Elvebakk 16-069* photographed in the field on Great Barrier Island, together with *P. allorhiza* (*Elvebakk 16:068*) to the right.

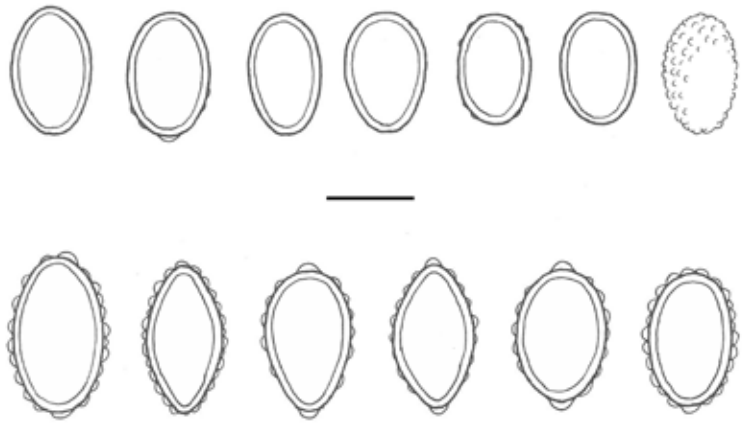

Fig. 4. Ascospores of *P. pyxinoides* (above, an immature spore to the far right) compared with *P. sphinctrina* (below). Scale bar = 10 µm.

New combinations of *Tetramelas* (Caliciaceae, Ascomycota) and a key to the species in Antarctica

John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Abstract

The new combinations *Tetramelas anisomerus* (Nyl.) Elix, *T. cladocarpizus* (I.M.Lamb) Elix, *T. darbishirei* (I.M.Lamb) Elix, *T. grimmiae* (Filson) Elix, *T. inordinatus* (Hue) Elix, *T. nelsonii* (Darb.) Elix and *T. subpedicellatus* (Hue) Elix are proposed, and a key is provided to the eleven species of *Tetramelas* present in Antarctica.

Introduction

In their monograph of the *Lichens of Antarctica and South Georgia,* Øvstedal & Lewis-Smith (2001) recorded a total of 30 species of *Buellia sens. lat.* Four of those species have since been transferred to *Amandinea* (Søchting *et al.* 2004), and four to *Tetramelas* (Kalb 2004; Nordin 2004; Elix 2017). Phylogenetic studies have confirmed that *Tetramelas* Norman constitutes a well-founded segregate of *Buellia sens. lat.* (Helms *et al.* 2003; Nordin & Tibell 2005). Generic characters often include the presence of xanthones (arthothelin, 6-*O*-methylarthothelin, isoarthothelin or 2,5,7-trichloro-3-*O*-methylnorlichexanthone), commonly curved, 1–3-septate ascospores with pointed apices that show *Callispora*-type thickenings in early ontogeny (Giralt *et al.* 2009), and a predominantly Arctic-Antarctic or alpine-subalpine distribution (Kalb 2004). Careful study has shown that a further seven species among the remaining 22 buellioid taxa recorded from Antarctica by Øvstedal & Lewis-Smith (2001) belong to *Tetramelas*.

In this contribution, a key is provided to the species of *Tetramelas* present in Antarctica, and seven new combinations are proposed for the genus.

Methods

Observations and measurements of thallus and apothecium anatomy, asci, ascospores and conidia were made on hand-cut sections mounted in water and treated with 10% potassium hydroxide (K) and 50% nitric acid (N). Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Chemical constituents were identified by thin-layer chromatography (TLC) (Elix 2014) and comparison with authentic samples.

The new combinations

1. Tetramelas anisomerus (Vain.) Elix, comb. nov.
MycoBank number: **MB 825485**
Basionym: *Buellia anisomera* Vain., Lichens. In *Expédition Antarctique Belgique. Résultats du Voyage du S.Y. Belgica en 1897–1898–1899 sous le commandement de A. Gerlache de Gomery. Rapports Scientifiques. Botanique*: 26 (1903).
Type: Antarctica, West Graham Land, Wiencke Island, 64°50'S, 63°25'W, on granodioritic rock, *E. Racovitza BAE 447 pr.p.*, 1897–1899 (BR – holotype; TUR – isotype not seen).
The synonymy, a detailed description and illustrations of this species can be found in Lamb (1968).
Chemistry: Thallus K– or K+ pale yellow, P–, C+ yellow-orange, UV+ orange; containing arthothelin (major), atranorin (minor or trace), thiophanic acid (minor or trace), 4,5-dichloronorlichexanthone (minor), 2,5-dichloronorlichexanthone (trace), 2,4-dichloronorlichexanthone (trace).

This widespread Antarctic species is known from the Antarctic Peninsula, South Georgia, Bouvetøya, South Sandwich Islands, South Orkney Islands and South Shetland Islands (Øvstedal & Lewis Smith 2001; Søchting *et al.* 2004). It is characterized by a yellow to pale yellow-grey, crustose thallus that contains arthothelin but lacks medullary calcium oxalate, an amyloid medulla, sessile, lecideine apothecia, 0.5–1.3 mm wide, a dark brown to olive-brown, N– epihymenium, often curved, *Callispora*- then *Buellia*-type ascospores, 16–[*19.6*]–24 × 6–[*8.2*]–10 µm, that become constricted at maturity and have a microrugulate outer spore-wall, and bacilliform conidia, 4–6 × 0.8–1 µm. The spores are usually 1-septate, but sometimes develop 1 or 2 additional septa. The species closely resembles *T. concinnus* (Th.Fr.) Giralt, which differs in having shorter ascospores, 13–[*17.1*]–22 µm long, a thinner hymenium, 60–80 µm thick (cf. 75–110 µm thick in *T. anisomerus*) and shorter conidia, 2–4 × 1–2 µm.

SPECIMENS EXAMINED
Antarctica: ● South Shetland Islands, Livingston Island, Punta Polaca, 62°40'S, 60°23'W, on bird perching stone near the shore, *U. Søchting 7593*, 12–28.ii.1998 (C).
Australia: *Macquarie Island*: ● Gadgets Gully, *c.* 2.4 km S of ANARE Station, 54°30'S, 158°55'E, 60 m alt., on rock with E aspect, *R.B. Filson 6358B & P. Atkinson*, 18.iii.1964 (MEL); ● Hasselborough Bay, 54°30'S, 158°57'E, 10 m alt., on stones in scree outwash at base of plateau slope, upper raised beach terrace, *R.D. Seppelt 19524 pr.p.*, 5.ii.1995 (HO) [these specimens were previously misidentified as *T. concinnus*].
South Georgia: ● Royal Bay, above Köppen Point, 54°30'S, 36°02'W, 30 m alt., on dry, S-facing bird perching stone, *D.C. Lindsay s.n.*, 25.i.1972 (MEL).

2. Tetramelas cladocarpizus (I.M.Lamb) Elix, comb. nov.
MycoBank number: **MB 825486**
Basionym: *Buellia cladocarpiza* I.M.Lamb, *British Antarctic Survey Scientific Reports* **61**, 24 (1968).
Type: Antarctica, West Graham Land, Wiencke Island, Noble Peak, 64°48'S, 63°25'W, 135 m alt., on S-facing, slightly overhanging face of granodioritic rock in an outcrop, *I.M. Lamb FIDS A1782*, 19.xi.1944 (BM – holotype not seen).

A detailed description and illustrations of this species can be found in Lamb (1968).
Chemistry: Thallus K+ yellow, P+ pale yellow, C–, UV–; containing atranorin (major).

This Antarctic endemic is known from the Antarctic Peninsula and South Shetland Islands (Øvstedal & Lewis Smith 2001; Søchting *et al.* 2004). It is characterized by a thick, grey to grey-white, crustose thallus that forms granular cushions to 15 mm thick, and contains atranorin but lacks medullary calcium oxalate. It has an amyloid medulla, broadly adnate to sessile, lecideine apothecia, 0.5–2 mm wide, a dark brown to olive-brown, N– epihymenium, a finely inspersed hymenium, often curved, *Callispora*- then *Buellia*-type ascospores, 17–[*19.8*]–24 × 7–[*9.5*]–11 µm, which become constricted at maturity and have a microrugulate outer spore-wall, and bacilliform conidia, 5–7 × 1 µm. The spores are usually 1-septate, but sometimes develop 1 or 2 additional septa. It is chemically identical to *T. papillatus* (Sommerf.) Kalb, but the latter differs in growing on moribund bryophytes, in having a non-inspersed hymenium and a non-amyloid medulla (Nordin 2005).

