



# Australasian Lichenology

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Thalli of the cosmopolitan *Lecanora rupicola* form mosaics on high-altitude acidic rocks in Australia and New Zealand. They're commonly parasitized by *Rimularia insularis* (shown on the left). *Lecanora rupicola*'s distinctive grey-pruinose apothecial discs react C+ orange. The species' secondary chemistry includes the depsides atranorin and chloratranorin, the xanthone thiophanic acid, and the dibasic aliphatic fatty acid roccellic acid.

5 mm 

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**New species and new records of buellioid lichens  
(Caliciaceae, Ascomycota) from southern Africa**

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**Abstract**

*Amandinea brussei* Elix & H.Mayrhofer, *Buellia capensis* Elix & H.Mayrhofer, *B. namaquensis* Elix, H.Mayrhofer & Wetschnig and *Tetramelas franklinbrussei* Elix & H.Mayrhofer are described as new to science. In addition, *Amandinea polyxanthonica* (Elix) Elix, *Buellia tesserata* Körb. and *Tetramelas coquimbensis* (C.W.Dodge) Elix are reported from southern Africa for the first time, as is *Buellia hyporosea* Elix from Madagascar.

**Introduction**

Although the biodiversity of microlichens in southern Africa is not well documented, in recent times the region has proved to be a rich source of crustose Caliciaceae (Bungartz & Wirth 2007; Wirth & Bungartz 2009; Wirth 2010; Fryday *et al.* 2020) and Physciaceae (Matzer & Mayrhofer 1994, 1996; Mayrhofer & Wirth 2011; Mayrhofer *et al.* 2014).

The present paper continues our investigation of *Buellia*-like lichens in the Southern Hemisphere. For the more recent additions, see Elix *et al.* (2017a, b), Elix & McCarthy (2018) and Elix & Mayrhofer (2020) and references cited therein. In this paper, we describe new saxicolous species of *Amandinea*, *Buellia sens. str.* and *Buellia* in the broad sense, and a new terricolous species of *Tetramelas*. Methods are as described in our previous papers cited above.

**The new species**

**1. *Amandinea brussei* Elix & H.Mayrhofer, sp. nov.**  
Mycobank No.: **MB 838268**

Figs 1, 2

Similar to *Amandinea conglomerata* Elix & Kantvilas, but differs in having somewhat longer ascospores, 13–18 µm long, and a medulla that lacks calcium oxalate.

*Type*: Republic of South Africa, Natal, Tsheseng Pass, Kwa-Kwa, Bethlehem, 20 km S of Phuthaditjhaba (Witsieshoek), [SA-Grid System: 2828DB (Leistner & Morris 1976)], on NE dome-shaped Clarens (Cave) sandstone, *F. Brusse* 4507, 20.i.1986 (holotype – CANB).

*Thallus* crustose, forming extended patches to 60 mm wide, epilithic, areolate; the areoles dispersed or rarely aggregated, 0.1–0.4 mm wide and to 0.1 mm thick, angular, irregular; upper surface off-white, dull; prothallus absent; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I-; photobiont cells 8–20 µm wide. *Apothecia* 0.2–0.7 mm wide, lecideine, immersed then broadly adnate to sessile and constricted at the base, scattered or crowded, rounded or irregular through mutual pressure; disc black, epruinose, weakly concave to plane, or becoming weakly convex. *Proper exciple* narrow, persistent or excluded in older, convex apothecia, in section 15–25 µm thick, with outer zone olive-brown, K-, paler brown within. *Epihymenium* 8–10 µm thick, red-brown to olive-brown, K-, N-. *Hypothecium* 45–55 µm thick, red-brown to very pale red-brown, K-. *Hymenium* 60–70 µm thick, colourless, not interspersed; subhymenium 20–25 µm thick, colourless, interspersed with oil droplets. *Paraphyses* 1.5–2.5 µm wide, simple to moderately branched, capitate, the apices 3.5–5 µm wide, with

brown caps. *Asci* *Bacidia*-type, 8-spored. *Ascospores* *Buellia*-type, 1-septate, pale olive-brown to brown, ellipsoid, 13–[15.4]–18 × 5–[6.2]–8 µm, ± constricted at the septum; outer spore-wall weakly ornamented. *Pycnidia* pyriform, immersed, black. *Conidia* filiform, curved, 20–28 × 0.7–1 µm.

*Chemistry*: Thallus K–, P–, C–, UV–; no lichen substances detected.

*Etymology*: The species is named in honour of Franklin A. Brusse, the collector of the type specimen.

#### Remarks

This species is characterized by the areolate, off-white crustose thallus, non-amyloid medulla that lacks calcium oxalate, the interspersed subhymenium, the *Buellia*-type ascospores, 13–18 × 5–8 µm, the curved, filiform conidia, 20–28 µm long and the absence of lichen substances. It resembles some forms of the Australian *A. conglomerata* in that both lack lichen substances, have discontinuous areolate thalli and analogous conidia. However, *A. conglomerata* has somewhat shorter ascospores, 10–[13.1]–17 µm long, and it contains medullary calcium oxalate (Elix & Kantvilas 2013). *Amandinea neoconglomerata* Elix is also similar, and although that species lacks calcium oxalate as does *A. brussei*, it has even shorter ascospores, 8–[11.6]–15 µm long (Elix *et al.* 2017b).

At present *A. brussei* is only known from the type collection; no associated species were recorded.

#### 2. *Buellia capensis* Elix & H. Mayrhofer, sp. nov.

Figs 3, 4

Mycobank No.: **MB 838269**

Similar to *Buellia procellarum* A. Massal., but differs in having 8-spored asci, smaller ascospores, 16–24 × 8–13 µm, and in containing lichexanthone and secalonic acid A.

*Type*: Republic of South Africa, Cape Province, Seeberg, c. 3 km S of Langebaan, [SA-Grid: 3318AA], 33°07'S, 18°04'E, 80–130 m alt., on granitic rock on S-exposed slope, *D. Triebel* & *G. Rambold* 8406, 6.iv.1990 (holotype – M).

*Thallus* crustose, to 25 mm wide and 0.1 mm thick, continuous, verrucose-areolate to sublobate or subeffigurate at the margins; individual areoles rounded, 0.5–1.2 mm wide, contiguous; upper surface white, matt, epruinose; prothallus not apparent; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), I–; photobiont cells 6–14 µm wide. *Apothecia* 0.4–1.2 mm wide, abundant, lecideine, roundish, scattered, immersed to just adnate, disc black, epruinose, weakly concave to flat. *Proper exciple* thin, black, persistent, in section 25–50 µm thick, outer part dark brown to brown-black, K–, N–, inner part brown. *Epithymenium* 10–13 µm thick, brown to dark brown, N–. *Hypothecium* 100–170 µm thick, brown to brown-black, K–, N+ deep red-brown. *Hymenium* 75–95 µm thick, colourless, densely interspersed with oil droplets. *Subhymenium* 10–15 µm thick, pale brown. *Paraphyses* 1.8–2 µm wide, shortly septate, sparsely branched, the apices 3–4 µm wide, with brown caps. *Asci* *Bacidia*-type, (4–6)–8-spored. *Ascospores* *Callispora*-type, 1-septate, pale then dark brown, ellipsoid, 16–[19.9]–24 × 8–[9.3]–13 µm, becoming constricted at the septum; outer wall smooth to finely ornamented. *Pycnidia* punctiform, immersed; ostiole brown. *Conidia* bacilliform, straight, 5–6.5 × 1 µm.

*Chemistry*: Thallus K–, C–, P–, UV+ yellow; lichexanthone (major), secalonic acid A (major), fumarprotocetraric acid (trace), succinprotocetraric acid (trace). It is possible that the lichexanthone detected in this specimen has leached from the adjacent *Lepra* species.

*Etymology*: The specific epithet refers to the geographical region of the type locality.

#### Remarks

This new species resembles *B. procellarum* in that both have densely interspersed hymenia, *Callispora*-type ascospores, bacilliform conidia and belong to *Buellia sens. str.* (syn. *Hafellia*

Kalb, H. Mayrhofer & Scheid.). However, *B. procellarum* differs in having asci with fewer ascospores (2–6), larger ascospores, 22–40 × 10–18 µm, and in containing atranorin and diploicin as major substances. In addition, the thalli of *B. procellarum* are crustose and continuous to rimose-areolate, but never sublobate or subeffigurate (Elix 2009a). *Buellia leptoclinoides* (Nyl.) J. Steiner is also similar and has ascospores of comparable size to those of *B. capensis*. However, the former contains atranorin and placodiolic acid and has some 3-septate ascospores (Giral *et al.* 2000).

At present this new species is known only from the type locality, where it is associated with a *Lecanora* species and *Lepra subventosa* (Malme) I. Schmitt & Lumbsch.

#### 3. *Buellia namaquaensis* Elix, H. Mayrhofer & Wetschnig, sp. nov.

Figs 5, 6

Mycobank No.: **MB 838271**

Similar to *Buellia follmannii* C. W. Dodge, but differs in having commonly constricted, *Buellia*-type ascospores and in containing stictic acid.

*Type*: Republic of South Africa, Cape Province, Namaqualand, Knersvlakte, c. 25 km N of Vanrhynsdorp, in direction of “Douse the Glim”, [SA-Grid: 3118BC], 31°23'S, 18°42'E, 150 m alt., on quartziferous rock, *W. & U. Wetschnig s.n.*, 2.x.1987 (holotype – GZU).

*Thallus* crustose, to 15 mm wide and 0.15 mm thick, finely rimose; upper surface pale tan to orange-brown, dull; prothallus absent; medulla white, containing calcium oxalate (H<sub>2</sub>SO<sub>4</sub>+), I–; photobiont cells 7–16 µm wide. *Apothecia* 0.1–0.5 mm wide, lecideine, adnate to sessile and constricted at the base, round; disc black, epruinose, plane to convex. *Proper exciple* distinct, excluded in convex apothecia, in section 35–45 µm thick, outer zone dark brown to aeruginose, K–, N+ purple, inner zone pale brown. *Epithymenium* 8–12 µm thick, aeruginose-brown, K–, N+ purple. *Hypothecium* brown, 50–57 µm thick, K–. *Hymenium* 50–55 µm thick, colourless, not interspersed. *Paraphyses* 1.5–2 µm wide, sparsely branched, the apices 4.5–5.5 µm wide, with aeruginose caps. *Asci* *Bacidia*-type, 8-spored. *Ascospores* *Buellia*-type, brown, ellipsoid, 8–[10.9]–13 × 5–[6.1]–8 µm, older spores constricted at the septum; outer spore-wall weakly ornamented. *Pycnidia* not seen.

*Chemistry*: Thallus K+ yellow, P+ yellow-orange, C–, UV–; containing stictic acid (major) and cryptostictic acid (trace).

*Etymology*: The species is named after the geographical region of the type locality.

#### Remarks

This species is characterized by the pale tan to orange-brown crustose thallus, the adnate to sessile, lecideine apothecia, the non-amyloid medulla containing calcium oxalate, the aeruginose, N+ purple epithymenium, a non-interspersed hymenium, the ellipsoid, 1-septate, *Buellia*-type ascospores, 8–13 × 5–8 µm, and the presence of stictic acid. The ascospores are very similar to those of *B. follmannii*, but that species differs in having an upper surface comprising chunky, porcelain-like scales, non-constricted ascospores and in containing norstictic acid (Wirth 2010; Bungartz *et al.* 2011).

*Buellia namaquaensis* is known only from the type collection where it co-occurs with a *Caloplaca* species. The surrounding vegetation is classified as Knersvlakte Quartz Vygieveld (SKk3) and Central Knersvlakte Vygieveld (SKk2). The region is characterized by winter rainfall peaking from May to August, and dry hot summers, with a mean annual precipitation of 110 mm and rare occurrence of frost (Mucina & Rutherford 2006). Knersvlakte is well known worldwide for succulents, including many endemic taxa (Fig. 9).

**4. *Tetramelas franklinbrussei*** Elix & H.Mayrhofer, sp. nov.  
Mycobank No.: **MB 838272**

Figs 7, 8

Similar to *Tetramelas terricolus* (A.Nordin) Kalb, but differs in having epruinose discs, somewhat shorter ascospores, 20–[24.3]–32 µm long, and a medulla that lacks calcium oxalate and norstictic acid.

*Type:* Republic of South Africa, Natal, Farm Eenzaamheid, 2 km from the Balmoral interchange to Pretoria on the Witbank–Pretoria highway, on soil and dead mosses near granite pavement on SW slope, 1500 m alt., *F. Brusse* 5785, 3.vii.1990 (holotype – GZU).

*Thallus* crustose, to 60 mm wide and 0.15 mm thick, verrucose-areolate to subpulvinate; verrucae 0.05–0.1 mm wide, rounded, agglomerated into irregular clumps; upper surface white, dull, granular or smooth; prothallus absent; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–), I–; photobiont cells 4–10 µm wide. *Apothecia* 0.2–0.7 mm wide, lecideine, adnate to sessile and constricted at the base, scattered, rounded; disc black, epruinose, weakly concave to plane. *Proper exciple* tumid, persistent, in section 30–50 µm thick, cupuliform, outer zone brown-black, K+ forming a yellow solution, paler brown within. *Epithymenium* 15–25 µm thick, brown to dark brown, K–, N–. *Hypothecium* 75–125 µm thick, pale brown to dark brown. *Hymenium* 180–200 µm thick, colourless, not interspersed; subhymenium 30–50 µm thick, colourless, not interspersed. *Paraphyses* 1.5–2 µm wide, simple to branched towards the apices, the apices 4–5 µm wide, with brown caps. *Asci* *Bacidia*-type, 8-spored. *Ascospores* 1- to mainly 3-septate, pale olive-brown to brown, ellipsoid to narrowly fusiform, 20–[24.3]–32 × 8–[9.0]–11 µm, ± constricted at the septum; outer spore-wall weakly ornamented. *Pycnidia* not seen.

*Chemistry:* Thallus K+ yellow, C+ pale orange, KC+ orange, P+ pale yellow, UV+ pale orange; containing atranorin (major), 6-*O*-methylarthonelin (minor).

*Etymology:* The species is named in honour of Franklin A. Brusse, the collector of the type.