SPECIMEN EXAMINED
Antarctica: ● South Shetland Islands, King George Island, E side of Esther Harbour, 61°55'S, 57°59'W, 0–1 m alt., on rock, Discovery Expedition 1936–37, *collector unknown 1949–3*, 6.i.1937 (BM).

3. Tetramelas darbishirei (I.M.Lamb) Elix, comb. nov.
MycoBank number: **MB 825487**
Basionym: *Buellia darbishirei* I.M.Lamb, *British Antarctic Survey Scientific Reports* **61**, 23 (1968).
Type: Antarctica, East Graham Land, Hope Bay, 63°24'S, 57°00'W, on rocks, *C. Skottsberg SAE 170,* 11.xi.1903 (S – holotype!).

A detailed description and illustrations of this species can be found in Lamb (1968).
Chemistry: Thallus K+ pale yellow or K–, P+ pale yellow or P–, C+ pale orange, UV+ pale orange; containing atranorin (major or minor), 6-*O*-methylarthothelin (major or minor), 4,5-dichloro-6-*O*-methylnorlichexanthone (minor or trace).

This species is known from the Antarctic Peninsula and continental Antarctica (Øvstedal & Lewis Smith 2001). It is characterized by a verruculose, off-white to grey-brown thallus in which the verrucae can form small cushion-like clumps to 3 mm thick, and it contains 6-*O*-methylarthothelin but lacks medullary calcium oxalate. It has an amyloid medulla, immersed then adnate to sessile, lecideine apothecia, 0.3–0.8 mm wide, a dark brown to olive-brown, N– epihymenium, often curved, *Callispora*- then *Buellia*-type ascospores, 14–[*17.4*]–21 × 6–[*7.3*]–9 µm, which become constricted at maturity and have a microrugulate outer spore-wall, and bacilliform conidia, 4–6 × 0.7–1 µm. The spores are mostly 1-septate, but rarely develop 1 or 2 additional septa. It is morphologically similar to *T. inordinata* (below), but the latter differs in having an aeruginose, N+ red-violet to purple-brown epihymenium.

SPECIMEN EXAMINED
Antarctica: ● Marie Bryd Land, Edward VII Peninsula, Rockefeller Mountains, Paterson Ridge, 78°03'S, 155°00'W, on rock, *P.A. Broady 48,* 1.i.1988 (HO).

4. Tetramelas grimmiae (Filson) Elix, comb. nov.
MycoBank number: **MB 825488**
Basionym: *Buellia grimmiae* Filson, *Lichens and Mosses of MacRobertson Land* (Melbourne) 34 (1966).
Type: Antarctica, MacRobertson Land, Field Rock, 1.6 km E of Mawson, 67°36'S, 62°54'E, growing over patches of *Grimmia lawiana*, *R. Filson 4456*, 9.xii.1962 (MEL– holotype!).

A detailed description and illustrations of this species can be found in Filson (1966).
Chemistry: Thallus K–, P–, C–, UV–; no lichen substances detected by TLC.

This species is known from continental Antarctica, the Antarctic Peninsula and the South Shetland Islands (Filson 1966; Øvstedal & Lewis Smith 2001; Søchting *et al.* 2004). It is characterized by a thick, verruculose, white to grey-white, compacted granular to areolate or verrucose thallus that lacks lichen substances and medullary calcium oxalate. It has a strongly amyloid medulla, sessile, lecideine apothecia, 0.5–1 mm wide, a dark olive-brown to aeruginose-black, N+ red-violet to purple-brown epihymenium, sometimes curved, *Callispora*- then *Buellia*-type ascospores, 15–[*17.1*]–25 × 7–[*8.4*]–13 µm, which become constricted at maturity and have a microrugulate to rugulate outer spore-wall, and bacilliform conidia, 3–5 × 0.7–1 µm. The spores are invariably 1-septate.

SELECTED SPECIMENS EXAMINED
Antarctica: ● Wilkes Land, Windmill Islands, Bailey Peninsula, SSSI 60 m N of melt lake, 66°17'S, 110°32'E, *c.* 45 m alt., on sand and dead *Ceratodon purpureus* in moraine debris, *R.D. Seppelt 13121*, 14.xii.1982 (HO); ● *loc. id., R.D. Seppelt 13237*, 20.xii.1982 (HO); ● *loc. id., R.D. Seppelt 16761*, 5.xii.1986 (HO).

5. Tetramelas inordinatus (Hue) Elix, comb. nov.
MycoBank number: **MB 825489**
Basionym: *Lecidea inordinata* Hue, Lichens. In *Deux Expéditions Antarctiques Française (1908–10), sciences naturelles*: 122 (1915).
Buellia inordinata (Hue) Darb., *British Antarctic Terra Nova Expedition 1910, Natural History Reports*, Botany, **1**(3), 63 (1923).
Type: Antarctica, West Graham Land, Booth Island, Jeanne Hill, 65°04'S, 64°02'W, 30–100 m alt., on diorite rocks, *unknown collector FAE 1908-10/115 pr.p.*, 30.xii.1908 (PC – lectotype *fide* I.M. Lamb *British Antarctic Survey Scientific Reports* **61**, 23, 1968; not seen).

A detailed description of this species can be found in Lamb (1968) and an illustration of the ascospores in Hue (1915, as *Lecidea inordinata*).
Chemistry: Thallus K+ pale yellow or K–, P+ pale yellow or P–, C+ pale orange, UV+ pale orange; containing ± atranorin (major or minor), 6-*O*-methylarthothelin (major or minor), 4,5-dichloro-6-*O*-methylnorlichexanthone (minor or trace).

This species is known from the Antarctic Peninsula and the South Orkney Islands (Lamb 1968). It is characterized by a thick, straw-yellow to cream, granular-verruculose, crustose thallus that contains atranorin and 6-*O*-methylarthothelin. It has an amyloid medulla, broadly adnate to sessile, lecideine apothecia, 0.4–1 mm wide, an aeruginose to brown-black, N+ red-purple to purple-brown epihymenium, often curved, *Callispora*- then *Buellia*-type ascospores, 14–[*17.5*]–23 × 6–[*7.3*]–10 µm, which become constricted at maturity and have a microrugulate outer spore-wall, and bacilliform conidia, 4–6 × 0.7–1 µm. The spores are mostly 1-septate, but very rarely develop 1 or 2 additional septa. It is morphologically similar to *T. anisomerus* (above), but differs mainly in having an aeruginose, N+ epihymenium (Lamb 1968) and different chemistry.

SPECIMEN EXAMINED
Antarctica: ● West Graham Land, Wiencke Island, Goudier Island, 64°50'S, 63°31'W, 7.5 m alt., on basalt dyke, *I.M. Lamb FIDS A2232j*, 14.i.1945 (BM).

6. Tetramelas nelsonii (Darb.) Elix, comb. nov.
MycoBank number: **MB 825490**
Basionym: *Buellia nelsonii* Darb., *Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition 1901–1903*, **4**(11), 15 (1912).
Type: Nelson Island, South Shetland Islands, 62°17'S, 59°02'W, on rock, *C. Skottsberg SAE 35/37 pr.p.*, 11.i.1902 (S – holotype!).

A detailed description and illustrations of this species can be found in Lamb (1968).
Chemistry: Thallus K+ pale yellow or K–, P–, C+ yellow, UV+ yellow-orange; containing ± atranorin (major or minor), 6-*O*-methylarthothelin (major or minor), 4,5-dichloro-6-*O*-methylnorlichexanthone (minor or trace).

This species is known from the South Shetland Islands (Lamb 1968) and continental Antarctica. It is characterized by a dirty yellow, rimose-areolate thallus containing atranorin and 6-*O*-methyl-arthothelin, with a marginal, black prothallus. It has a non-amyloid medulla, crowded, broadly adnate to sessile, lecideine apothecia, 0.3–0.5 mm wide, an aeruginose-black, N+ red-purple to purple-brown epihymenium, often curved, *Callispora*- then *Buellia*-type ascospores, 14–[*16.6*]–20 × 6–[*7.1*]–9 µm, which become constricted at maturity and have a microrugulate outer spore-wall, and bacilliform conidia, 4–6 × 0.7–1 µm. The spores are mostly 1-septate, but very rarely develop 1 or 2 additional septa. It is similar to *T. inordinatus* (above), but differs in having a well-developed black prothallus, a much thinner thallus, a non-amyloid or very weakly amyloid medulla and slightly smaller ascospores (Lamb 1968).

SPECIMEN EXAMINED
Antarctica: ● Wilkes Land, Bunger Hills, Obruchev Hills, NE end, 66°35'S, 99°45'E, on stones in talus, *D. Adamson & R.D. Seppelt 17064*, 4.ii.1986 (HO).

7. Tetramelas subpedicellatus (Hue) Elix, comb. nov.
MycoBank number: **MB 825491**
Basionym: *Lecidea subpedicellata* Hue, Lichens. In *Deux Expéditions Antarctiques Française* (*1908–10*)*, sciences naturelles* 140 (1915).
Type: Antarctica, West Graham Land, Wiencke Island, Goudier Island, near Port Lockroy, 64°50'S, 63°31'W, on diorite rock, *unknown collector FAE 1908–10/84*, 28.xii.1908 (PC – holotype, not seen).

A detailed description and illustrations of this species can be found in Lamb (1968).
Chemistry: Thallus K+ pale yellow, P+ pale yellow or P–, C+ pale orange, UV+ pale orange; containing ± atranorin (major or minor), 6-*O*-methylarthothelin (major or minor), 4,5-dichloro-6-*O*-methylnorlichexanthone (minor or trace).

This species occurs on the Antarctic Peninsula, the South Orkney Islands (Øvstedal & Lewis Smith 2001), the South Shetland Islands (Søchting *et al.* 2004) and Tasmania. It is characterized by a yellow to off-white, crustose to subeffigurate, verrucose thallus in which the verrucae become conglutinated in the centre and sometimes form finger-like extensions. It contains atranorin and 6-*O*-methylarthothelin, has an amyloid medulla, broadly adnate to sessile, lecideine apothecia, 0.4–1 mm wide, a dark brown, N– epihymenium, often curved, *Callispora*-then *Buellia*-type ascospores, 16–[*21.8*]–30 × 8–[*9.3*]–12 µm, which become constricted at maturity and have a microrugulate outer spore-wall, and bacilliform conidia, 3–5 × 0.7–1 µm. The spores are mostly 1-septate, but very rarely develop 1 or 2 additional septa. It is similar to *T. darbishirei* (above), but differs in having larger ascospores (Lamb 1968).

SPECIMENS EXAMINED
Antarctica: ● West Graham Land, Wiencke Island, Goudier Island, 64°50'S, 63°31'W, 8 m alt., on granodioritic rocks, *I.M. Lamb FIDS A1169,* 17.iii.1944 (BM).
Australia: ●Tasmania, Harz Peak summit, 43°15'S, 146°46'E, 1250 m alt., on the sheltered eastern face of an alpine dolerite tor, *G. Kantvilas 500/14*, 14.xii.2014 (HO) [this specimen was previously misidentified as *Tetramelas allisoniae* Elix, H.Mayrhofer & Glenny].

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Key to species

1 Thallus growing on soil, moss or bryophytes 2
1: Thallus growing on rocks 5

2 Thallus sorediate ..... **T. graminicola**
2: Thallus not sorediate 3

3 Epihymenium aeruginose-black, N+ red-violet to purple-brown ..... **T. grimmiae**
3: Epihymenium dark brown or dark olive-brown, N– 4

4 Thallus containing 6-*O*-methylarthothelin and norstictic acid .... **T. austropapillatus**
4: Thallus containing only atranorin ..... **T. papillatus**

5 Epihymenium aeruginose-black, N+ red-violet to purple-brown 6
5: Epihymenium dark brown or dark olive-brown, N– 7

6 Thallus verrucose, to 2 mm thick; medulla strongly I+ blue-violet; prothallus absent or poorly developed ..... **T. inordinatus**
6: Thallus rimose-areolate, to only 0.2 mm thick; medulla I– or weakly I+ purple; prothallus well-developed, black ..... **T. nelsonii**

7 Thallus composed of small, cushion-like clumps, 5–15 mm high .... **T. cladocarpizus**
7: Thallus forming a crust up to 3 mm thick 8

8 Ascospores commonly 3-septate or becoming submuriform ..... **T. granulosus**
8: Ascospores mainly 1-septate, ± with additional endosepta 9

9 Arthothelin present; ascospores 16–24 × 6–10 µm ..... **T. anisomerus**
9: 6-*O*-Methylarthothelin present 10

10 Ascospores 16–30 × 8–12 µm ..... **T. subpedicellatus**
10: Ascospores 14–21 × 6–9 µm ..... **T. darbishirei**

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Validation of the recent combination *Lepra roseola*

Alan W. Archer
National Herbarium of New South Wales, Royal Botanic Gardens and Domain Trust,
Mrs Macquaries Road, Sydney, N.S.W. 2000, Australia
e-mail: alanw.archer@bigpond.com

John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Abstract
The recent combination *Lepra roseola* (A.W.Archer & Elix) A.W.Archer & Elix is validated.

When the new combination *Lepra roseola* (A.W.Archer & Elix) A.W.Archer & Elix was published recently, (Archer & Elix 2018), the basionym cited lacked the epithet *roseola*. Consequently, the name was invalid. *Lepra roseola* is validated here.

Lepra roseola (A.W.Archer & Elix) A.W.Archer & Elix, *comb. nov.*
Mycobank no: **822556**
Basionym: *Pertusaria roseola* A.W.Archer & Elix, *in* Elix, Jariangprasert & Archer, *Telopea* **12**, 269 (2008).

Acknowledgement
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Reference
Archer, AW; Elix, JA (2018): New combinations of Australian species in the genus *Lepra* Scop. *Australasian Lichenology* **82**, 130–136.

A new species of *Enterographa* (lichenized Ascomycota, Roccellaceae) from Lord Howe Island, Australia

Patrick M. McCarthy
64 Broadsmith St, Scullin, A.C.T. 2614, Australia
e-mail: pmcc2614@hotmail.com

John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Abstract
Enterographa membranacea sp. nov. (Roccellaceae) is described from the trunk of a palm tree in Lord Howe Island, south-western Pacific Ocean. A key is provided to the 12 species of *Enterographa* known from Australia and its island territories.

The genus *Enterographa* Fée *sens. lat.* (Roccellaceae) includes *c.* 65 species that grow on bark, rock or leaves, or as parasites of other lichens, mainly in the tropics and subtropics (Sparrius 2004; Lücking 2008; Seavey & Seavey 2014). Eleven species are currently known from Australia including its oceanic island territories (McCarthy 2018). In this contribution, *E. membranacea* is described as new from a palm trunk in Lord Howe Island, and a key is provided to the Australian species of *Enterographa*.

Methods
Observations and measurements of photobiont cells, thalline and ascomatal anatomy, asci, ascospores, pycnidial anatomy and conidia were made on hand-cut sections mounted in water and treated with 10% potassium hydroxide (K). Calcium oxalate was detected by treatment of thalline and pseudostromatal sections with a 10% aqueous solution of sulfuric acid; it forms colourless, needle-shaped crystals. Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K. Chemical constituents were identified by thin-layer chromatography (Elix 2014) and comparison with authentic samples.

New species

Enterographa membranacea P.M.McCarthy & Elix, sp. nov. Figs 1, 2
MycoBank No.: **MB 825507**

Characterized by the combination of the very thin, effuse and inconspicuous, whitish, membranous thallus, lacking lichen substances and calcium oxalate; lirelliform ascomata immersed in conspicuous, off-white pseudostromata that are rounded to ellipsoid or elongate to irregular in outline, 0.4–2 mm long, 0.4–1 mm wide, containing psoromic acid (major) and calcium oxalate; asci of the *Opegrapha*-type; uniformly branched and loosely anastomosing paraphysoids; colourless, fusiform to oblong-fusiform, (5–)6-septate, microcephalic ascospores, 18–25 × 2–3 µm, with a perispore 1.5–4 µm thick; and curved to arcuate, filiform conidia, 12–22 × *c.* 0.5 µm.

Type: Australia, New South Wales, Lord Howe Island, Mt Lidgbird, SSE slope, just E of Goat House Cave, 31°34'S, 159°06'E, alt. 450 m, on the thin, very smooth, flaking outer layer of a palm trunk (*Howea forsteriana*?) along base of basalt cliffs in *Metrosideros nervulosa*, tree fern and *Dracophyllum fitzgeraldii*-dominated rainforest, *D.H. Vitt 28714*, 21.xi.1981 (holotype – CANB).