#### Remarks

This species is characterized by the verrucose-areolate to subpulvinate, white crustose thallus, a non-amyloid medulla that lacks calcium oxalate, the mainly 3-septate ascospores, 20–32 × 8–11 µm, and the presence of atranorin and 6-*O*-methylarthonelin. It resembles some forms of the Arctic-alpine *T. terricolus*, known from North America, Greenland and Siberia. Both species contain xanthenes, have similar apothecial anatomy and mainly 3-septate ascospores and they grow on soil or dead bryophytes. However, *T. terricolus* differs in having somewhat longer ascospores, 26–[29.5]–34 µm long, pruinose apothecial discs, and in containing medullary calcium oxalate and norstictic acid (Nordin 2000). Also similar is the European *T. geophilus* (Flörke ex Sommerf.) Kalb, but that species has even longer ascospores, 24–[30.1]–38 µm long, as well as pruinose apothecial discs, and it contains medullary calcium oxalate (Nordin 2000).

At present, *T. franklinbrussei* is only known from the type collection, and no associated species were recorded.

#### New records for Southern Africa and Madagascar

**1. *Amandinea polyxanthonica*** (Elix) Elix var. **polyxanthonica**, *Australas. Lichenol.* **85**, 79 (2019)

This species was previously known from tropical northern Australia (Elix 2009b). It is characterized by a yellow to yellow-green, rimose-areolate thallus, scattered, broadly adnate to sessile apothecia to 0.4 mm wide, a non-amyloid medulla that lacks calcium oxalate, a non-interspersed hymenium, *Physconia*- to *Buellia*-type ascospores, 12–20 × 6–8 µm, curved, filiform conidia, 18–30 µm long, and presence of thiophanic acid, 3-*O*-methylthiophanic acid and other xanthenes. A detailed description and illustration are given in Elix (2009b).

#### SPECIMENS EXAMINED

Republic of Zambia. *Copperbelt Province*. ● Ndola Hill, 4–5 km N of Ndola, [12°59'S, 28°39'E, 1300 m alt.], on rock, *E. Hausmann s.n.*, 8.iii.1962 (2 collections, GZU).

#### **2. *Buellia hyporosea*** Elix, *Australas. Lichenol.* **77**, 45 (2015)

This species was previously known from tropical northern Australia (Elix 2015). It is characterized by the smooth, dull, areolate to subsquamulose, off-white to pale whitish grey or whitish yellow thallus, sessile apothecia, an excipulum, hypothecium and subhypothecium that give an intense red solution on treatment with K, *Buellia*-type ascospores, 12–20 × 5–10 µm, and the presence of thiophanic and ± 3-*O*-methylthiophanic acids. A detailed description and illustration are given in Elix (2015).

#### SPECIMEN EXAMINED

Republic of Madagascar. *Fianarantsoa Province*. ● Col des Tapias, N of Ambositra on road to Antsirabe, 20°15'S, 47°06'E, c. 1600 m alt., on quartzite pebble on top of mountain, *W. Knirsch s.n.*, 1.xi.2006 (J. Hafellner nr. 78314, GZU).

#### **3. *Buellia tesserrata*** Körb., *Parerga Lichenol.* 189 (1860)

This species was previously known from Asia Minor, Europe, North America, Macaronesia, North Africa and the Cape Verde Islands (Rico *et al.* 2003). It is characterized by a grey-white to grey crustose thallus, a fimbriate, brown-black, marginal prothallus, cryptolecanorine then lecideine apothecia, often with white-pruinose discs, 1-septate, *Buellia*-type ascospores, 8–15 × 5–7 µm, which become constricted at the septum and have a rugulate outer spore-wall, the bacilliform conidia, 7–11 × 1 µm, and the presence of 3-chlorodivaricatic acid. A detailed description and illustration are given in Rico *et al.* (2003).

#### SPECIMEN EXAMINED

Republic of South Africa. *Western Cape Province*. ● Sandveld W of Richtersveld, c. 9 km ENE of Beauvallon on the Orange River, SE of Brandkaros, 28°29'S, 16°41'E, [SA-Grid: 2816BC], 110 m alt., on greywacke rock, *W. & U. Wetschnig s.n.*, 5.x.1987 (GZU).

#### **4. *Tetramelas coquimbensis*** (C.W.Dodge) Elix, *Opusc. Philolichenum*, **18**, 390 (2019)

This species was previously known from Chile (Bungartz *et al.* 2016; Elix 2019). It is characterized by a mustard-coloured, subsquamulose to squamulose thallus with flattened to ± convex, marginal areoles, lecideine apothecia with an aeruginose, N+ purple epithymenium, 1-septate, *Physconia*- then *Buellia*-type ascospores, 12–16 × 5–9 µm, which become constricted at the septum and have a smooth to faintly ornamented outer spore-wall, the bacilliform conidia, 5–7 × 1.5–2 µm, and the presence of 2,5,7-trichloro-3-*O*-methylnorlichexanthone (major) and isoarthonelin (minor). A detailed description and illustration are given in Bungartz *et al.* (2016).

#### SPECIMEN EXAMINED

Republic of South Africa. *Western Cape Province*. ● Sandveld W of Richtersveld, c. 9 km ENE of Beauvallon on the Orange River, SE of Brandkaros, 28°29'S, 16°41'E, [SA-Grid: 2816BC], 110 m alt., on greywacke rock, *W. & U. Wetschnig s.n.*, 5.x.1987 (GZU).

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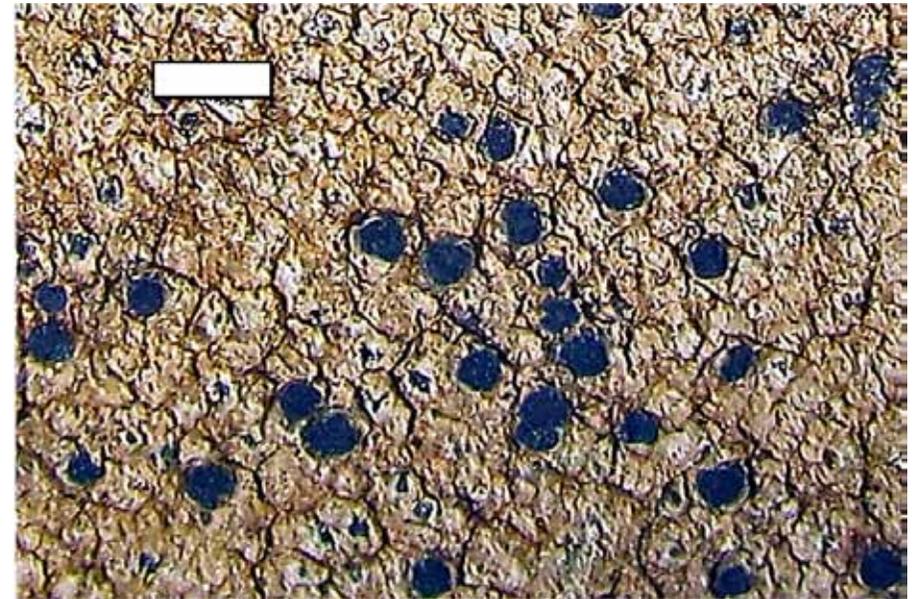


Figure 1. *Amandinea brussei* (holotype in CANB). Scale = 1 mm.

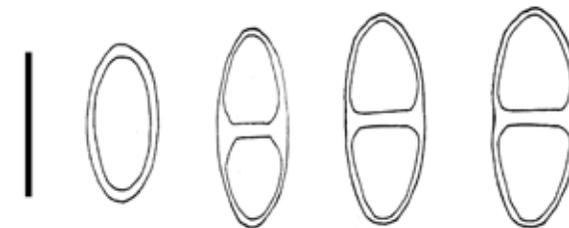


Figure 2. Ascospore ontogeny of *Amandinea brussei*. Scale = 10 µm.



Figure 3. *Buellia capensis* (holotype in M). Scale = 2 mm.



Figure 5. *Buellia namaquaensis* (holotype in GZU). Scale = 1 mm.

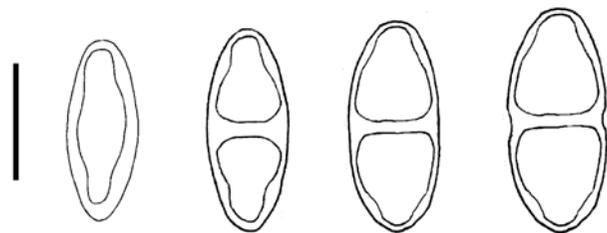


Figure 4. Ascospore ontogeny of *Buellia capensis*. Scale = 10  $\mu$ m.

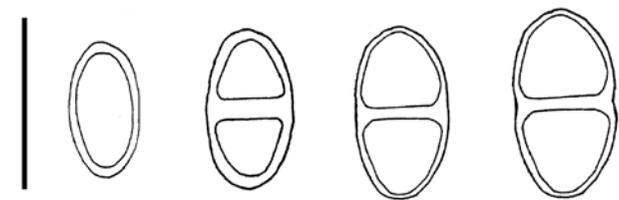


Figure 6. Ascospore ontogeny of *Buellia namaquaensis*. Scale = 10  $\mu$ m.



Figure 7. *Tetramelas franklinbrussei* (holotype in GZU). Scale = 2 mm.

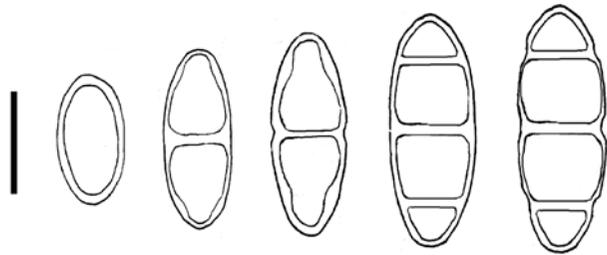


Figure 8. Ascospore ontogeny of *Tetramelas franklinbrussei*. Scale = 10  $\mu$ m.



Figure 9. Knersvlakte vegetation at the type locality of *Buellia namaquaensis*.

## A new species and further new records of *Sarcogyne* (Acarosporaceae) from Australia

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### Abstract

*Sarcogyne regalis* P.M. McCarthy & Elix sp. nov. (Acarosporaceae) is described from consolidated, siliceous soil in the Southern Tablelands, New South Wales, Australia. Four other species, *S. canberrensis* P.M. McCarthy & Elix, *S. molongloensis* P.M. McCarthy & Elix, *S. porphyricola* P.M. McCarthy & Elix and *S. terrulenta* P.M. McCarthy & Elix, are reported for the first time from New South Wales; the last-named species is also recorded from central Queensland.

### Introduction

This paper is part of an ongoing investigation of the saxicolous and terricolous lichen genus *Sarcogyne* Flot. (Acarosporaceae) in Australia (McCarthy & Kantvilas 2013; McCarthy & Elix 2014, 2017a, b, 2020). The description of *S. regalis* sp. nov. brings to 13 the number of known taxa (McCarthy 2020), ten of which appear to be endemic, while ten have also been reported from temperate south-eastern Australia.

### Methods

Observations and measurements of thallus and apothecium anatomy, asci and ascospores 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 pre-treatment in K.

### New species

*Sarcogyne regalis* P.M. McCarthy & Elix, sp. nov.  
Mycobank No.: MB 836923

Figs 1, 2

Characterized by the following combination of attributes: thallus pseudoareolate, pale greyish green, to 150  $\mu\text{m}$  thick; apothecia black, usually innate, 0.34–0.78 mm diam., with a slightly concave to plane, coarsely roughened, epruinose disc and an often ragged proper margin; excipulum cupular, greenish black to brown-black, 30–70  $\mu\text{m}$  thick laterally, the base 25–60  $\mu\text{m}$  thick or up to 80(–100)  $\mu\text{m}$  thick in the centre; hypothecium hyaline, 25–50  $\mu\text{m}$  thick; hymenium 100–130  $\mu\text{m}$  thick; epihymenium dark olive-brown to green-black, coarsely uneven in section, 18–50  $\mu\text{m}$  thick; ascospores *c.* 150–200 per ascus, 2–5  $\times$  1.5–3  $\mu\text{m}$ .

*Type:* Australia, New South Wales, Southern Tablelands, beside Kings Highway, *c.* 8 km E of Bundoora, 35°15'30"S, 149°31'44"E, 795 m alt., on consolidated, siliceous soil in open *Eucalyptus* woodland, P.M. McCarthy 4934, 20.ii.2020 (holotype – CANB; isotype – CANB).