Thallus epiphytic on the epidermis of a palm trunk, crustose, effuse and inconspicuous, dull, smooth, whitish to pale grey, filmy and 20–30(–50) µm thick when dry, slightly pulpy and a little thicker when wet, esorediate, ecorticate, not containing calcium oxalate (H_2SO_4–); colonies consisting of discontinuous mosaics of thalli to 5 mm wide, these separated by a

whitish and slightly raised prothallus to 50 µm wide. *Algae Trentepohlia*, comparatively sparse in the vegetative thallus, dominating ascomatal and pycnidial pseudostromata (see below); cells ellipsoid, 8–14 × 7–10 µm, solitary or in very short filaments; interstitial hyphae short-celled, 2–2.5(–4) µm thick. *Medulla* absent. *Ascomata* very numerous, lirelliform, immersed in off-white (with a greenish tint), thin, scarcely prominent to slightly convex pseudostromata that are rounded to ellipsoid or elongate to irregular in outline, solitary or with groups of up to 4 merging, not water-repellent, 0.4–1.5(–2) mm long, 0.4–0.8(–1) mm wide [n = 50]; surface smooth, dull, unbroken or faintly rimulose, the cracks usually parallel to the lirella. *Lirellae* simple to sparingly branched, pale to medium brown in surface view, 0.2–1.2(–1.5) mm long, superficially 60–80(–100) µm wide, 80–100 µm wide at the base (thin section); disc plane, very narrow, slit-like and epruinose, or not apparent; margin scarcely visible in surface view. *Pseudostromata* 80–110 µm thick adjacent to the lirella, tapering gradually towards the margin, dominated by photobiont cells and plate-like crystals of calcium oxalate (H_2SO_4+), without a discernible medulla, with an uppermost, alga-free layer, 10–15(–20) µm thick, amorphous or consisting of hyaline, columnar hyphae 2–2.5 µm wide. *Proper excipulum* visible only in thin section, medium to dark olive-brown above and 20–30 µm thick, pale yellow-brown to orange-brown laterally and at the base, 10–15 µm thick; cells periclinal, 5–8 × 2–2.5 µm. *Hypothecium* hyaline to pale yellowish brown, 15–22 (–25) µm thick, not inspersed with granules or oil globules, KI–, K–. *Hymenium* 65–85 µm deep, not inspersed, KI+ pale violet-blue; subhymenium hyaline, to 10 µm thick, usually indistinguishable from the hypothecium. *Epihymenium* poorly defined, 5–10 µm thick, pale yellowish brown, K–. *Paraphysoids* only slightly conglutinate in the hymenial gel, 0.7–1.2 µm thick, uniformly branched and loosely anastomosing, long-celled, the septa not constricted; apices not swollen or pigmented. *Asci* 8-spored, *Opegrapha*-type, broadly cylindrical or cylindroclavate, thin-walled, 45–64 × 12–15 µm; apex rounded, with a tholus 2–3 µm thick, with or without a conical ocular chamber to 2 µm wide which is often, but not always, encircled by a minute amyloid ring; ascoplasma gradually turning pale reddish brown in KI. *Ascospores* colourless, irregularly massed in the ascus, (5–)6-septate at maturity, fusiform to oblong-fusiform, usually straight, occasionally slightly curved or faintly sigmoidal, not constricted at the septa, (18–)22(–25) × (2–)2.5(–3) µm excluding the perispore [n = 50]; cells of ± equal size throughout spore ontogeny (microcephalic); perispore 1.5–2.5(–4) µm thick, developing to its full extent only outside the ascus; apices rounded or subacute; contents clear. *Pycnidia* moderately numerous, solitary, immersed in whitish, low-convex, thallus-dominated structures that are anatomically identical to ascomatal pseudostromata, 70–100 µm wide; apex punctiform, pale brown or not apparent; internal wall hyaline to pale brown (thin section), 4–5 µm thick, with a simple conidiogenous layer; conidiogenous hyphae 6–10 × 0.5–0.7 µm. *Conidia* hyaline, simple, filiform, usually curved to arcuate, occasionally sigmoidal, 12–20(–22) × *c.* 0.5 µm. *Chemistry*: Pseudostromata K–, C–, KC–, PD+ yellow, UV–; containing psoromic acid (major) by TLC. Pseudostromata H_2SO_4+, containing calcium oxalate. Thallus, K–, C–, KC–, PD–, UV–, H_2SO_4–; lacking lichen substances and calcium oxalate.

Etymology: The epithet *membranacea* refers to the filmy, whitish thallus of the new species.

Remarks

Enterographa membranacea is unique among non-foliicolous species with a *Trentepohlia* photobiont due to its thin, filmy and effuse thallus that contrasts with small, sharply delimited, whitish pseudostromata in which are embedded narrow, outwardly brownish, lirelliform ascomata. The pantropical *E. anguinella* (Nyl.) Redinger has a thicker, continuous to areolate thallus, and the ascospores are 6–11-septate and 25–52 × 2–3 µm (Sparrius 2004). Moreover, while the corticolous *E. kalbii* Sparrius, from Brazil, has broadly similar ascomatal anatomy and ascospore septation, the thallus is considerably thicker (0.5–0.7 mm) and contains lichexanthone, but lacks psoromic acid (Sparrius 2004).

This species is known from only the type locality in Lord Howe Island, where it grows on the epidermis of the very smooth, flaking outer layers of a palm trunk (*Howea forsteriana*?).

Key to the species of *Enterographa* in Australia

[Based on Sparrius (2004); Lücking (2008); McCarthy & Elix (2016)]

1 Growing on leaves; photobiont *Phycopeltis*. 2
1: Growing on rock, bark or wood; photobiont *Trentepohlia* 3

2 Thallus C+ red; margins of pseudostromata greenish white; conidia filiform, *c.* 20 × 1 µm [Christmas Island] ..... **E. deslooveri**
2: Thallus C–; margins of pseudostromata orange-brown; conidia bacilliform, 4–6 × 1.5–2 µm [SE Australia] ..... **E. bella**

3 Growing on rock 4
3: Growing on bark or wood 5

4 Thallus cream-coloured, forming rimose-areolate colonies, P+ yellow (psoromic acid?), lacking dehydroconstipatic acid; pycnidial apices orange-brown ..... **E. subgelatinosa**
4: Thallus chalky white, effuse, scarcely forming continuous colonies, P–, lacking psoromic acid, containing dehydroconstipatic acid (major); pycnidial apices black ..... **E. cretacea**

5 Most or all ascospores 3-septate 6
5: Ascospores with more than 3 septa 8

6 Thallus P–, lacking psoromic acid; ascomata punctiform, in lines or clusters ..... **E. compunctula**
6: Thallus P+ yellow, containing psoromic acid; ascomata rounded to short- or elongate-lirelliform 7

7 Thallus smooth; ascospores 15–25 µm long; ascomata mostly elongate-lirelliform and often richly branched, with a brown disc; hypothecium to 40 µm thick ..... **E. micrographa**
7: Thallus verrucose, ascospores 25–31 µm long; ascomata round to short-lirelliform, not or sparingly branched, with a blackish disc; hypothecium *c.* 80 µm thick ..... **E. elixii**

8 Thallus P–, lacking psoromic acid. 9
8: Thallus P+ yellow, containing psoromic acid 10

9 Thallus C+ red, containing gyrophoric acid; ascomata short, branched lirellae, with a pink to pale brown disc; ascospores 6–12(–15)-septate ..... **E. pallidella**
9: Thallus C–, lacking gyrophoric acid; ascomata ellipsoid, or short, scarcely branched lirellae, with a dark brown to black disc; ascospores 5–7-septate ..... **E. divergens**

10 Ascomata punctiform, outwardly black, forming lines or clusters; ascospores 5–7 µm wide ..... **E. subserialis**
10: Ascomata lirelliform; ascospores 2–3 µm wide 11

11 Ascospores 5(–6)-septate, 18–25 µm long ..... **E. membranacea**
11: Ascospores 6–11-septate, 25–52 µm long ..... **E. anguinella**

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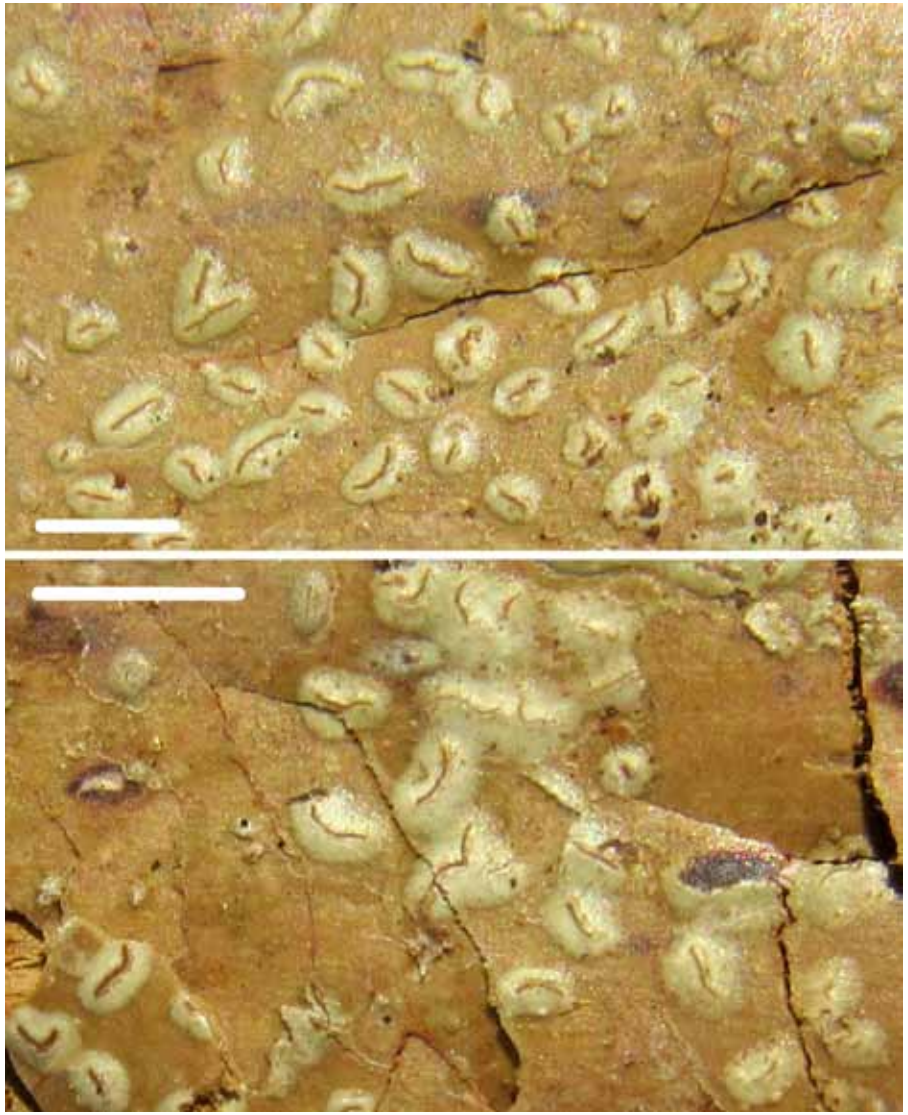

Figure 1. *Enterographa membranacea* (holotype). Scales: 2 mm.

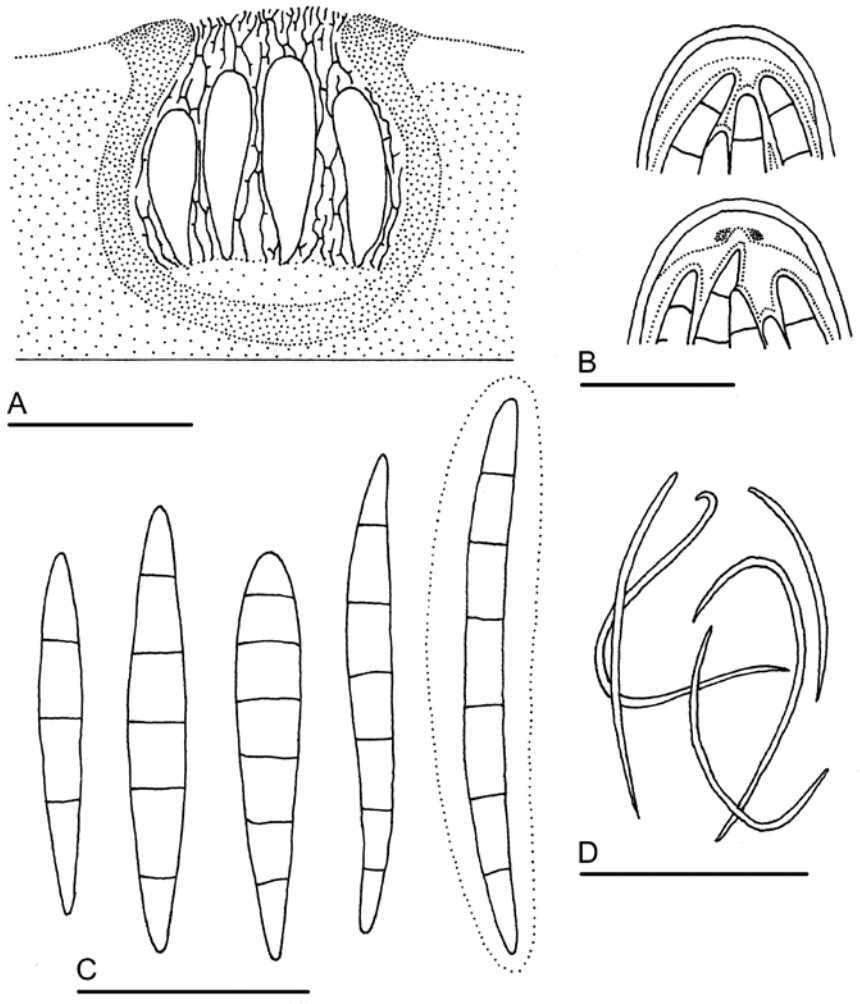

Figure 2. *Enterographa membranacea* (holotype). A, Vertical section through an ascoma (semi-schematic); B, Ascus apices without (above) and with an ocular chamber enclosed within a faint, amyloid ring; C, Immature (left) and mature ascospores; D, Conidia. Scales: A = 50 µm; B–D = 10 µm.

Anisomeridium disjunctum (Monoblastiaceae), a new lichen species from Tasmania, with a key to the genus in Australia

Patrick M. McCarthy
64 Broadsmith St, Scullin, A.C.T. 2614, Australia
e-mail: pmcc2614@hotmail.com

Gintaras Kantvilas
Tasmanian Herbarium, PO Box 5058, UTAS LPO, Sandy Bay, Tasmania 7005, Australia
e-mail: Gintaras.Kantvilas@tmag.tas.gov.au

Abstract

Anisomeridium disjunctum sp. nov. (Monoblastiaceae) is described from *Callitris* wood and *Leucopogon* bark in eastern, north-eastern and north-western Tasmania. It has a very thin, whitish to pale grey thallus that is UV+ pale yellow, small, perithecioid ascomata with a comparatively thick ascomatal wall, 1(–3)-septate ascospores (12–21 × 4.5–7.5 µm), macroconidia 5–8 × 2.5–4 µm, and exceptionally minute microconidia (0.8–1.5 × 0.7–1.1 µm). A preliminary key is provided to the 18 species of *Anisomeridium* currently known from Australia.

The pyrenocarpous lichen genus *Anisomeridium* (Müll.Arg.) M.Choisy (Monoblastiaceae) is nearly cosmopolitan in its distribution, with almost 100 species worldwide, the majority occurring in the wet tropics and subtropics. Most of the 17 species currently known from Australia are corticolous in eastern Queensland and in coastal and hinterland areas of the Northern Territory, but several, *A. anisolobum* (Müll.Arg.) Aptroot, *A. austroaustraliense* P.M.McCarthy & Kantvilas, *A. biforme* (Borrer) R.C.Harris, *A. carinthiacum* (J.Steiner) R.C.Harris and *A. polypori* (Ellis & Everh.) M.E.Barr, have been reported from the cool-temperate south-east (McCarthy 2018).

In this paper, *Anisomeridium disjunctum* is described and illustrated from *Callitris* wood, at the type locality near Little Swanport in eastern Tasmania; it was also collected from the bark of *Leucopogon parviflorus* in north-western Tasmania and on Deal Island in the eastern Bass Strait. The holotype of this species was just one of several novel lichens gathered in the course of a multidisciplinary biological collecting expedition undertaken by the Tasmanian Museum and Art Gallery (to be reported elsewhere), targeting poorly documented and under-collected areas of Tasmania.

Methods

Observations and measurements of photobiont cells, ascomatal and pycnidial anatomy, asci, ascospores and conidia were made on hand-cut sections mounted in water and 10% KOH (K). Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K, while pycnidial contents were also examined in ammoniacal erythrosin.