*Thallus* crustose, nondescript, effuse and scarcely distinguishable from the substratum, or determinate, pseudoareolate, pale greyish green, up to 150  $\mu\text{m}$  thick and forming colonies to *c.* 5 cm wide. *Areoles* contiguous or scattered, usually plane, occasionally slightly concave and with faintly raised margins, 0.5–1(–1.2) mm wide, rounded, angular or irregular, separated by shallow channels, not deep cracks, non-amyloid (I–), not containing calcium oxalate (H<sub>2</sub>SO<sub>4</sub>–); surface smooth to minutely and irregular uneven, dull to slightly glossy; areolar plateaux commonly overgrown by a blackish crust of mixed coccoid and gloeocapsid cyanobacteria

and free-living, filamentous and unicellular green algae. *Cortex* poorly delimited or hyaline,  $\pm$  prosoplectenchymatous and 15–25  $\mu\text{m}$  thick; hyphae periclinal and 2–3  $\mu\text{m}$  wide. *Algal layer* indistinct to dense and well-delimited, continuous, 40–70  $\mu\text{m}$  thick; cells green, chlorococcoid, globose, 7–16(–18)  $\mu\text{m}$  wide. *Medulla* poorly defined and dominated by soil material, rock fragments and crystals; hyphae forming a loose reticulum, short- to long-celled, 2–3  $\mu\text{m}$  wide. *Prothallus* not apparent. *Apothecia* very numerous, lecideine, usually innate in the substratum (some larger and older apothecia becoming almost adnate), mostly solitary, rounded or broadly ellipsoid in outline, some irregular or angular, (0.34–)0.54(–0.78) mm diam. [*n* = 100]; disc shallow-concave and slightly curled up at the edge to plane, markedly uneven and with minute ridges, channels and pits, epruinose, dull greenish black to black, the colour not changing when wetted; margin *c.* 50–80  $\mu\text{m}$  thick, entire or uneven, discontinuous and ragged, slightly prominent, usually persistent at maturity, concolorous with the disc. *Proper excipulum* cupular, predominantly greenish black to brown-black, not carbonized, 30–70  $\mu\text{m}$  thick laterally (in section), radiating-prosoplectenchymatous, the outer 10–15(–20)  $\mu\text{m}$  brown-black (K+ intensifying reddish brown, N+ paler brown), the hyphae tightly conglutinate, elongate, thick-walled, with cells 2.5–4  $\mu\text{m}$  wide, the outermost cells similarly elongate or subglobose to globose and 3–5  $\mu\text{m}$  wide; inner marginal zone hyaline to pale brown, 15–25  $\mu\text{m}$  thick, with longer, thinner-walled, paler hyphae; excipulum base uniformly greenish black or brown-black, (25–)30–50(–60)  $\mu\text{m}$  thick, or up to 80(–100)  $\mu\text{m}$  thick in the centre, mainly composed of long-celled and moderately thick-walled periclinal hyphae 3–5  $\mu\text{m}$  wide, the centre paraplectenchymatous, with cells 3–5(–8)  $\mu\text{m}$  wide, commonly with broad, dark-pigmented columns of tightly conglutinate paraphyses extending vertically up through the hymenium to the epihymenium. *Hypothecium* hyaline, 25–40(–50)  $\mu\text{m}$  thick, not interspersed with granules or oil droplets, I–, KI–, K–, N–, of loose, short-celled, variously orientated hyphae 1.5–2  $\mu\text{m}$  wide. *Hymenium* 100–120(–130)  $\mu\text{m}$  thick, not interspersed; hymenial gel I+ red-brown, KI+ deep blue, K–, N–. *Epihymenium* dark olive-brown to green-black, coarsely uneven in section and (18–)25–40(–50)  $\mu\text{m}$  thick, K+ intensifying reddish brown, N+ paler olive-brown, this zone subtending a hyaline necral layer 8–15  $\mu\text{m}$  thick which also extends over the lateral excipulum, or the necral layer absent. *Paraphyses* tightly conglutinate in water, loosening in the hymenium in K, but not the apices in the epihymenium, unbranched to furcate-branched or loosely anastomosing (especially near the excipulum), long-celled, 1–1.5(–2)  $\mu\text{m}$  wide, not constricted at the septa; contents clear to minutely vacuolate; walls dark olive-brown in the epihymenium; apices tightly fused, 2–3(–3.5)  $\mu\text{m}$  wide. *Asci* narrowly to broadly ellipsoid, less commonly narrowly to broadly clavate, containing *c.* 150–200 ascospores, 80–95  $\times$  20–35  $\mu\text{m}$  [*n* = 15], with a short abrupt stalk; apex rounded, with a thin, uniformly lightly amyloid tholus; ocular chamber not apparent. *Ascospores* colourless, simple, broadly ellipsoid to subglobose (occasionally narrowly ellipsoid), with rounded ends, lacking a perispore, commonly monoguttulate, (2–)3.8(–5)  $\times$  (1.5–)2.2(–3)  $\mu\text{m}$  [*n* = 50]; spore contents usually clear. *Pycnidia* not seen.

*Etymology:* The epithet *regalis* (L., royal) refers to the discovery of the new species beside the Kings Highway in the Southern Tablelands, New South Wales.

### Remarks

*Sarcogyne regalis* is characterized by its mainly superficial, pseudoareolate thallus on siliceous soil, moderately large and mostly innate apothecia with a slightly concave to plane and coarsely roughened disc and an often ragged but not markedly jointed margin; in section the proper excipulum and the epihymenium are blackish but not carbonized. Most strikingly, the hyaline hypothecium is subtended by the thick, blackish base of the cupular excipulum. This unique suite of characters sets it apart from all other Australian taxa (McCarthy & Elix 2020). Indeed, the diagnostically dark and thick excipular base further distinguishes the species from *Sarcogyne* in other regions of the world, including those, such as the saxicolous *S. clavus* (DC.) Kremp. and *S. hypophaeoides* Vain. ex H. Magn., both having a superficially similar apothecial base anatomy, but one dominated by a dark hypothecium rather than an excipulum base (Magnusson 1935; Knudsen & Standley 2008;

Knudsen & Kocourková 2018; Roux *et al.* 2019).

The new species is known only from consolidated, siliceous soil at the type locality in the Southern Tablelands, New South Wales. Associated, terricolous species include *Diploschistes thunbergianus* Lumbsch & Vězda, *E. pusillum* Hedw., *Lecidea ochroleuca* Pers., *Micarea humilis* P.M.McCarthy & Elix and *Trapelia terrestris* Elix & P.M.McCarthy.

#### ADDITIONAL SPECIMEN EXAMINED

*New South Wales*. ● type locality, *J.A. Elix 46919*, 20.ii.2020 (CANB).

#### New records

Four other species of *Sarcogyne*, all recently described from the Australian Capital Territory (McCarthy & Elix 2017a, 2020), are reported here from adjacent parts of New South Wales and, in the case of *S. terrulenta*, from central Queensland.

***Sarcogyne canberrensis*** P.M.McCarthy & Elix, *Australas. Lichenol.* **80**, 17 (2017)

#### SPECIMENS EXAMINED

*New South Wales*: ● Southern Tablelands, beside Kings Highway, c. 12 km E of Bungendore, 35°15'01"S, 149°34'29"E, 865 m alt., on discarded, bonded cement-asbestos tile on forest floor, *P.M. McCarthy 4924 (part)*, 20.ii.2020 (CANB); ● Southern Tablelands, beside Kings Highway, c. 8 km E of Bungendore, 35°15'30"S, 149°31'44"E, 795 m alt., on concrete rubble in open *Eucalyptus* woodland, *P.M. McCarthy 4939*, 20.ii.2020 (CANB).

***Sarcogyne molongloensis*** P.M.McCarthy & Elix, *Australas. Lichenol.* **86**, 74 (2020)

#### SPECIMENS EXAMINED

*New South Wales*: ● Southern Tablelands, Wallaroo District, McCarthy Road, c. 300 m E of Murrumbidgee River, c. 12 km WNW of Hall, 35°07'45"S, 148°56'56"E, 420 m alt., on soil bank on roadside adjacent to pasture, *P.M. McCarthy 4930*, 23.iii.2020 (CANB); ● Southern Tablelands, Wallaroo District, McCarthy Road, c. 100 m E of River Bend Road, c. 9 km WNW of Hall, 35°08'20"S, 148°56'10"E, 555 m alt., on soil bank on roadside adjacent to pasture, *J.A. Elix 47016*, 23.iii.2020 (CANB); ● Southern Tablelands, Burra Road, near junction with Williamsdale Road, c. 10 km ENE of Williamsdale, 35°33'14"S, 149°13'32"E, 750 m alt., on soil bank on roadside, *P.M. McCarthy 4944*, 9.vi.2020 (CANB).

***Sarcogyne porphyricola*** P.M.McCarthy & Elix, *Australas. Lichenol.* **86**, 76 (2020)

#### SPECIMENS EXAMINED

*New South Wales*: ● Southern Tablelands, Wallaroo District, Brooklands Road, c. 2 km W of Southwell Road, c. 7 km W of Hall, 35°09'49"S, 148°59'37"E, 605 m alt., on soil bank on roadside adjacent to pasture, *J.A. Elix 47013*, *47014*, 23.iii.2020 (CANB); ● *loc. id.*, *P.M. McCarthy 4933*, 23.iii.2020 (CANB).

***Sarcogyne terrulenta*** P.M.McCarthy & Elix, *Australas. Lichenol.* **86**, 78 (2020)

#### SPECIMENS EXAMINED

*Queensland*: ● Central Highlands, State Forest 212, Baralaba–Woorabinda road, 50 km S of Duaringa, 24°10'S, 149°38'E, 190 m alt., on consolidated soil in *Eucalyptus-Callitris* woodland on flats, *J.A. Elix 34939*, 29.viii.1993 (CANB).

*New South Wales*: ● Central Tablelands, Gooloogong–Grenfell road, 5 km N of Grenfell, 33°51'16"S, 148°10'37"E, 385 m alt., on consolidated soil in *Eucalyptus-Callitris* woodland, *P.M. McCarthy 4900*, 2.x.2019 (CANB).

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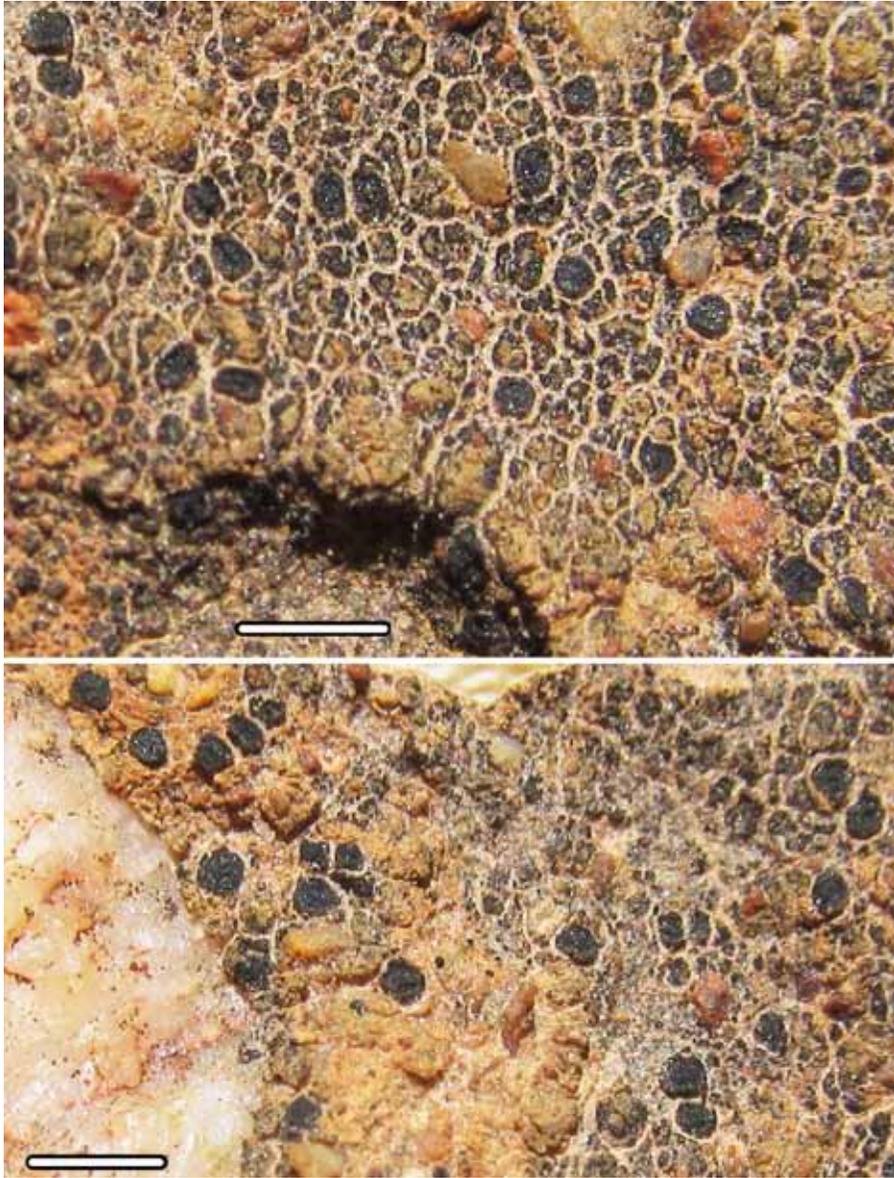


Figure 1. *Sarcogyne regalis* (holotype). Scales: 2 mm.

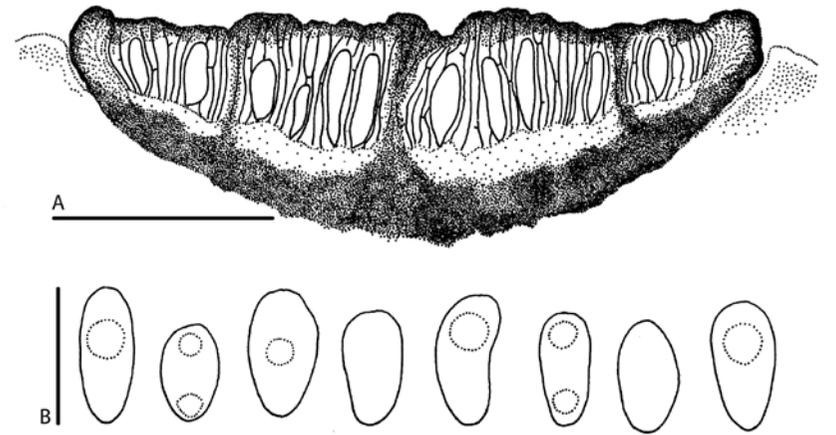


Figure 2. *Sarcogyne regalis* (holotype). A, Vertical section of an apothecium (semi-schematic); B, Ascospores. Scales: A = 0.2 mm; B = 5  $\mu$ m.

**Three new species of buellioid lichens (Caliciaceae, Ascomycota) from New Zealand and the first report of *Rinodinella dubyanoides* (Physciaceae, Ascomycota) from Australia and New Zealand**

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**Abstract**

*Amandinea delangei* Elix & H.Mayrhofer, *Buellia blahaiana* Elix & H.Mayrhofer and *B. harrisiana* Elix & H.Mayrhofer are described as new to science. In addition, *Rinodinella dubyanoides* (Hepp) H.Mayrhofer & Poelt is reported for the first time from Australia and New Zealand.

**Introduction**

This paper continues our investigation of *Buellia*-like lichens in New Zealand. For the more recent additions see Blaha *et al.* (2016), Elix & Mayrhofer (2016, 2017, 2018), Mayrhofer *et al.* (2016) and references cited therein. In this paper, we describe a new species of *Amandinea* and two new species of *Buellia* in the broad sense, and we report the occurrence of *Rinodinella dubyanoides* (Hepp) H.Mayrhofer & Poelt in both New Zealand and Australia. Methods are as described in the papers cited above.

**New species**

**1. *Amandinea delangei*** Elix & H.Mayrhofer, sp. nov. Figs 1, 2  
Mycobank No.: **MB 836829**

Similar to *Amandinea litoralis* (Zahlbr.) H.Mayrhofer & Elix, but differs in having a granular-sorediate upper surface and pruinose apothecial discs.