Anisomeridium disjunctum P.M.McCarthy & Kantvilas, sp. nov. Figs 1, 2
MycoBank No.: **MB826785**

Characterized as follows: thallus effuse to determinate, off-white to very pale grey, immersed to thinly superficial, UV+ pale yellow; photobiont *Trentepohlia*; ascomata perithecioid, 0.22–0.51 mm diam., semi-immersed to 2/3 immersed in the substratum, with a brown-black (K+ greenish black) ascomatal wall 40–60(–70) µm thick and a ± apical ostiole; pseudoparaphyses anastomosing; asci narrowly clavate, narrowly or broadly cylindrical or cylindroclavate, 60–88 × 12–17 µm, with a tuberculate to broadly convex or inconspicuous ocular chamber; ascospores (4–)8 per ascus, uniseriate to irregularly biseriate, (1–)3-septate, 12–21 × 4.5–7.5 µm; micropycnidia semi-immersed to almost completely immersed in the substratum, with broadly ellipsoid, subglobose, obovoid or obpyriform microconidia, 0.8–1.5 × 0.7–1.1 µm; macroconidia subglobose, broadly ellipsoid or oblong-ellipsoid, 5–8 × 2.5–4 µm.

Type: Australia, Tasmania, Little Swanport, Wind Song property, Callitris Gully, 42°21'S, 147°55'E, alt. 40 m, on dry, bleached wood of *Callitris* in *C. rhomboidea* woodland, *G. Kantvilas 404/17*, 24.x.2017 (holotype — HO 591834).

Thallus crustose, immersed in to thinly superficial on the substratum, effuse to determinate, forming contiguous colonies to *c.* 1 cm wide, off-white to very pale grey or slightly cream-coloured, continuous to very sparingly rimose, to 20–50 µm thick, ecorticate, UV+ pale yellow (containing lichexanthone). *Photobiont Trentepohlia*; cells sparse (in thalli that are 20–30 µm thick) or abundant (in thicker thalli), forming clusters or short filaments, 8–18 × 7–14 µm; interstitial hyphae 2.5–3.5 µm thick; thin areas of thallus, with few or no photobiont cells, are dominated by a compact reticulum of hyaline hyphae 2.5–3.5 µm thick. *Prothallus* not apparent. *Ascomata* numerous, perithecioid, semi-immersed to 2/3 immersed in the substratum, mostly solitary, occasionally paired or in clusters of 3 or 4, dull black, circular to elliptic in outline, moderately to strongly convex, or almost hemispherical, the surface smooth or becoming irregularly fissured after maturity, (0.22–)0.36(–0.51) mm wide [*n* = 90]; apex rounded, but often becoming plane or slightly excavate with age. *Ostiole* apical or slightly off-centre, inconspicuous or in a shallow, concave depression 30–50 µm wide. *Ascomatal wall* 40–60(–70) µm thick near the apex and laterally, 60–80(–90) µm thick towards the base, brown-black in section, K+ greenish black, elongate-cellular in medial section (cells 4–7 × 2–4 µm) and, when growing on wood, incorporating long, loose lignin fibres, extending down to excipulum-base level, contiguous with the excipulum or diverging a little at the base, not or scarcely overgrown by the thallus. *Excipulum* consisting of elongate, periclinal hyphae, 15–20 µm thick and brown-black laterally, 8–15 µm thick, pale to medium or dark brown and poorly delimited at the base. *Centrum* depressed-ovate, to 0.38 mm wide. *Hymenium* non-amyloid, KI–, not inspersed or with sparse oil globules; ascoplasma KI+ orange-brown. *Subhymenium* hyaline, 25–50 µm thick, KI+ pale yellow-brown; hyphae 1.5–2.5(–3.5) µm wide, inspersed with minute granules and oil globules. *Pseudoparaphyses* 1–1.5(–2) µm wide, long-celled, with abundant, mainly distal anastomoses; apices not swollen; contents clear or with numerous minute oil globules. *Asci* narrowly clavate, narrowly or broadly cylindrical or cylindroclavate, usually 8-spored, occasionally with up to 4 aborted, 60–88 × 12–15(–17) µm [*n* = 20]; apex rounded; ocular chamber of immature asci tuberculate, at maturity remaining short-tuberculate, becoming broadly convex, or almost disappearing. *Ascospores* hyaline, narrowly ellipsoid to oblong-ellipsoid or shorter and obovate or broadly ellipsoid, 1(–3)-septate (fewer than 10 percent of mature propagules with 2 or 3 septa), occasionally slightly constricted at the single or primary septum, straight or slightly bent, overlapping-uniseriate, obliquely uniseriate, proximally uniseriate and distally massed, or irregularly biseriate in the ascus, (12–)16(–21) × (4.5–)6(–7.5) µm [*n* = 120]; spore-wall uniformly thin (< 1 µm), smooth, lacking a perispore; septum usually medial, occasionally slightly submedial, rarely strongly submedial, very rarely supramedial; distal apex rounded to subacute; proximal apex more commonly subacute or acute; contents usually clear, occasionally guttulate. *Micropycnidia* sparse to numerous, outwardly black, semi-immersed to almost completely immersed in the substratum, 0.08–0.12 mm wide, circular to elliptic in outline; pycnidial wall brown-black above, K+ green-black, 15–25 µm thick, anatomically identical with the ascomatal wall; basal wall hyaline, 5–8 µm thick, of periclinal hyphae 1.5–2 µm wide; conidiophores unbranched, 8–15 × 1–1.5(–2) µm, ± of uniform thickness from base to apex. *Microconidia* colourless, simple, budding from the tips of conidiophores, broadly ellipsoid, subglobose, obovoid or obpyriform, 0.8–1.2(–1.5) × 0.7–1.1 µm [*n* = 40]. *Macropycnidia* sparse (seen only in HO 561068), very similar to micropycnidia in size, shape and immersion in the substratum; condiophores 8–13 × 2–3 µm. *Macroconidia* colourless, simple, subglobose, broadly ellipsoid or oblong-ellipsoid, 5–8 × 2.5–4 µm [*n* = 20].

Etymology: The epithet *disjunctum* (L, distinct, separate) alludes to the considerable difference in size between the exceptionally small microconidia and the comparatively massive macroconidia.

Remarks

The highly distinctive *A. disjunctum* is doubly unusual in having a significant minority of 3-septate ascospores, along with exceptionally minute microconidia. These attributes, in conjunction with the UV+ thallus, the size of the ascomata and the thickness of the ascomatal wall, the dimensions and shape of the asci and the arrangement of ascospores therein, as well as the shape of ascospores and the position of the septum at or below the middle of 1-septate propagules, confirm the novelty of the new species.

Perhaps surprisingly, 3-septate ascospores tend to be shorter and slightly narrower than 1-septate individuals. Indeed, the former are more likely to occur in ± biseriate arrangement in comparatively short, broad asci, while the longest and most elongate ascospores, 17–21 µm long, are invariably 1-septate. The widely occurring and corticolous *A. polypori* includes more abundant 3-septate ascospores, but second and third septa develop late in their ontogeny. Moreover, that species has considerably smaller ascomata (0.15–0.25 mm diam.), micropycnidia with a beaked apex and larger, more ellipsoid microconidia (2–3 × 1–1.3 µm; Harris 1995; Coppins *et al.* 2009). *Anisomeridium tuckerae* (R.C.Harris) R.C.Harris, from southeastern U.S.A., also contains lichexanthone in the thallus and has ascospores of similar size to those of *A. disjunctum*, but the ascospores are invariably 1-septate and have more pointed ends, and the microconidia are either ellipsoid or subglobose but larger (Tucker & Harris, 1980; Harris 1995).

The substratum of the type specimen is also somewhat anomalous, i.e. dry, bleached wood of *Callitris*, which provides a spongy, yielding surface for the developing lichen, so that loose lignin fibres are readily incorporated into the walls of ascomata and pycnidia. By contrast, most corticolous *Anisomeridium* species rarely have bark cells intruding into fruiting structures, other than near the base. Indeed, the two corticolous specimens of *A. disjunctum* examined differ principally from the type only in having slightly thicker and firmer thalli, and an almost carbonized ascomatal wall that does not incorporate bark cells.

The type specimen of *A. disjunctum* was collected in eastern Tasmania, where it grew in a relict corridor of open woodland dominated by *Callitris rhomboidea*. Although this tree is widespread and abundant in eastern Tasmania, contiguous stands of mature trees are relatively unusual and typically support a diverse range of lichens not found in surrounding vegetation (usually eucalypt-dominated, dry sclerophyll woodland). This particular locality was no exception, supporting a rich array of species, especially on mature *Callitris* trunks and fallen logs. The new species grew directly on the dead wood of a standing, mature tree. Associated taxa included *Buellia* cf. *extenuatella* Elix & Kantvilas, *Mycocalicium victoriae* (C.Knight ex F.Wilson) Nádv., *Rinodina obscura* Müll.Arg., *Schismatomma occultum* (C.Knight & Mitt.) Zahlbr. and *S.* cf. *dirinellum* (Nyl.) Zahlbr.