*Type*: New Zealand, North Island, Te Aupouri, Oneroa-a-Tohe (Ninety Mile Beach), Te Wakatehau (The Bluff), 34°41'06"S, 172°53'22"E, 20 m alt., on weathered basalt cliff face in the spray zone, *P.J. de Lange 13389, T.J.P. de Lange & K.A. Raharaha*, l.i.2017 (holotype – CANB; isotype – UNITEC).

*Thallus* crustose, continuous, areolate to subsquamulose, to 30 mm wide and 1 mm thick; individual areoles rounded to irregular, 0.2–0.6 mm wide, sometimes becoming aggregated to form a secondary subsquamulose crust; upper surface grey-white to pale grey, matt, maculate to ± pruinose; upper cortex eroding to form granular soredia in irregular, crateriform soralia; prothallus not apparent; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I-; photobiont cells 5–14 µm in diam. *Apothecia* 0.3–1 mm wide, lecideine, broadly adnate then sessile and constricted at the base, isolated, rounded; disc black, epruinose or weakly pale grey-pruinose, plane then markedly convex. *Proper exciple* tumid at first, excluded in older convex apothecia, in section the outer zone brown-black, 35–55 µm thick, K-, N-, inner zone pale brown to colourless. *Ephymenium* 10–15 µm thick, brown to dark brown, K-, N-. *Hypothecium* brown-black, 120–150 µm thick, K-. *Hymenium* 70–80 µm thick, colourless, not interspersed; subhymenium 25–35 µm thick, pale brown, interspersed with oil droplets. *Paraphyses* 1.2–1.5 (–2) µm wide, sparsely branched, with apices 4–5 µm wide and brown caps. *Asci* of the

*Bacidia*-type, with 8 or fewer (3, 5) spores. *Ascospores* *Physconia*-type when immature, *Buellia*-type when mature, brown, ellipsoid, 12–[13.9]–16 × 6–[7.4]–9 µm, older spores constricted at the septum; outer spore-wall weakly ornamented. *Pycnidia* immersed; ostiole black; conidia filiform, curved, 16–25 × 0.7–1 µm.

*Chemistry*: Thallus K-, P-, C-, UV-; no lichen substances detected.

*Etymology*: The species is named after the New Zealand botanist Dr Peter J de Lange, collector of the type specimen.

**Remarks**

This species is characterized by the crustose, areolate to subsquamulose, grey-white to pale grey thallus with a granular-sorediate upper surface, the broadly adnate then sessile apothecia, the non-amyloid medulla, an interspersed subhymenium, the 1-septate, *Physconia*- then *Buellia*-type ascospores, 12–16 × 6–9 µm, curved, filiform conidia, 16–25 µm long, and the absence of lichen substances. Morphologically, it can resemble specimens of *A. litoralis*, but that species lacks a sorediate upper surface and an interspersed subhymenium (Blaha *et al.* 2016). *Amandinea rangitatisensis* Elix & H.Mayrhofer, from the South Island of New Zealand, also has a sorediate upper surface, but it differs in having larger ascospores, 14–[17.1]–20 × 7–[9.2]–11 µm, with a strongly rugulate outer spore-wall, a non-interspersed subhymenium and in containing atranorin (Elix & Mayrhofer 2017).

At present *A. delangei* is known only from the type collection. Associated species include *Buellia halonia* (Ach.) Tuck., *B. spuria* var. *amblyogona* (Müll.Arg.) Elix, *B. stellulata* (Taylor) Mudd var. *stellulata*, *B. stellulata* var. *tasmanica* Elix & Kantvilas, *Caloplaca eos* S.Y.Kondr. & Kärnefelt, *C. gallowayi* S.Y.Kondr., Kärnefelt & Filson, *Halecania subsquamosa* (Müll.Arg.) van den Boom & H.Mayrhofer, *Pertusaria xanthoplaca* Müll.Arg., *Rinodina oxydata* (A.Massal.) A.Massal. and *Jackelixia ligulata* (Körb.) S.Y.Kondr. & Kärnefelt.

**2. *Buellia blahaiana*** Elix & H.Mayrhofer, sp. nov. Fig. 3

Mycobank No.: **MB 836830**

Similar to *Buellia straminea* Tuck., but differs in lacking extended marginal lobes and in having somewhat shorter ascospores, 9–13 µm long.

*Type*: New Zealand, North Island, Coromandel Peninsula, Fletchers Bay, N of Coromandel Town, E of Port Jackson, 36°28'35"S, 175°23'25"E, 0–3 m alt., on coastal greywacke rocks, *J. Blaha 0205*, 17.iv.2001 (holotype – GZU).

*Thallus* crustose, to 12 mm wide and 0.1 mm thick, areolate to rimose-areolate; areoles crowded or dispersed, 0.1–0.4 mm wide; upper surface yellow-white to pale yellow-brown, dull; prothallus absent; medulla white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I-; photobiont cells 8–15 µm wide. *Apothecia* 0.1–0.4 mm wide, lecideine, adnate to sessile, round; disc black, epruinose, plane to weakly convex. *Proper exciple* thick, excluded in convex apothecia, in section 45–55 µm thick, outer zone dark brown to brown-black, K-, N-, inner zone brown. *Ephymenium* 8–10 µm thick, dark brown, K-, N-. *Hypothecium* brown to brown-black, 70–125 µm thick, K-. *Hymenium* 55–65 µm thick, colourless, not interspersed; subhymenium 15–20 µm thick, pale brown, not interspersed. *Paraphyses* 1.5–2 µm wide, sparsely branched, the apices 4–6 µm wide with brown caps. *Asci* of the *Bacidia*-type, with 8 spores. *Ascospores* *Buellia*-type, brown, ellipsoid, 9–[11.8]–13 × 5–[5.9]–7 µm, not constricted at the septum; outer spore-wall weakly ornamented. *Pycnidia* not seen.

*Chemistry*: Thallus K-, P-, C-, UV-; containing arthothelin.

*Etymology*: The species is named after the Austrian biologist Dr Juliane Blaha, the collector of the type specimen.

## Remarks

This species is characterized by the crustose thallus consisting of crowded to dispersed yellow-white to pale yellow-brown areoles, the adnate to sessile, lecideine apothecia, the non-amyloid medulla, a dark brown, N– excipulum and epihymenium, a non-inspersed hymenium, ellipsoid, 1-septate, *Buellia*-type ascospores,  $9\text{--}13 \times 5\text{--}7 \mu\text{m}$  and the presence of arthothelin. Chemically, it is identical to *B. straminea*, and although that species has similar ascospores, it differs in having linear-elongate marginal areoles, a bright yellow upper surface and somewhat longer ascospores,  $11\text{--}[12.8]\text{--}15 \times 5\text{--}[6.5]\text{--}8 \mu\text{m}$  (Imshaug 1955; Aptroot & Sparrius 2013).

At present *B. blahaiana* is known only from the type collection. Associated species include *Amandinea decedens* (Nyl.) Blaha, H. Mayrhofer & Elix, *A. pelidna* (Ach.) Fryday & L. Arcadia, *Buellia cranwelliae* Zahlbr., *Caloplaca cribrata* (Hue) Zahlbr., *C. gallowayi* S.Y. Kondr., Kärnefelt & Filson, *Halecania subsquamosa* (Müll. Arg.) van den Boom & H. Mayrhofer, *Lecanora subcoarctata* (C. Knight) Hertel, *Pertusaria xanthoplaca* Müll. Arg., *Rinodina blastidiata* Matzer & H. Mayrhofer and *Xanthoria ligulata* (Körb.) P. James. Previously, *B. blahaiana* was erroneously reported as *B. straminea* (Elix & Mayrhofer 2018).

**3. *Buellia harrisiana*** Elix & H. Mayrhofer, sp. nov.  
Mycobank No.: **MB 836831**

Figs 4–6

Similar to *Buellia sharpiana* Lendemer & R.C. Harris, but differs in having a brown hypothecium, an aeruginose, N+ purple-brown epihymenium and slightly longer ascospores,  $12\text{--}15 \mu\text{m}$  long.

*Type:* New Zealand, South Island, [Canterbury], Malvern County, grassy hillside on north side of Route 73 along the Craigieburn River, [ $43^{\circ}8.270'S$ ,  $171^{\circ}45.525'E$ , 675 m alt.], on rock, *R.C. Harris 6433*, 24.i.1971 (holotype – MSC).

*Thallus* crustose, to 15 mm wide and 0.1 mm thick, areolate; areoles crowded or dispersed, 0.2–0.5 mm wide; upper surface pale grey, dull; prothallus black, marginal; medulla white, lacking calcium oxalate ( $\text{H}_2\text{SO}_4$ -), 1+ purple-blue; photobiont cells 6–14  $\mu\text{m}$  wide. *Apothecia* 0.1–0.25 mm wide, lecideine, immersed then adnate to sessile, 1 per areole, round; disc black, epruinose, plane to convex. *Proper exciple* thick, excluded in convex apothecia, in section 35–50  $\mu\text{m}$  thick, outer zone dark brown to aeruginose-black, K–, N+ purple-brown, inner zone brown. *Epihymenium* 10–12  $\mu\text{m}$  thick, dark brown to deep aeruginose, K–, N+ purple-brown. *Hypothecium* pale brown to brown, 60–80  $\mu\text{m}$  thick, K–. *Hymenium* 55–80  $\mu\text{m}$  thick, colourless, not inspersed. *Paraphyses* 1.5–2  $\mu\text{m}$  wide, sparsely branched, with apices 3–4  $\mu\text{m}$  wide and aeruginose caps. *Asci* of the *Bacidia*-type, with 8 spores. *Ascospores* *Buellia*-type, brown, ellipsoid,  $12\text{--}[13.3]\text{--}15 \times 7\text{--}[7.4]\text{--}8 \mu\text{m}$ , older spores rarely constricted at the septum; outer spore-wall weakly ornamented. *Pycnidia* not seen. *Chemistry:* Thallus K–, P–, C–, UV–; containing arthothelin.

*Etymology:* The species is named after the American lichenologist Richard C. Harris, the collector of the type specimen.

## Remarks

This species is characterized by the crustose thallus consisting of crowded to dispersed grey areoles, the immersed to sessile, lecideine apothecia, the amyloid medulla, an aeruginose, N+ purple-brown excipulum and epihymenium, a non-inspersed hymenium, ellipsoid, 1-septate, *Buellia*-type ascospores,  $12\text{--}15 \times 7\text{--}8 \mu\text{m}$  and the presence of arthothelin. Chemically, it is identical to *B. sharpiana*, but that species differs in having a colourless hypothecium, a brown, N– epihymenium and somewhat shorter ascospores,  $11\text{--}[12.4]\text{--}13.5 \mu\text{m}$  long.

At present *B. harrisiana* is known only from the type collection. Associated species were not recorded. The illustrations of this species (Figs 4–6) were originally published as *Buellia* sp. (*Harris 6344*) in Fryday (2019), and are reprinted here with permission.

## New record

***Rinodinella dubyanoides*** (Hepp) H. Mayrhofer & Poelt, *Hoppea* [*Denkschr. Regensb. Bot. Gesellschaft*] **37**, 98 (1978)  
Basionym: *Lecidea dubyanoides* Hepp, *Flechten Europas*: no. 323 (1857).

*Thallus* crustose, immersed and not apparent, or thin and inconspicuous, more rarely granulose, continuous to 25 mm wide or discontinuous; upper surface white to grey-white, dull; prothallus not apparent; medulla white, lacking calcium oxalate ( $\text{H}_2\text{SO}_4$ -), 1–; photobiont cells 6–14  $\mu\text{m}$  diam. *Apothecia* 0.2–0.6 mm wide, initially lecanorine and innate, then pseudolecanorine or biatorine, broadly adnate to sessile and constricted at the base; disc brown to black, epruinose, concave to plane or weakly convex. *Thalline margin* thin, whitish, soon excluded. *Proper exciple* prominent, entire, persistent, in section 30–40  $\mu\text{m}$  thick, the outer zone brown, K–, N–, inner zone pale brown. *Epihymenium* 12–15  $\mu\text{m}$  thick, red-brown, K–, N–. *Hypothecium* colourless, 50–150  $\mu\text{m}$  thick, K–. *Hymenium* 60–90  $\mu\text{m}$  thick, colourless, not inspersed. *Paraphyses* 1.8–2.2  $\mu\text{m}$  wide, sparsely branched towards the apices, the apices 5–7  $\mu\text{m}$  wide with brown caps. *Asci* *Lecanora*-type, 8-spored. *Ascospores* *Rinodinella*-type, 1-septate, pale brown, narrowly ellipsoid,  $12\text{--}[15.1]\text{--}21 \times 5\text{--}[6.1]\text{--}7.5 \mu\text{m}$ , constricted at the septum; outer spore-wall smooth. *Pycnidia* immersed, black; conidia bacilliform, 5–6  $\times$  1  $\mu\text{m}$ . *Chemistry:* Thallus K–, P–, C–, UV–; no lichen substances detected by TLC.

## Remarks

This species was previously known from southern Europe and Asia Minor (Mayrhofer & Poelt 1978). It is characterized by the crustose, immersed to white to grey-white, or rarely granular thallus, the immersed to sessile, lecanorine then pseudolecanorine or biatorine apothecia, the non-amyloid medulla, a non-inspersed hymenium, the narrowly ellipsoid, 1-septate, *Rinodinella*-type ascospores,  $12\text{--}21 \times 5\text{--}7.5 \mu\text{m}$ , bacilliform conidia, 5–6  $\mu\text{m}$  long, and the absence of lichen substances. Excellent illustrations are given in Mayrhofer & Poelt (1978).

## SPECIMENS EXAMINED

*Australia:* ● South Australia, South Flinders Ranges, 10 km SSW of Hawker,  $31^{\circ}57'S$ ,  $138^{\circ}23'E$ , 465 m alt., on limestone-impregnated siliceous rock in grassland with remnant *Callitris*, *H.T. Lumbsch 10729a*, *E. Lumbsch & J. Curnow*, 3.ix.1994 (CANB).

*Italy:* ● Calabria, Prov. Cosenza, Golfo de Policastro, Isola di Dino N Scalea, 100 m alt., on chalk, *H. Mayrhofer*, 1.vi.1979 (GZU).

*New Zealand:* ● South Island, Alexandra, Little Valley Road, 6 km from Alexandra,  $45^{\circ}17'S$ ,  $169^{\circ}27'E$ , 460 m alt., on rock, *H. Mayrhofer 10506*, *H. Hertel & P. Child*, 2.ii.1985 (GZU).

## Acknowledgements

We thank Dr Mireia Giralt for examining the Australian collection of *Rinodinella dubyanoides* and Dr Alan Fryday for permission to use his photographs of *Buellia harrisiana*. H.M. is indebted to Dr Hannes Hertel and the late Peter Child for their support during the 1985 field trip.

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Figure 1. *Amandinea delangei* (holotype in CANB). Scale = 1 mm.

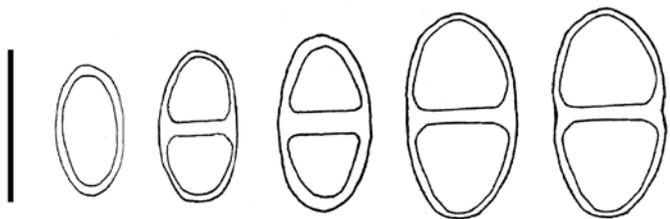


Figure 2. Ascospore ontogeny of *A. delangei*. Scale = 10  $\mu$ m.



Figure 3. *Buellia blahaiana* (holotype in GZU). Scale = 1 mm.

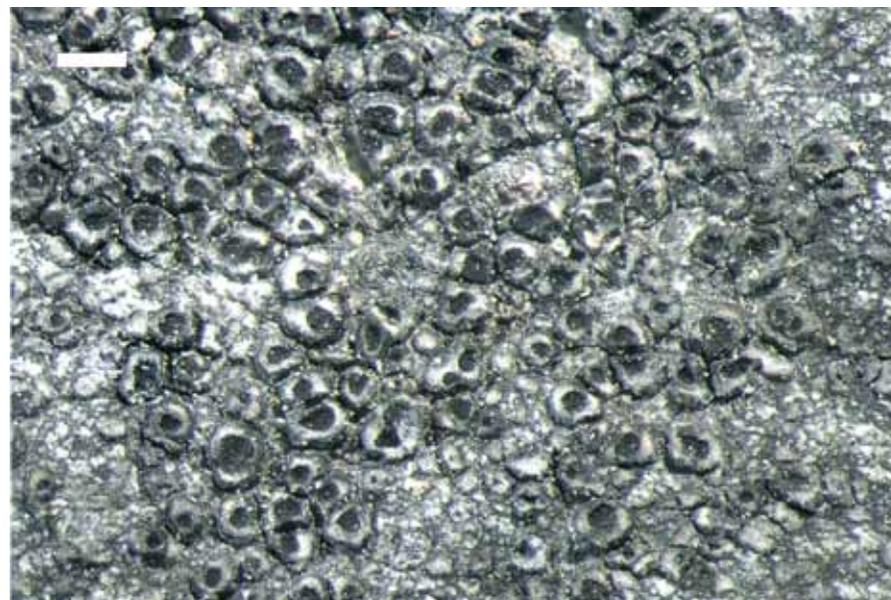


Figure 4. *Buellia harrisiana* (holotype in MSC). Scale bar = 0.5 mm.



Figure 5: *Buellia harrisiana* (holotype in MSC). Ascospores. Scale bar = 25  $\mu$ m.

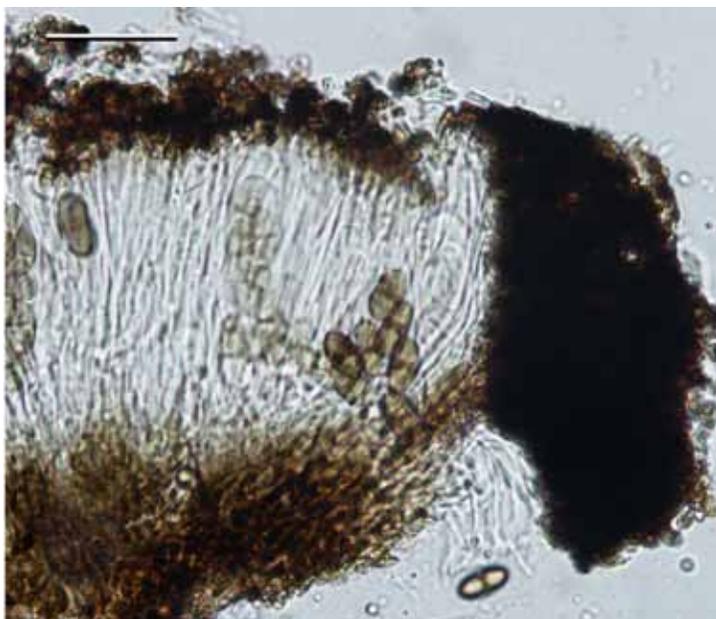


Figure 6: *Buellia harrisiana* (holotype in MSC). Apothecium xs. Scale bar = 25  $\mu$ m.

## An outline of some lichen communities on consolidated, siliceous soils in south-eastern Australia

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### Introduction

Our recent investigations of soil-inhabiting lichens in the Australian Capital Territory and adjacent parts of New South Wales led to the discovery of new national, state and territory records and the recognition of novel species of *Diploschistes*, *Micarea*, *Sarcogyne*, *Trapelia* and *Ferrucaria* (Elix & McCarthy 2018, 2020a, b, 2021; McCarthy 2020a, b; McCarthy & Elix 2020a, b, 2021). In addition to the taxonomic and floristic novelties, it became apparent that certain, less elevated, terricolous communities, as opposed to their subalpine or alpine counterparts, were dominated by elements of a broad and distinctive suite of mainly crustose and squamulose lichens. These quite diverse terricolous communities inhabited comparatively stable and strongly compacted, nutrient-poor, siliceous soil banks on roadsides and in eucalypt- and *Callitris*-dominated woodland. Often markedly xeric, being exposed to drying winds and subject to high summer temperatures, they were further characterized by the very sparse or non-existent cover of flowering plants, bryophytes and most Cladoniaceae.

We observed terricolous lichen communities at 19 localities (460–780 m altitude) in the Australian Capital Territory (Figs 1, 2), and at 23 other sites (420–950 m altitude) in nearby areas of the Southern and Central Tablelands, New South Wales (Table 1). Table 2 lists the 52 terricolous lichen taxa seen in these habitats, and it includes a qualitative assessment of their distribution and abundance.

### Discussion

The terricolous lichen communities of these roadside soil banks and dry woodland habitats often have a quite distinctive species composition dominated by comparatively robust crusts, as well as squamulose taxa and *Xanthoparmelia* species (the  $\pm$  ubiquitous and frequent to common species in Table 2). Thirteen of the species from the 42 collection sites are currently thought to be endemic to south-eastern Australia (including Tasmania), and all of those are exclusively terricolous. Moreover, the soil substratum can be so hard and unyielding that 20 or more of the species are occasionally to primarily saxicolous, often occupying nearby outcrops as well as loose stones and boulders of shale, slate, sandstone, granite, basalt and quartzite. They include *Baeomyces heteromorphus*, *Caloplaca arandensis*, *Candelariella vitellina*, *Lecanora pseudistera*, *Parapropidia leptocarpa*, *Xanthoparmelia subprolixa* and *X. tasmanica*.

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Table 1. Collecting localities, 2017–20.

**Australian Capital Territory**

Mt Majura Nature Reserve (NR), Mawson Trail, 35°13'34"S, 149°10'48"E, 720 m alt.

Mt Ainslie, E-facing slope below summit, 35°15'59"S, 149°09'43"E, 780 m alt.

Uriarra Crossing, 12 km W of Canberra, 35°14'35"S, 148°57'11"E, 460 m alt.

Bindubi St., c. 5 km W of Canberra, Cook, 35°16'08"S, 149°04'29"E, 630 m alt.

Mount McDonald Summit Track, Cotter Avenue, Canberra, 35°18'48"S, 148°56'50"E, 595 m alt.

Aranda Bushland, powerline track, c. 4 km W of Canberra, 35°15'32"S, 149°04'53"E, 670 m alt.

Aranda Bushland, powerline track, c. 4 km W of Canberra, 35°16'00"S, 149°04'54"E, 650 m alt.

near Coppins Crossing, 35°17'17"S, 149°02'04"E, 510 m alt.

c. 1 km W of Coppins Crossing, 35°17'17"S, 149°01'58"E, 515 m alt.

Kowen Forest, 17 km E of Canberra, 35°19'02"S, 149°15'07"E, 700 m alt.

Latham, 11 km NW of Capital Hill, Canberra, 35°14'S, 149°02'E, 550 m alt.

Shepherds Lookout, Woodstock NR, 20 km WNW of Canberra, 35°14'34"S, 148°58'38"E, 555 m alt.

NE slope of Mt Mugga Mugga, Canberra Nature Park, 35°20'43"S, 149°07'10"E, 660 m alt.

Tuggeranong Parkway, near entrance to arboretum, 35°17'33"S, 149°04'22"E, 505 m alt.

Tuggeranong Parkway, near entrance to arboretum, 35°17'35"S, 149°04'24"E, 580 m alt.

Gatty St, Scullin, 35°15'03"S, 149°05'02"E, c. 560 m alt.

Black Mountain NR, near Caswell Drive, c. 4 km W of Canberra, 35°16'28"S, 149°05'18"E, 600 m alt.

Black Mountain NR, near Frith Road, 2 km W of Canberra, 35°16'05"S, 149°06'36"E, 570 m alt.

Canberra Nature Park, O'Connor Ridge, 4 km NW of Canberra, 35°14'41"S, 149°07'04"E, 610 m alt.

Table 1. Collecting localities, 2017–20 (continued)

**New South Wales**

Federal Hwy, 24 km N of Canberra, 35°09'39"S, 149°19'05"E, 749 m alt.  
 beside Kings Hwy, c. 8 km E of Bungendore, 35°15'30"S, 149°31'44"E, 795 m alt.  
 beside Kings Hwy, c. 12 km E of Bungendore, 35°15'01"S, 149°34'29"E, 865 m alt.  
 Wallaroo District, c. 12 km WNW of Hall, 35°07'45"S, 148°56'56"E, 420 m alt.  
 Wallaroo District, c. 9 km WNW of Hall, 35°08'20"S, 148°56'10"E, 555 m alt.  
 Wallaroo District, c. 7 km W of Hall, 35°09'49"S, 148°50'10"E, 555 m alt.  
 Wallaroo District, c. 10 km W of Hall, 35°08'20"S, 148°59'37"E, 605 m alt.  
 Burra Road, c. 10 km ENE of Williamsdale, 35°33'14"S, 149°28'53"E, 780 m alt.  
 Lucky Pass, Collector–Tarago road, 34°59'05"S, 149°24'19"E, 630 m alt.  
 Gundaroo–Collector road, c. 4 km W of Collector, 34°55'12"S, 149°24'19"E, 630 m alt.  
 Cumberun NR, c. 5 km SE of Queanbeyan, 35°21'17"S, 149°16'20"E, 775 m alt.  
 Cumberun NR, c. 6 km SE of Queanbeyan, 35°21'29"S, 149°16'30"E, 730 m alt.  
 Gillindich NR, 10 km N of Binda, 34°12'59"S, 149°20'09"E, 830 m alt.  
 Tuena–Bathurst road, c. 10 km N of Tuena, 33°55'38"S, 149°21'09"E, 650 m alt.  
 Wamboin road, 10.5 km NW of Bungendore, 35°12'18"S, 149°20'46"E, 685 m alt.  
 Gooloogong–Grenfell road, 5 km N of Grenfell, 33°51'16"S, 148°10'37"E, 385 m alt.  
 Weddin State Forest, 25 km WSW of Grenfell, 34°01'S, 148°01'E, 300 m alt.  
 Murrumbateman–Gundaroo road, c. 2 km E of Nanima Rd, 35°01'06"S, 149°06'54"E, 622 m alt.  
 Murrumbateman–Gundaroo road, Tallagandra Hill, 35°03'00"S, 149°09'29"E, 685 m alt.  
 Murrumbateman–Gundaroo road, c. 2 km from Sutton road turnoff, 35°03'19"S, 149°14'08"E, 590 m alt.  
 Old Cooma Rd, c. 3 km from Monaro Hwy, 35°28'33"S, 149°10'32"E, 835 m alt.  
 Coommartha NR, Numeralla road, 15 km E of Cooma, 36°11'12"S, 149°16'50"E, 950 m alt.

Table 2. Lichens on consolidated, nutrient-poor, siliceous soils in the A.C.T. and nearby Southern and Central Tablelands, New South Wales.

**± Ubiquitous and often very abundant**

*Diploschistes thumbergianus* (Ach.) Lumbsch & Vězda  
*Lecidea ochroleuca* Nyl.  
*Micarea humilis* P.M.McCarthy & Elix  
*Sarcogyne terrulenta* P.M.McCarthy & Elix  
*Trapelia pruinoso* Elix & P.M.McCarthy  
*Xanthoparmelia flavescens* (Gyeln.) Hale  
*Xanthoparmelia subprolixa* (Nyl. ex Kremp.) O.Blanco, A.Crespo, Elix, D.Hawksw. & Lumbsch  
*Xanthoparmelia substrigosa* (Hale) Hale

**Frequent to common (often as sparse colonies, but can be locally abundant)**

*Baeomyces heteromorphus* Nyl. ex C.Bab. & Mitt.  
*Buellia suttonensis* Elix & A.Knight  
*Catoplaea arandensis* Elix, S.Y.Kondr. & Kärnefelt  
*Cladia aggregata* (Sw.) Nyl.  
*Dibaeis arcuata* (Stirt.) Kalb & Gieri  
*Endocarpon pallidum* Ach.  
*Endocarpon pusillum* Hedw.  
*Lecanora pseudistera* Nyl.  
*Lecidea terrena* Nyl.  
*Parapropidia leptocarpa* (C.Bab. & Mitt.) Rambold & Hertel  
*Placidium squamulosum* (Ach.) Breuss  
*Psora crystallifera* (Taylor) Müll.Arg.  
*Psora decipiens* (Hedw.) Hoffm.  
*Trapelia crystallifera* Kantvilas & Elix  
*Trapelia rosetiformis* Elix & P.M.McCarthy  
*Trapelia terrestris* Elix & P.M.McCarthy

Table 2. Lichens on consolidated, nutrient-poor, siliceous soils in the A.C.T. and nearby Southern and Central Tablelands, New South Wales (continued).