Two additional collections are from coastal scrub where they grew on the twigs and small branches of *Leucopogon parviflorus*. Whilst on the face of it, this appears a habitat vastly different from that of the type specimen, the two vegetation communities share many vascular species as well as epiphytic lichens that are typical of sunny exposed woodlands at low elevation in low rainfall areas. Lichens associated with the new species on *Leucopogon* included *Cliostomum griffithii* (Sm.) Coppins, *Lecanora flavopallida* Stirt., *Lecidella destituta* Kantvilas & Elix, *Ochrolechia africana* Vain. and *Porina decrescens* P.M.McCarthy & Kantvilas, as well as such widespread macrolichens as *Flavoparmelia rutidota* (Hook.f. & Taylor) Hale and *Menegazzia subpertusa* P.James & D.J.Galloway.

ADDITIONAL SPECIMENS EXAMINED

Tasmania: ● Bass Strait, Kent Group, Deal Island, 165 m due W of head of East Cove (Browns Bay), 39°28'S, 147°21'E, 5 m alt., on bark of *Leucopogon parviflorus*, *J.S. Whinray s.n.*, 11.xii.1971 (HO 561068; duplicate in MEL 1012603, *n.v.*); ● West Point, W of Marrawah, 40°57'S, 144°37'E, 10 m alt., on bark of *Leucopogon parviflorus* in coastal heathland, *G. Kantvilas 480/11*, 30.xi.2011 (HO 563957).

Preliminary key to the species of *Anisomeridium* in Australia

[Based on Harris (1975, 1995); McCarthy (1992, 1993); McCarthy & Johnson (1995); Aptroot *et al.* (1995, 1997); Coppins *et al.* (2009); McCarthy & Kantvilas (2016). For authors, publication details, distribution and additional references, see McCarthy (2018)]

1 Thallus growing on leaves ..... **A. foliicola**
1: Thallus growing on rock, bark or wood 2

2 Thallus growing on rock 3
2: Thallus growing on bark or wood 5

3 Ascospores 3-septate, 21–36 × 7.5–13 µm ..... **A. australiense**
3: Ascospores 1-septate 4

4 Ascomata 0.18–0.27 mm diam.; ascospores 9–15 × 4.5– 6.5 µm ..... **A. carinthiacum**
4: Ascomata 0.2–0.44 mm diam.; ascospores 12–23 × 5–10 µm ..... **A. laevigatum**

5 Ascospores 1–3-septate 6
5: Ascospores persistently 1-septate 7

6 Ascomata 0.15–0.25 mm diam.; microconidia 2–3 × 1–1.3 µm; thallus UV– **A. polypori**
6: Ascomata 0.22–0.51 mm diam.; microconidia 0.8–1.5 × 0.7–1.1 µm; thallus UV+ pale yellow ..... **A. disjunctum**

7 Ostiole markedly eccentric; ascospores granular-ornamented 8
7: Ostiole apical or slightly off-centre; ascospores usually smooth 9

8 Ascospores 19–27(–30) × 5.5–8 µm ..... **A. terminatum**
8: Ascospores 26–35(–42) × 7.5–12 µm ..... **A. americanum**

9 Ascospores 9–18(–24) µm long 10
9: Ascospores 23–34 µm long 15

10 Ascospores 9–15 × 4–5 µm; microconidia 3–4 × 1.5–2 µm ..... **A. albisedum**
10: Most ascospores more than 15 µm long 11

11 Asci slender, cylindrical or narrowly clavate, 9–12 µm wide 12
11: Asci broadly cylindrical or clavate, 10–17 µm wide 14

12 Microconidia ellipsoid, 2.5–4 × *c.* 2 µm ..... **A. subprostans**
12: Microconidia globose, *c.* 2 µm diam 13

13 Ascospores 10–18 × 4.5–6(–7) µm, uniseriate or irregularly biseriate in the asci ..... **A. biforme**
13: Ascospores 15–22(–24) × 4.5–5.5(–6) µm, biseriate in the asci ..... **A. tamarindi**

14 Ascospore septum median; spore wall evenly thickened; ascomata 0.18–0.35 mm diam. ..... **A. austroaustraliense**
14: Ascospore septum markedly submedian; spore wall unevenly thickened; ascomata 0.4–0.7 mm diam. ..... **A. anisolobum**

15 Thallus UV+ yellow ..... **A. consobrinum**
15: Thallus UV– 16

16 Ascospores 8.5–11.5 µm wide ..... **A. subnexum**
16: Ascospores 12–18 µm wide 17

17 Ascospores smooth, biseriate in the asci ..... **A. subnectendum**
17: Ascospores granular-ornamented, uniseriate in the asci ..... **A. adnexum**

Acknowledgements

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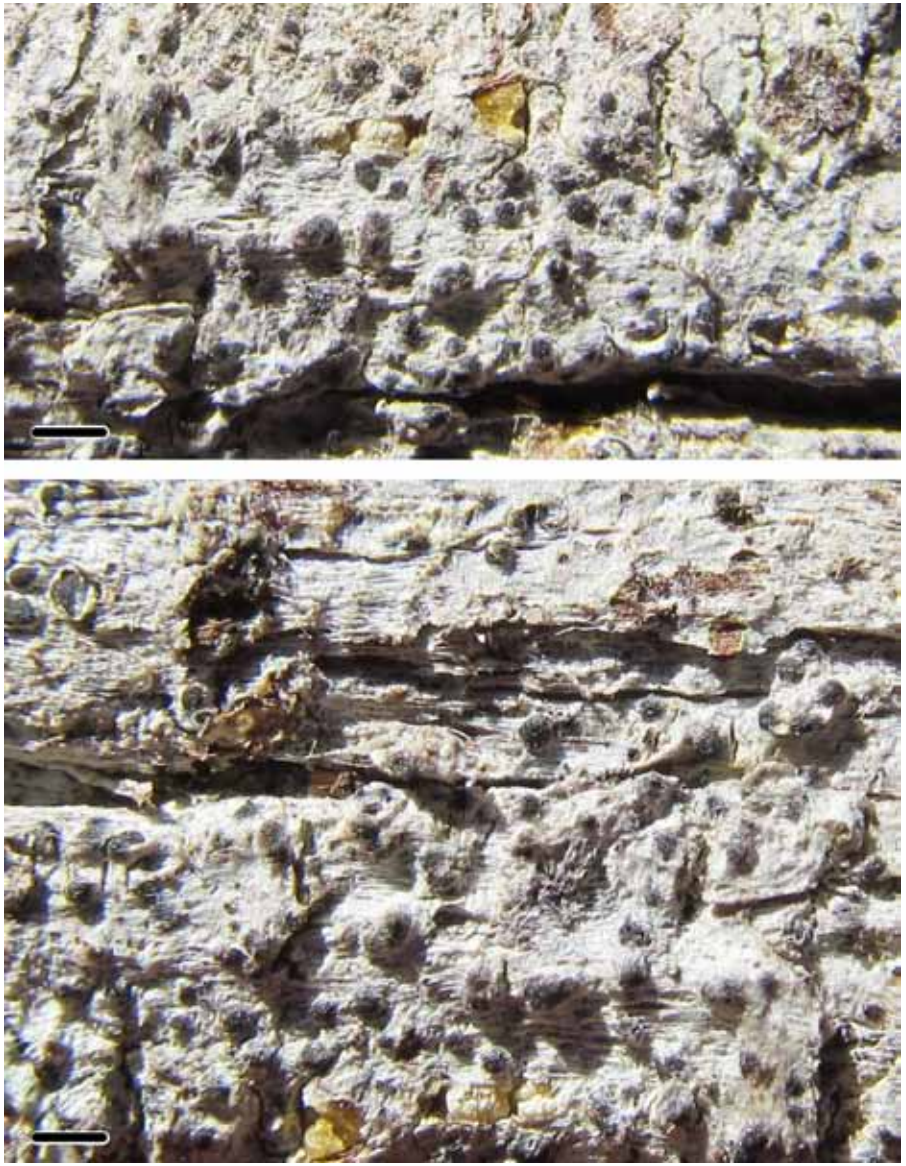

Figure 1. *Anisomeridium disjunctum* (holotype). Scales: 1 mm.