**Occasional (usually as sparse colonies, rarely locally abundant)**

*Acarospora tasmaniensis* K. Knudsen & Kocourk.  
*Candelariella vitellina* (Hofim.) Müll. Arg.  
*Diploschistes muscorum* (Scop.) R. Sant. subsp. *bartlettii* Lumbsch  
*Fuscopannaria submixta* (C. Knight) P.M. Jørg.  
*Gyalidea psammoica* (Nyl.) Lettau ex Vězda  
*Heterodea muelleri* (Hampe) Nyl.  
*Lichenomphalia chromacea* (Cleland) Redhead, Lutzoni, Moncalvo & Vilgalys  
*Micarea almbornii* Coppins  
*Sarcogyne porphyricola* P.M. McCarthy & Elix  
*Trapelia atrocarpa* Elix & P.M. McCarthy  
*Verrucaria kowenensis* P.M. McCarthy  
*Xanthoparmelia reptans* (Kurok.) Elix & J. Johnst.  
*Xanthoparmelia tasmanica* (Taylor) Hale

**Rare to very rare (known from only one or two localities)**

*Acarospora veronensis* A. Massal.  
*Arthonia aff. fusca* (A. Massal.) Hepp  
*Diploschistes sarcogynoides* Elix & P.M. McCarthy  
*Diploschistes* sp. [Wallaroo District]  
*Endocarpon simplicatum* var. *bisporum* P.M. McCarthy  
*Endocarpon simplicatum* Nyl. var. *simplicatum*  
*Lecidea sarcogynoides* Körb.  
*Lecidea* sp. [Shepherds Lookout]  
*Micarea diminuta* Coppins  
*Parapropidia glauca* (Taylor) Rambold  
*Rinodina conradii* Körb.  
*Sarcogyne regalis* P.M. McCarthy & Elix  
*Sarcogyne tholicola* P.M. McCarthy & Elix  
*Trapelia concentrica* Elix & P.M. McCarthy  
*Verrucaria aff. nigrescens* Pers.



Figure 1. Mt Mugga Mugga, A.C.T. The low, eroded soil 'step' is the type locality of *Sarcogyne porphyricola*.



Figure 2. O'Connor Ridge, A.C.T. Terricolous lichen community dominated by *Micarea humilis*, *Lecidea ochroleuca* and *Trapelia pruinosa*.

## Two new species of *Tetramelas* (Caliciaceae, Ascomycota) from Antarctica

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### Abstract

*Tetramelas drakonensis* Elix from Princess Elizabeth Land in eastern Antarctica and *T. grevei* Elix from Enderby Land in north-eastern Antarctica are described as new to science. An updated key is provided to the 15 Antarctic species of *Tetramelas*.

### Introduction

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 include commonly curved, 1–3-septate ascospores with pointed apices which show *Callispora*-type thickenings in early ontogeny (Giralt *et al.* 2009), the 1-septate ascospores often having additional endosepta, a predominantly Arctic-Antarctic or alpine-subalpine distribution (Kalb 2004) and the frequent presence of xanthones (arthothelin, 6-*O*-methylarthothelin, isoarthothelin or 2,5,7-trichloro-3-*O*-methylnorlichexanthone) or atranorin only (Kalb 2004; Elix 2018, 2019a, b). Following the study of Antarctic collections housed in MEL, I am describing two new species of *Tetramelas* and presenting an updated key for the genus in the continent.

### Methods

Observations and measurements of thalline and apothecial 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.

### New species

***Tetramelas drakonensis*** Elix, sp. nov.  
Mycobank No.: **MB 836686**

Figs 1, 2

Similar to *Tetramelas filsonii* Elix, but differs in having an aeruginose, N+ purple epihymenium and in lacking 6-*O*-methylarthothelin and norstictic acid.

*Type:* Antarctica, Princess Elizabeth Land, Rauer Group, Cape Drakon [68°54'54"S, 77°54'E], on rock, R.B. Filson 14850, 2.v.1974 (holotype – MEL 1021158).

*Thallus* crustose, to 40 mm wide and 1 mm thick, verruculose; verrucules corticate, rounded and elevated, irregularly branched and appearing like inflated isidia, 0.2–1 mm wide and up to 1.2 mm tall, becoming granular, coralloid, elevated to form small, pulvinate cushions to 1.5 mm tall, often ecorticate in part; upper surface dull, off-white, cream to pale brown or brown-black; prothallus not apparent; photobiont cells 10–23 µm wide. *Medulla* lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I-. *Apothecia* 0.2–1 mm wide, abundant, lecideine, roundish, scattered, broadly adnate to sessile on top of elevated areoles; disc brown to black, epruinose, plane to convex. *Proper exciple* thin, excluded in older convex apothecia, in section 25–40 µm thick; outer part dark brown to brown-black, K-, N+ purple-brown; inner part brown. *Epihymenium* 10–12 µm thick, brown to aeruginose, K-, N+ purple. *Hypotheicum* 150–200 µm thick, brown, K-. *Hymenium* 75–95 µm thick, colourless, not interspersed; subhymenium 20–30 µm thick, pale brown, not interspersed. *Paraphyses* 1.5–2 µm wide, sparingly branched, with apices 4–6 µm wide and brown caps. *Asci* 8-spored, *Bacidia*-type. *Ascospores* initially *Callispora*-then *Buellia*-type, 1-septate, brown, ellipsoid to fusiform, 11–[14.9]–19 × 6–[6.6]–8 µm,

becoming constricted at the septum, sometimes curved; outer spore-wall finely ornamented (microrugulate). *Pycnidia* common, superficial; ostiole brown-black. *Conidia* bacilliform to ellipsoid, 2.5–4 × 1–1.5 µm.

*Chemistry:* Thallus K- or K+ yellow, P- or P+ pale yellow, C-, UV-; containing atranorin (major or minor).

*Etymology:* The species is named after the type locality.

### Remarks

This species is characterized by a verruculose, off-white, cream to brown or brown-black thallus; the verrucules are elevated and isidia-like or become compacted and form small cushion-like clumps to 1.5 mm tall; it contains atranorin, but lacks medullary calcium oxalate. It has a non-amyloid medulla, adnate to sessile, lecideine apothecia, 0.2–1 mm wide, a dark brown to aeruginose, N+ purple epihymenium, *Callispora*- then *Buellia*-type ascospores, 11–19 × 6–8 µm, which become constricted at maturity, and bacilliform conidia, 2.5–4 × 1–1.5 µm. It is morphologically very similar to *T. filsonii* Elix, but the latter differs in having an amyloid medulla, a brown N- epihymenium and in containing 6-*O*-methylarthothelin and ± norstictic acid (Elix 2019a). *Tetramelas lokenensis* Elix from Antarctica has chemistry identical to that of *T. drakonensis* and an aeruginose, N+ purple epihymenium, but it has an amyloid medulla and does not develop elevated verrucules, nor do they become granular and compacted to form small cushion-like clumps (Elix 2019a).

At present this species is only known from the type locality. Associated lichens include *Candelariella flava* (C.W.Dodge & G.E.Baker) Castello & Nimis, *Buellia frigida* Darb., *Rinodina olivaceobrunnea* C.W.Dodge & G.E.Baker and *Usnea antarctica* Du Rietz.

***Tetramelas grevei*** Elix, sp. nov.  
Mycobank No.: **MB 836687**

Figs 3, 4

Similar to *Tetramelas grimmiae* (Filson) Elix, but differs in having a non-amyloid medulla and a brown, N- epihymenium.

*Type:* Antarctica, Enderby Land, Mt Gleadell [66°57'S, 50°27'E], 170 m alt., on moss and gravel in crevice between rocks, E. Greve 2321, 12.i.1980 (holotype – MEL).

*Thallus* crustose, granular to verruculose, to 30 mm wide and 2 mm thick; verrucules irregular, rounded, convex, 0.05–0.2 mm wide, contiguous and crowded; upper surface whitish brown to pale grey-brown, dull, epruinose; prothallus not apparent; photobiont cells 10–22 µm wide. *Medulla* white, lacking calcium oxalate (H<sub>2</sub>SO<sub>4</sub>-), I-. *Apothecia* 0.1–0.5 mm wide, lecideine, broadly adnate to sessile; disc dark brown to black, epruinose, plane to uneven with age. *Proper exciple* distinct, persistent, in section 25–35 µm thick; outer part dark brown, K-, N-, pale brown within. *Hypotheicum* 50–75 µm thick, brown to dark brown. *Epihymenium* 8–10 µm thick, brown to olive-brown or dark brown, K-, N-. *Hymenium* 75–85 µm thick, colourless, not interspersed; subhymenium 10–15 µm thick, pale brown. *Paraphyses* 1.5–2 µm wide, simple to sparsely branched, with apices 4–5 µm wide and brown caps. *Asci* *Bacidia*-type, 8-spored or sometimes with fewer spores. *Ascospores* initially *Physconia*- then *Buellia*-type, 1-septate, brown, ellipsoid to broadly fusiform, 12–[15.5]–18 × 5–[6.4]–8 µm, becoming constricted at the septum, sometimes curved, endosepta not seen; outer spore-wall finely ornamented (microrugulate). *Pycnidia* immersed, punctiform. *Conidia* bacilliform, 5–6 × 1 µm. *Chemistry:* Thallus K-, P-, C-, UV-; no lichen substances detected by TLC.

*Etymology:* The species is named after E. Greve, the collector of the type specimen.

### Remarks

The thalline, apothecial and ascospore morphology of the new species closely resemble those of the common Antarctic lichen *Tetramelas grimmiae*. While both species grow on similar

substrata and lack lichen substances, *T. grimmiae* differs in having a strongly amyloid medulla and an aeruginose-black epihymenium that reacts N+ purple or purple-brown (Øvstedal & Lewis-Smith 2001, 2004; Elix 2018).

At present the new species is only known from the type collection. Associated species were not recorded.

#### Key to *Tetramelas* in Antarctica

- 1 Thallus growing on soil, moss or bryophytes ..... 2  
 1: Thallus growing on rocks ..... 6
- 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 lacking lichen substances ..... **T. grevei**  
 4: Thallus containing lichen substances ..... 5
- 5 Thallus containing 6-*O*-methylarthothelin and norstictic acid ... **T. austropapillatus**  
 5: Thallus containing atranorin only ..... **T. papillatus**
- 6 Epihymenium aeruginose-black, N+ red-violet to purple-brown ..... 7  
 6: Epihymenium dark brown or dark olive-brown, N- ..... 10
- 7 Thallus containing atranorin or lacking lichen substances ..... 8  
 7: Thallus containing 6-*O*-methylarthothelin and ± atranorin ..... 9
- 8 Medulla strongly I+ blue-violet ..... **T. lokenensis**  
 8: Medulla I- ..... **T. drakonensis**
- 9 Thallus verrucose, thick (to 2 mm); medulla strongly I+ blue-violet; prothallus absent or poorly developed ..... **T. inordinatus**  
 9: Thallus rimose-areolate, thin (to 0.2 mm); medulla I- or weakly I+ purple; prothallus black, well developed ..... **T. nelsonii**
- 10 Thallus composed of small, cushion-like clumps 5–15 mm tall ... **T. cladocarpizus**  
 10: Thallus forming a crust up to 3 mm thick ..... 11
- 11 Ascospores commonly 3-septate or becoming submuriform ..... **T. granulatus**  
 11: Ascospores mainly 1-septate, ± with additional endosepta ..... 12
- 12 Arthothelin present; ascospores 16–24 × 6–10 µm ..... **T. anisomerus**  
 12: 6-*O*-Methylarthothelin present ..... 13
- 13 Ascospores 18–30 × 8–12 µm ..... **T. subpedicellatus**  
 13: Ascospores 12–21 × 6–10 µm ..... 14
- 14 Ascospores 12–17 µm long; norstictic acid often present ..... **T. filsonii**  
 14: Ascospores 15–21 µm long; norstictic acid absent ..... **T. darbshirei**

#### Acknowledgements

I thank the curators of MEL for their kind cooperation in providing a loan of the collections used in this study, and Mr Brendan Lepschi (CANB) for organizing the loan.

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Figure 1. *Teramelas drakonensis* (holotype in MEL). Scale = 1 mm.



Figure 3. *Tetramelas grevei* (holotype in MEL). Scale = 1 mm.

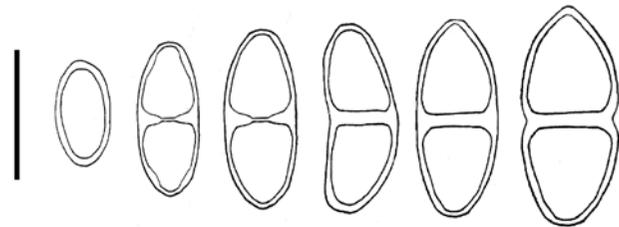


Figure 2. Ascospore ontogeny of *T. drakonensis* Scale = 10  $\mu$ m.

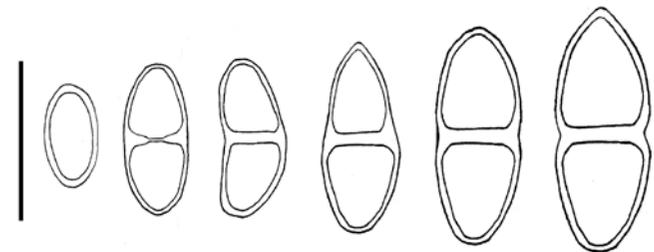


Figure 4. Ascospore ontogeny of *T. grevei*. Scale = 10  $\mu$ m.

## A new *Sclerococcum* (Dactylosporaceae, Ascomycota) on *Gloeocapsa* from Antarctica

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### Abstract

The new species *Sclerococcum gloeocapsae*, growing on the cyanobacterium *Gloeocapsa* sp. in Marie Byrd Land, Antarctica, is described and illustrated.

### Introduction

In the austral summer of 1987–1988, a combined geological and biological expedition was made to Edward VII Peninsula (77°00'–78°30'S, 152°–156°W), Marie Byrd Land. A general survey was made of algae, mosses, lichens and microfauna (Broady 1989) and of bird life (Broady *et al.* 1989). In total, 376 samples of lichens were collected at 23 nunataks in the Rockefeller and Alexandra Mountains. The collections are deposited at CHR. A few of the collections contain a black crust, identified as a *Gloeocapsa* species, of which five were found with apothecia. The apothecia proved to belong to an undescribed *Sclerococcum* species, which is documented below.

### Methods

Apothecial characteristics were examined by light microscopy on hand-cut sections mounted in 10% KOH or Lugol's reagent. Thallus sections were investigated in 10% KOH. Measurements of ascospores and paraphyses were made in 10% KOH. Hamathecial filaments are referred to as "paraphyses" regardless of their origin.

### New species

*Sclerococcum gloeocapsae* Øvstedal, Broady & Fryday, sp. nov. Figs 1–4  
Mycobank No.: MB 838543

*Type*: Antarctica. Marie Byrd Land, Edward VII Peninsula, Rockefeller Mountains, Mount Franklin (78°5'S, 154°57'W), *P.A. Broady s.n.*, xii.1987–i.1988 (holotype—CHR-647568).

Somatic stage as ramified, brown hyphae in colonies of cyanobacteria. *Apothecia* up to 0.8 mm wide, flat with a thin margin, brown-black, sessile to half-immersed. *Hymenium* pale brownish, 70–80 µm high, 1+ blue. *Asci* 30–32 × 7–8 µm, non-amyloid, clavate, no apical amyloid structures observed. *Paraphyses* c. 1.5 µm wide, ramified to slightly anastomosed, the end cell not enlarged. *Ascospores* 8 per ascus, brown, 3-septate, 19–21 × 5–6 µm, not constricted at the septa. *Hypothecium* brown, 50–60 µm high, pseudoparenchymatous. *Proper exciple* as an extension of the hypothecium. Below the hypothecium a 40–45 µm high zone of brown tissue, with cell walls darker brown, pseudoparenchymatous, with large cells, the individual cells 8–9 µm wide.

*Ecology*: growing in *Gloeocapsa* sp., which occurs as crustose, blackish mats, 3–4 cm wide, the colonies up to 30 µm diam. over moribund bryophytes and mineral soil. Mucilage slightly pink-purple, lamellate, the individual cells globose, 2–2.5 µm diam. Also, some filaments of *Stigonema* are found in the thalli, but they appear not to be associated with the hyphae.

### Remarks

The genus *Sclerococcum* Fr. (incl. *Dactylospora* Körb., see Diederich *et al.* 2018) includes approximately 60 species, mostly lichenicolous, but some at least partly saprophytic (Hafellner 1979; Triebel 1989). It is characterized above all by having brown, septate to submuriform ascospores, with black, apothecial ascomata and the asci with an external euamyloid gelatinous cap (Hafellner 1979; Elix *et al.* 2019). The present species more or less conforms to the description of the genus, except that an external euamyloid gelatinous cap of the asci is not developed, and the paraphysis tips are not enlarged and dark-capped. Olariaga *et al.* (2019) described the new genus *Pseudosclerococcum*, growing on wood, with many similarities to *Sclerococcum*, but differing in having cylindrical asci lacking a euamyloid gelatinous cap. A multigene phylogeny affirmed that both genera belong in Dactylosporaceae with *Pseudosclerococcum* basal to *Sclerococcum*. Unfortunately, the material of *S. gloeocapsae* is too old for molecular studies to be successful.

We originally intended to name our new species *Sclerococcum antarcticum*, but discovered that Alstrup *et al.* (2018) had described a new species *Dactylospora antarctica* Alstrup & Olech from the South Shetland Islands, which would have to be transferred to *Sclerococcum* as *S. antarcticum* (Diederich *et al.* 2018). Unfortunately, the authors failed to register any of the six new genera and 31 new species described in that paper, so none is validly published, and therefore the names are still available. However, anticipating that the authors will eventually rectify their omission and validate the names, as well as describe *D. antarcticum* in its correct genus, we decided not to use that epithet.

*Dactylospora antarcticum* nom. inval. differs from our new species in having 1-septate ascospores and being lichenicolous on a *Lecidea* sp. Alstrup *et al.* (2018) also mention a collection from the South Shetland Islands, which was lichenicolous on a *Pertusaria* sp., that they called *D. rostrupii* Alstrup (= *Sclerococcum rostrupii* (Alstrup) Ertz & Diederich). It was described from the Faroe Islands, where it occurred on *Pertusaria dactylina* (Ach.) Nyl. [= *Lepra dactylina* (Ach.) Hafellner], and has 3-septate ascospores of a length similar to those of *S. gloeocapsae* but significantly wider (19–25 × 8.5–11 µm; Alstrup *et al.* 1994). Most other *Sclerococcum* species with 3-septate ascospores have much shorter ascospores (<15 µm long), although those of *S. suburceolatum* (Fryday & Coppins) Ertz & Diederich (Fryday & Coppins 2012) are similar [(14–)17–21(–24) × (4.8–)6.0–7.0(–9.5) µm]; however, that species is also lichenicolous.

The symbiosis between the fungus and the *Gloeocapsa* colonies could be mutualistic, commensalistic or antagonistic (Hawksworth 1988). In this case, both partners seem to be thriving, so there is obviously no antagonism (parasitism). Whether the symbiosis is mutualistic or commensalistic is impossible to determine at this stage. That the fungus profits from chemical products from *Gloeocapsa* is obvious, but whether the cyanobacterium profits from exudates from the fungus cannot be proven. If we define a lichen as a symbiosis of a fungus and an alga/cyanobacterium where both profit from the symbiosis, this might be a primitive lichen, even if the fungal partner does not contribute to the thallus structure.

Cyanobacterial crusts are common in both the Antarctic and Arctic, and they are important soil binders (Williams *et al.* 2017). The presence of a symbiotic fungus and a possible primitive lichen is an interesting addition to the biodiversity of these habitats.

### ADDITIONAL SPECIMENS EXAMINED

Antarctica. ● Marie Byrd Land, Edward VII Peninsula, Rockefeller Mountains, Mount Franklin, nunatak, black crust over mineral soil, *P.A. Broady s.n.*, xii.1987–i.1988 (CHR-647569; CHR-647552; CHR-647556; CHR-647557).

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Figure 1. *Sclerococcum gloeocapsae*, holotype. Section of apothecium. Scale = 200  $\mu$ m.

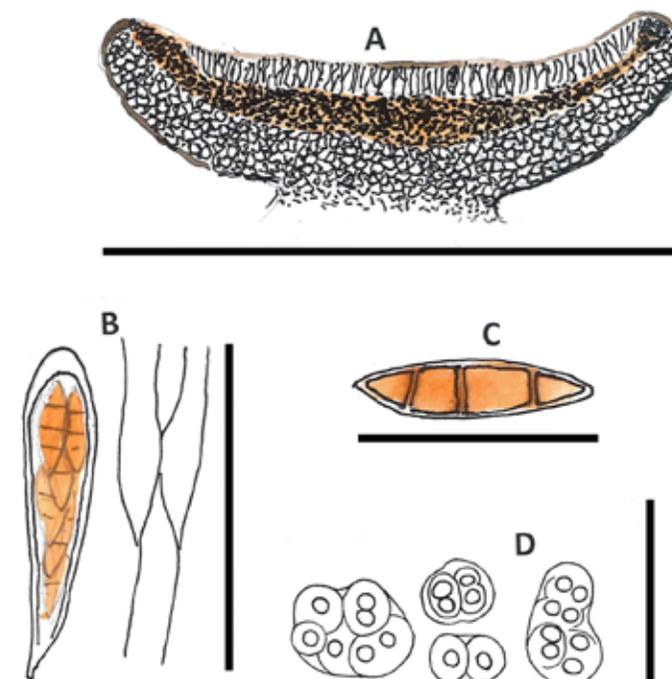


Figure 2. *Sclerococcum gloeocapsae*, holotype. A: section of apothecium; B: ascus and paraphyses; C: ascospore; D: cyanobacteria cells. Scales: A = 0.5 mm; B = 30  $\mu$ m; C = 20  $\mu$ m; D = 10  $\mu$ m.

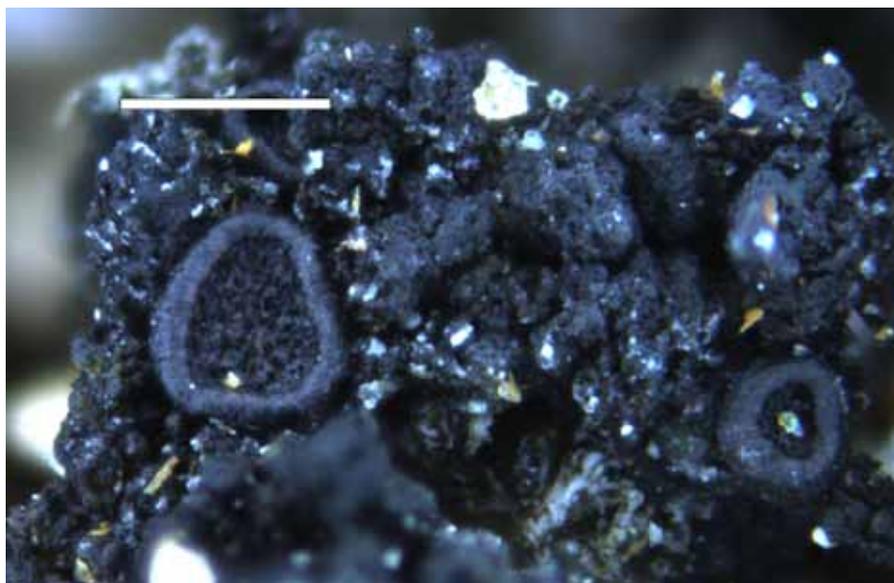


Figure 3. *Sclerococcum gloeocapsae*, holotype. Habit. Scale = 1 mm.

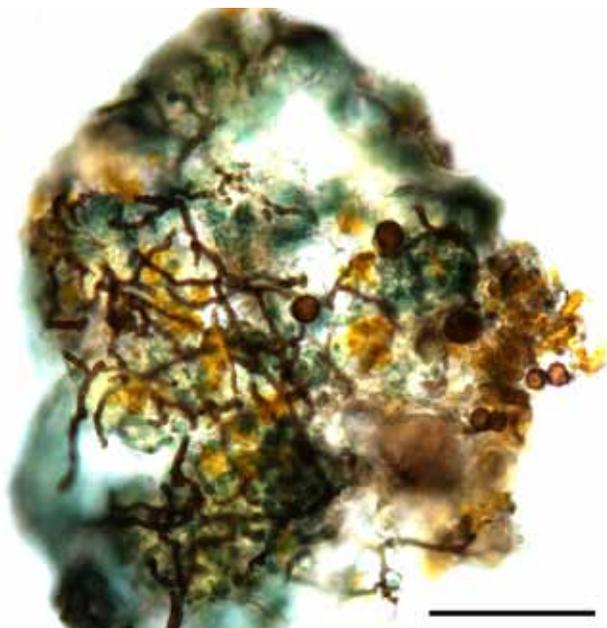


Figure 4. *Sclerococcum gloeocapsae*, holotype. Fungal hyphae in cyanobacterial colonies. Scale = 100  $\mu$ m.

**A new terricolous species of *Fellhaneropsis* (lichenized Ascomycota, Pilocarpaceae) from Papua New Guinea**

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**Abstract**

*Fellhaneropsis humicola* P.M.McCarthy is described from consolidated soil in montane rainforest in Morobe Province, Papua New Guinea. The new species has a pale, terricolous, crustose thallus that is corticate and lacks lichen substances, rather large, dark brown to blackish, adnate to sessile apothecia (the margin often a little paler and the excipulum partly K+ crimson-brown in section and leaching a yellowish, non-crystalline solution). The excipulum is predominantly dark brown and it is prosoplectenchymatous in section; the hypothecium is pale brown to pale golden brown, and the hyaline, narrowly ellipsoid to oblong-fusiform, 3-septate ascospores are 17–25  $\times$  5–8  $\mu$ m.

**Introduction**

*Fellhaneropsis* Sérus. & Coppins (Pilocarpaceae), a genus of ten species, is most reliably characterized and distinguished from *Fellhanera* Vězda by having apothecia with a proper excipulum of prosoplectenchymatous rather than paraplectenchymatous hyphae, and filiform rather than pyriform to bacilliform conidia, although not all of the described taxa are fertile or possess pycnidia (Sérusiaux 1996; Thor *et al.* 2000; Lücking *et al.* 2001; Øvstedal & Gremmen 2006, 2009; Kantvilas & Lücking 2009; Aptroot 2012; Ekman 2015; McCarthy *et al.* 2017). In this contribution, a new terricolous species is reported from montane rainforest in northern Papua New Guinea. Methods are as described in McCarthy *et al.* (2017).

***Fellhaneropsis humicola*** P.M.McCarthy, sp. nov.

Mycobank No.: **MB 838270**

Figs 1, 2

Characterized by the thin and very pale, terricolous thallus of smooth, interlocking areoles, green, globose algae, 7–10  $\mu$ m diam., a thin, prosoplectenchymatous cortex, and the absence of lichen substances. The apothecia are lecideine, adnate to sessile, (0.38–)0.72(–1.22) mm wide and dark greenish brown to blackish, also partly K+ crimson-brown in section and leaching a yellowish non-crystalline solution. The proper excipulum is cupulate, mainly dark brown and prosoplectenchymatous in section; epihymenium indistinct; hypothecium pale brown to pale golden brown; hymenium pale yellowish to pale brown; paraphyses simple, sparingly branched or distally anastomosing. Asci *Byssoloma*-type, (4–)8-spored; ascospores 3-septate at maturity, narrowly ellipsoid to oblong-fusiform, 17–25  $\times$  5–8  $\mu$ m.

*Type:* Papua New Guinea, Morobe Province, Angabena Ridge, Aseki–Bulolo road, 4 km NE of Aseki, 07°19'S, 146°13'E, alt. 1750 m, on consolidated soil of road bank in montane rainforest, *J.A. Elix 11956 & H. Streimann*, 4.xii.1982 (holotype – CANB 00677482).