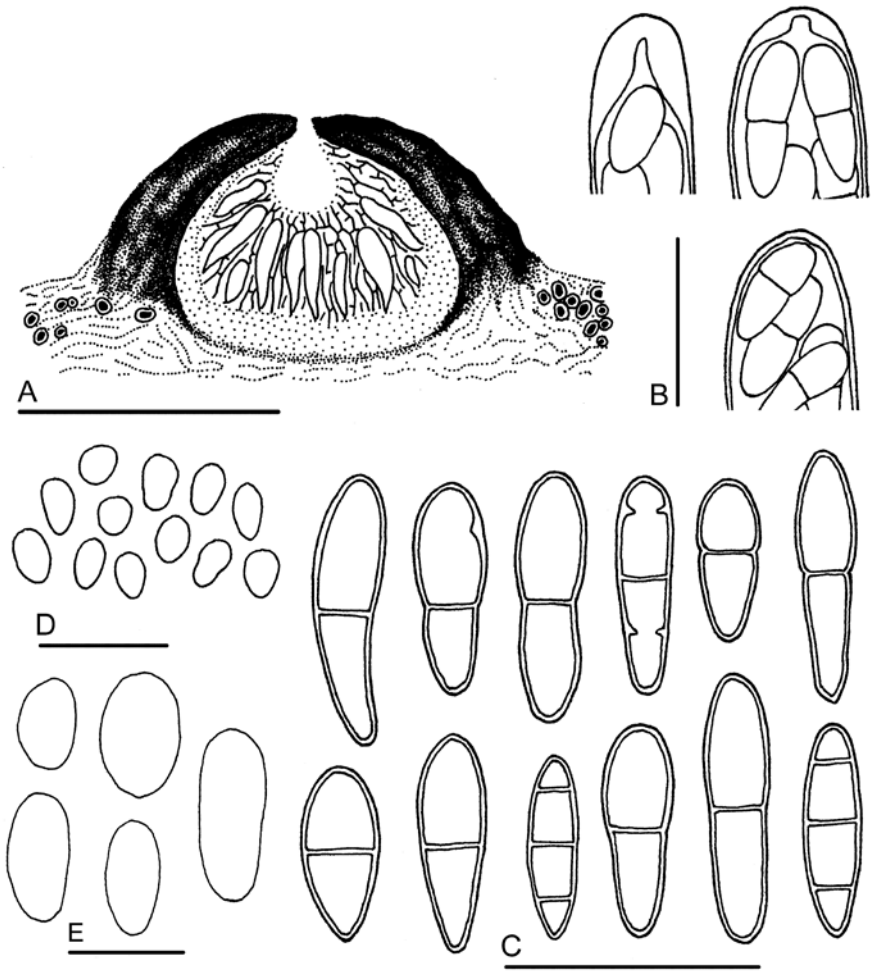

Figure 2. *Anisomeridium disjunctum* (A–D, holotype; E, HO 561068). **A**, Sectioned ascoma, with adjacent thallus and substratum (semi-schematic); **B**, Immature (upper left) and mature ascus apices; **C**, Mature ascospores; **D**, Microconidia; **E**, Macroconidia. Scales: A = 0.2 mm; B, C = 20 µm; D, E = 5 µm.

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Additional lichen records from Australia 84.
Three *Bactrospora* species (Roccellaceae, Ascomycota) from Queensland

Roderick W. Rogers
Queensland Herbarium, Mt. Coot-tha Rd, Toowong, Queensland 4068, Australia
e-mail: roderickrogers@westnet.com.au

Abstract

Bactrospora denticulata (Vain.) Egea & Torrente*, B. myriadea* (Fée) Egea & Torrente and *B. pleistophragmia* (Nyl.) Räsänen, are reported for the first time from Australia.

Kantvilas (2004) reported six species of *Bactrospora* A.Massal. from Tasmania, three of them newly described, and while Aptroot *et al.* (1995) recorded two taxa from Papua New Guinea, the genus has not yet been documented from mainland Australia. However, an examination of collections from mangrove or strand vegetation in Cape York Peninsula, Queensland, has revealed three species of *Bactrospora*. The collections match the accounts of the three taxa in the monograph of Egea & Torrente (1993), and the following descriptions are derived from that work.

The new records

1. Bactrospora denticulata (Vain.) Egea & Torrente, *Lichenologist* **25**, 229 (1993)
Lecanactis denticulata Vain., *Ann. Acad. Sci. Fenn.,* Ser. A, **6**(7), 141 (1915)

Thallus crustose, up to 20 mm diam., white to grey, thin, ecorticate; photobiont *Trentepohlia*; ascomata apothecia, immersed to sessile, black, epruinose; disc concave to plane with a prominent margin; margin often 4–5-toothed; asci subglobular, fissitunicate, with an amyloid cap, 8-spored; ascospores hyaline, with more than 25 thin, transverse septa, 70–130 × 2.0–3.0 µm; conidia not known. Previously reported from Florida (Egea & Torrente 1993).

SPECIMEN EXAMINED
Queensland: ● Chilli Beach, Cape York Peninsula, 12°37'5"S, 143°25'39"E, in evergreen to semi-evergreen notophyll vine forest dominated by *Syzygium forte,* on bark, *V.J. Neldner 5418*, vi.2014, (BRI, AQ906175).

2. Bactrospora myriadea (Fée) Egea & Torrente, *Lichenologist* **25**, 245 (1993)
Lecidea myriadea Fée *Bull. Soc. Bot. France* **21**, 318 (1873)

Thallus crustose, up to 20 mm in diam., white to grey, thin, ecorticate; photobiont *Trentepohlia*; ascomata apothecia, black, epruinose, sessile, plane to convex, 0.2–0.7 mm diam.; asci subglobular, fissitunicate, with an amyloid cap, 8-spored; ascospores hyaline, with 12–20 thin, transverse septa, 47–90 × 2.0–3.5 µm; conidia 5–7 µm long; Previously reported from Florida, Colombia, Brazil, India, the Galapagos Islands and Taiwan (Egea & Torrente 1993; Aproot & Sparrius 2008).

SPECIMENS EXAMINED
Queensland: ● Little Boydong Island, 11°29'S, 143°02'E, growing on *Pisonia grandis, E. Youman s.n.,* 17.vii.1985, (BRI, AQ807398); ● loc. id., *E.Youman s.n.,* 16.vii.1985, (BRI, AQ807399); ● Macarthur Islet (No. 3), 11°43'S, 142°59'E, on *Bruguiera aristata, E. Youman s.n.*, 19.vii.1985, (BRI, AQ807406); ● Macarthur Islet (No. 5), 11°43'S, 142°59'E, on *Comptostemon schultzii, E. Youman s.n.,* 19.vii.1985, (BRI, AQ807408); ● Heathlands QPWS Ranger Base, Cape York Peninsula, 11°45'07"S, 142°34'51"E, on branches of *Callitris intratropica* trees, *P.I. Forster PIF35018B,* 13.xi.2008, (BRI, AQ813489); ● North Bird Is., 11°46'S, 143°00'E, on *Terminalia* sp., *E. Youman s.n.,* 20.vii.1985, (BRI, AQ807391); ● Cape Melville National Park, NE base of Beeby Hill, S of Temple Creek and N of Ninian Bay, 14°17'10"S, 144°35'09"E, on bark of *Acacia oraria* in scrub behind high water mark, *P.I. Forster PIF43162*, 10.v.2014, (BRI, AQ839066).

3. Bactrospora pleistophragmia (Nyl.) Räsänen *Ann. Bot. Soc. Zool.-Bot. Fenn. 'Vanamo'* **20**(3), 32 (1944)
Lecidea pleistophragmia Nyl., *Bull. Soc. Linn. Normandie*, sér. 2, **2**, 85 (1867)

Thallus crustose, up to 20 mm diam., white to grey, thin, ecorticate; photobiont *Trentepohlia*; ascomata apothecia, immersed to sessile, black, epruinose, 0.4–0.9 mm diam.; disc concave to plane; asci subglobular, fissitunicate, with an amyloid cap, 8-spored; ascospores hyaline, with more than 40 thin, transverse septa, 110–150 × 4.5–7.0 µm; conidia not known. Previously reported from New Caledonia and Hawaii (Egea & Torrente 1993).

SPECIMEN EXAMINED
Queensland: ● Little Ramsay Bay, Hinchinbrooke Island, 18°17'S, 146°18'E, on *Heritiera littoralis* in mangrove, *A.B. Cribb 2427A*, 18 viii.1975, (BRI, AQ0693394).

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