*Thallus* crustose, superficial on consolidated soil, scattered or continuous and forming colonies up to c. 3 cm wide, white to very pale grey, 50–80(–100)  $\mu$ m thick, composed of tightly intertwined or interlocking lobe-like areoles (resembling minute jigsaw pieces), these smooth, plane to convex, internally 0.08–0.15(–0.2) mm in maximum extent, to 0.4 mm long and 0.1 mm wide at the thallus margin, non-amyloid (I–), not containing calcium oxalate ( $H_2SO_4$ –), *Cortex* prosoplectenchymatous, hyaline, 12–20  $\mu$ m thick; hyphae 1.5–2(–2.5)  $\mu$ m wide. *Algal layer* c. 50  $\mu$ m thick; cells green, globose, 7–10  $\mu$ m diam. *Medulla* poorly delimited; hyphae 1–2  $\mu$ m wide, thin-walled. *Prothallus* marginal, dark metallic grey and up to 1 mm wide, or not apparent. *Apothecia* very numerous, adnate to subsessile or sessile, lecideine, mostly solitary and rounded or shallowly lobate, (0.38–)0.72(–1.22) mm wide [ $n = 60$ ], partly K+ crimson-brown in section and leaching a yellowish non-crystalline solution; margin rather prominent, usually persistent and 70–100  $\mu$ m thick in surface view, or becoming almost

excluded about the largest and most convex, sessile apothecia, when present dull to slightly glossy, entire to flexuose, concolorous with or a little paler than the disc, somewhat darker than the disc when wetted; disc plane to slightly or moderately convex at maturity, occasionally strongly convex, dull dark greenish brown to brownish black, smooth, epruinose. *Proper excipulum* cupulate, ± prosoplectenchymatous, predominantly dark brown and 30–50(–60) µm thick laterally, including an outer, hyaline to pale brown zone [5–12(–20) µm thick laterally, 25–40(–50) µm thick at the base], the colour clearing in K and N, excipulum not impregnated with crystals; hyphae radiating, anastomosing and tightly conglutinate, rather thick-walled, to 10(–15) µm long, 2–4(–5) µm wide, the distalmost cells no broader than those immediately subtending them; basal excipulum predominantly dark brown, 85–110 µm thick. *Epithemium* indistinct, hyaline or pale yellowish to pale brown, clearing in K, N–. *Hypothecium* 30–50 µm thick, paraplectenchymatous, pale brown to pale golden brown, the colours intensifying in K and N, not interspersed with granules or oil globules. *Hymenium* 65–90 µm thick, pale yellowish to pale brown, not interspersed with granules or oil globules, KI+ dark blue, K–, N–. *Paraphyses* tightly conglutinate in water, loosening noticeably in K, simple to branched and with sparse to numerous anastomoses (mainly distally), long-celled, 1–1.5(–2) µm thick; apices neither swollen nor pigmented. *Asci* narrowly clavate or cylindroclavate, 75–88 × 12–18 µm [*n* = 10], (4–)8-spored, *Byssoloma*-type (see McCarthy *et al.* 2017; fig. 4). *Ascospores* colourless, overlapping-uniseriate to irregularly biseriata in the ascus, 3-septate at maturity, narrowly ellipsoid to oblong-fusiform, usually straight, occasionally a little bent, not constricted at the septa or slightly constricted at the primary septum when immature, (17–)20.5(–25) × (5–)6.5(–8) µm [*n* = 50], thin-walled, lacking a perispore; apices rounded to subacute; contents clear. *Pycnidia* not seen.

*Chemistry*: No lichen substances detected in the thallus or apothecia by TLC.

*Etymology*: The epithet *humicola* refers the new species growing on soil.

#### Remarks

Even in the absence of pycnidia with filiform conidia, the prosoplectenchymatous proper excipulum — combined with thalline and apothecial attributes such as the small, chlorococcoid photobiont, lecideine apothecia, variously branched and anastomosing paraphyses, *Byssoloma*-type asci and colourless, 3-septate ascospores — is, in my opinion, sufficient to confirm the new species as a *Fellhaneropsis* rather than, for example, being referable to broadly similar relatives such as *Fellhanera* or *Eugeniella* Lücking, Sérus. & Kalb (Sérusiaux 1996; Lücking 2008; Aptroot & Edwards 2009).

*Fellhaneropsis humicola* is characterized by the pale, terricolous, corticate thallus lacking lichen substances, comparatively large and dark apothecia that are distinctively pigmented, apothecial sections being partly K+ crimson-brown and leaching a yellowish non-crystalline solution, as well as rather broad 3-septate ascospores. Most of the ten previously known taxa of *Fellhaneropsis* are primarily corticolous or foliicolous. However, one species, the initially sterile *F. subantarctica* Øvstedal, was found on soil on Heard Island in the southern Indian Ocean (Øvstedal & Gremmen 2006), and subsequently as fertile thalli on dead *Azorella* in the Kerguelen Islands (Øvstedal & Gremmen 2009). Apothecia are up to 0.4 mm wide, with a pale grey-brown margin (prosoplectenchymatous in section) and a plane, dark brown disc; spores are 3-septate, 16–20 µm long and exceptionally narrow (2–2.5 µm wide; Øvstedal & Gremmen 2009).

The soil substratum supporting the type specimen is strongly compacted and so hard as to resemble some siliceous rocks. Consequently, comparison with the saxicolous, northern European *F. almquistiorum* S.Ekman is also appropriate. That species has a greenish, filmy thallus, much smaller apothecia, (0.2–)0.4(–0.6) mm wide, a dark brown to dark red-brown hypothecium and more elongate, mostly 3-septate ascospores (11–28 × 3–5.5 µm); the filiform conidia are 20–43 × 1–1.2 µm (Ekman 2015).

*Fellhaneropsis humicola* is known only from consolidated soil in rainforest at the type locality in northern Papua New Guinea.

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Figure 1. *Fellhaneropsis humicola* (holotype). Scale bars: 1 mm.

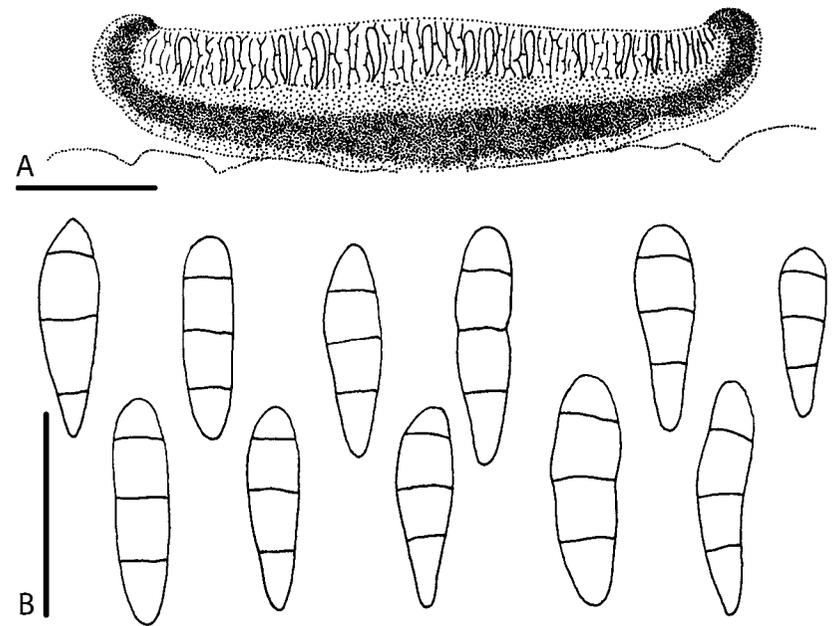


Figure 2. *Fellhaneropsis humicola* (holotype). A, Sectioned apothecium (semi-schematic); B, Ascospores. Scale bars: A = 0.2 mm; B = 20  $\mu$ m.

## A new species of *Diploschistes* (Graphidaceae) from consolidated soil in Australia

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### Abstract

*Diploschistes sarcogynoides* Elix & P.M. McCarthy sp. nov. (lichenized Ascomycota, Graphidaceae) is described from consolidated, siliceous soil in the Australian Capital Territory.

### Introduction

The genus *Diploschistes* Norman (1853), based on *Lichen scruposus* Schreb. [*Diploschistes scruposus* (Schreb.) Norman], includes lichens of the thelotrematioid Graphidaceae with a crustose thallus, a *Trebouxia*-type photobiont, perithecioid or urceolate ascomata with a carbonized proper exciple and lateral paraphyses, and the absence of a columella (Mangold *et al.* 2009). The asci are clavate to cylindrical, 1–8-spored, non-amyloid, with submuriform to muriform, colourless to brown ascospores, and bacilliform conidia (Lumbsch 1989; Mangold *et al.* 2009). Species can lack lichen substances or contain gyrophoric acid, lecanoric acid, diploschistic acid or related substances.

Sixteen species of *Diploschistes* have been reported from Australia (McCarthy 2020), 14 of which are widespread on soil and rocks in semi-arid areas around the world. Two species are Australian endemics, *D. elixii* Lumbsch & Mangold from siliceous soils in Western Australia and South Australia, and *D. microsporus* Lumbsch & Elix from siliceous rocks in inland New South Wales and Queensland. In this paper, *D. sarcogynoides*, from consolidated soil in the Australian Capital Territory, is described as new, and illustrated.

***Diploschistes sarcogynoides*** Elix & P.M. McCarthy, sp. nov.  
Mycobank No.: **MB 834954**

Fig. 1

Similar to *Diploschistes thunbergianus* (Ach.) Lumbsch & Vězda, but differs in lacking lichen substances and in having smaller apothecia, 0.5–0.7 mm wide, and longer ascospores, 19–40 µm long.

*Type*: Australia. Australian Capital Territory, Uriarra Road, 20 m E of Uriarra Crossing, 12 km W of Canberra, 35°14'35"S, 148°57'11"E, 460 m alt., on consolidated, siliceous soil adjacent to dry *Eucalyptus* woodland, *J.A. Elix 46907*, 12.ii.2020 (holotype – CANB; isotype – HO).

*Thallus* crustose, to 40 mm wide and 0.3 mm thick, rimose-areolate to verrucose-areolate, white, off-white or pale yellow-white; areoles roundish to irregular or angular, 0.2–0.5 mm wide, often with elevated margins; upper surface dull, coarsely pruinose and appearing granular; prothallus not apparent; vegetative propagules absent; medulla white, containing calcium oxalate (H<sub>2</sub>SO<sub>4</sub>+), I-. *Photobiont* green, of the *Trebouxia*-type, with individual cells 6–13 µm wide. *Apothecia* urceolate, common, 0.5–0.7 mm wide, irregularly roundish, immersed; disc visible from above, 0.3–0.5 mm wide, black, epruinose to weakly grey-white-pruinose. *Thalline margin* thin, ± rounded, concolorous with and having the same surface features as the thallus, immersed to slightly elevated. *Proper excipulum* 25–35 µm thick, dark brown, non-amyloid, N+ red-brown. *Hypothecium* 15–20 µm thick, colourless to pale brown. *Epihymenium* 10–15 µm thick, colourless to pale brown, granulate. *Hymenium* 100–160 µm thick, not interspersed, moderately conglutinated. *Paraphyses* 1.5–2 µm thick, simple, not expanded at apices. *Asci* I-, subclavate to cylindrical, 100–140 × 20–28 µm, (2–)4–8-spored. *Ascospores* broadly ellipsoidal, often subacute at one end, hyaline to brown, 19–[28.5]–40 ×

10–[12.6]–16 µm, with 3–5 transverse and 1–3 longitudinal septa; locules ± rounded to angular; septa thick, regular; ascospore wall thin; endospore thick. *Pycnidia* punctiform, brown, immersed; conidia bacilliform, 5–7 × 1–1.7 µm.

*Chemistry*: Thallus K-, P-, C-, UV-; no lichen substances detected by TLC (Elix 2014).

*Etymology*: The specific epithet alludes to the innate apothecia resembling those of certain species of *Sarcogyne* Flot. in very similar habitats.

### Remarks

Morphologically, *D. sarcogynoides* resembles diminutive forms of *D. thunbergianus* in that both species are terricolous on siliceous soils, have a pruinose upper surface, urceolate apothecia with black to weakly pruinose disc, 4–8-spored asci and muriform ascospores. *Diploschistes thunbergianus* differs in containing lecanoric and diploschistic acids, in having plane thallus areoles, larger apothecia, 1–1.5 mm wide, and shorter ascospores, 16–28 µm long (Mangold *et al.* 2009). *Diploschistes euganeus* (A. Massal.) J. Steiner also lacks lichen substances, but it grows on siliceous rocks and differs in having perithecioid apothecia, (6–)8-spored asci and shorter, broader ascospores, 16–32 × 10–20 µm (Mangold *et al.* 2009).

At present the new species is known only from the type locality where it grows in considerable abundance. Associated species include *Buellia suttonensis* Elix & A. Knight, *Candelariella vitellina* (Hoffm.) Müll. Arg., *Lecanora pseudistera* Nyl., *Lecidea terrena* Nyl. and *Xanthoparmelia tasmanica* (Taylor) Hale.

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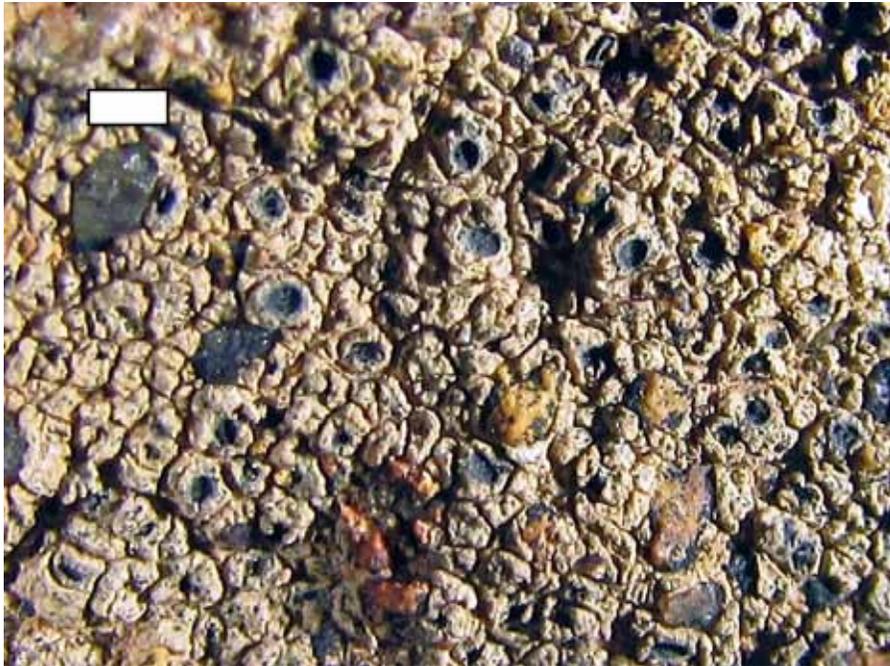


Figure 1. *Diploschistes sarcogynoides* (holotype). Scale: 1 mm.

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