Four new species of buellioid lichens (Caliciaceae, Ascomycota) from Australia

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Abstract
Amandinea meridionalis Elix from the Flinders Ranges in South Australia, *A. wagoorooensis* Elix from Carnarvon National Park in central Queensland, *Buellia gaahnabulensis* Elix from Mt Canobolas in central New South Wales, and *B. purdieae* Elix from southern Northern Territory and northern South Australia, are described as new to science.

Introduction
This paper continues my investigation of *Buellia*-like lichens in Australia. For the more recent additions see Elix (2020) and Elix & Kantvilas (2020) and references cited therein. In this paper, I describe two new species of *Amandinea* and two new species of *Buellia* in the broad sense. Methods are as described in the previous papers cited above.

New species

1. Amandinea meridionalis Elix, sp. nov. Fig. 1
MycoBank No.: **MB 840959**

Similar to *Amandinea montanensis* Elix & H.Mayrhofer, but differs in having shorter, straight, non-constricted *Buellia*-type ascospores, 9–14 µm long.

Type: Australia. South Australia, Flinders Ranges, Copley–Balcanoona road, 13 km E of Copley, 30°32'S, 138°31'E, 350 m alt., on rocks along ridge in chenopod shrubland, *J.A. Elix 18006 & L.H. Elix pr.p.*, 30.x.1984 (holotype – CANB).

Thallus crustose, to 40 mm wide and 0.25 mm thick, rimose to rimose-areolate; individual areoles contiguous to dispersed, angular, irregular, 0.2–1 mm wide; upper surface pale grey, matt; prothallus not apparent; medulla white, lacking calcium oxalate (H_2SO_4–), I–; photobiont cells 6–18 µm diam. *Apothecia* 0.1–0.5 mm wide, lecideine, broadly adnate, dispersed, rounded; disc black, epruinose, plane to convex. *Excipulum* thin, persistent or excluded in convex apothecia; in section 25–50 µm thick, the outer zone dark brown, K–, N–, inner zone pale brown. *Epihymenium* 8–12 µm thick, dark brown to brown-black, K–, N+ paler brown. *Hypothecium* deep red-brown, 50–70 µm thick, K–. *Hymenium* 50–60 µm thick, colourless, not inspersed; subhymenium 10–15 µm thick, colourless to pale brown, not inspersed. *Paraphyses* 1.2–1.5(–2) µm wide, sparsely branched, with apices 4–6.5 µm wide and dark brown caps. *Asci Bacidia*-type, 8-spored. *Ascospores Buellia*-type, brown, ellipsoid, 9–[*11.7*]–14 × 6–[*6.7*]–8 µm, straight, not constricted at the septum; outer spore-wall weakly ornamented. *Pycnidia* immersed; ostiole black. *Conidia* filiform, curved, 18–24 × 0.7 µm. *Chemistry*: Thallus K–, P–, C–, UV–; no lichen substances detected by TLC.

Etymology: The epithet *meridionalis* (L, southern), refers to the known Australian distribution of the new lichen.

Remarks
This species is characterized by the crustose, rimose-areolate, pale grey thallus, the broadly adnate, lecideine apothecia, the non-amyloid medulla, the 1-septate, *Buellia*-type ascospores, 9–14 × 6–8 µm, curved, filiform conidia, 18–24 µm long, and the absence of lichen substances. It is quite similar to *A. montanensis*, but that species has a thicker, often subsquamulose thallus

and longer, commonly curved, *Physconia*- then *Buellia*-type ascospores, 10–[*13.8*]–18 × 5–[*7.5*]–10 µm (Elix & Mayrhofer 2021).

Amandinea meridionalis is known from siliceous rocks in the Flinders Ranges in South Australia. Associated species include *Acarospora citrina* (Taylor) Zahlbr. ex Rech., *Buellia intergescens* Müll.Arg., *B. maficola* Elix, several *Caloplaca* species, *Circinaria contorta* (Hoffm.) A.Nordin and various *Xanthoparmelia* species.

ADDITIONAL SPECIMENS EXAMINED
South Australia. ● Flinders Ranges district, Main Road, 2 km W of Orroroo, 32°44'S, 138°35'E, on siliceous rock, *W.H. Ewers 7064 pr.p.*, *7073 pr.p.*, 20.vi.1990 (CANB).

2. Amandinea wagoorooensis Elix, sp. nov. Fig. 2
MycoBank No.: **MB 840960**

Similar to *Amandinea mountmeensis* Elix & H.Mayrhofer, but differs in having a squamulose to subsquamulose thallus with larger squamules, 1–3 mm wide, and a non-amyloid medulla that lacks calcium oxalate.

Type: Australia. Queensland, Wagooroo Creek, Carnarvon National Park, 94 km NNW of Injune, 25°02'S, 148°14'E, 520 m alt., on shaded boulder in *Eucalyptus* forest with well-developed shrub understorey, *H. Streimann 52169*, 21.viii.1993 (holotype – CANB; isotype – B, not seen).

Thallus squamulose to subsquamulose, to 70 mm wide and 0.5 mm thick; individual squamules irregular, 1–3 mm wide, often lobulate along margins or on the surface, lobules 0.1–0.3 mm wide; upper surface pale brown, matt; prothallus not apparent; medulla white, lacking calcium oxalate (H_2SO_4–), I–; photobiont cells 6–17 µm wide. *Apothecia* 0.5–1.2 mm wide, lecideine, broadly adnate to sessile and constricted at the base, dispersed; disc black, epruinose, plane to convex, ± distorted. *Excipulum* thin, excluded in older convex apothecia, in section 25–35 µm thick; outer zone brown, K–, N–, inner zone pale brown. *Epihymenium* 12–20 µm thick, brown, K–, N–. *Hypothecium* 75–125 µm thick, brown to dark brown, adjoining a central stipe, K–. *Hymenium* 100–125 µm thick, colourless, not inspersed; subhymenium 20–30 µm thick, pale brown, not inspersed. *Paraphyses* 1.5–2 µm wide, sparsely branched, with apices 3.5–5 µm wide and brown caps. *Asci* of the *Bacidia*-type, with 8 or fewer (4) spores. *Ascospores Physconia*- then *Buellia*-type, brown, ellipsoid, 16–[*19.5*]–24 × 9–[*10.9*]–14 µm, often with acute apices, older spores constricted at the septum; outer spore-wall rugulate. *Pycnidia* immersed; ostiole brown. *Conidia* filiform, curved, 14–22 × 0.7–1 µm.
Chemistry: Thallus K–, P–, C–, UV–; no lichen substances detected.

Etymology: The species is named after the type locality.

Remarks
This species is characterized by the squamulose to subsquamulose thallus, the squamules often becoming lobulate, a pale brown upper surface, the broadly adnate to sessile apothecia, the non-amyloid medulla which lacks calcium oxalate, a non-inspersed hymenium, the 1-septate, *Physconia*- then *Buellia*-type ascospores, curved, filiform conidia, 14–22 µm long, and the absence of lichen substances. Morphologically, it can resemble *A. mountmeensis* in that they both have similar-sized ascospores and conidia, but *A. mountmeensis* has a crustose to subsquamulose thallus composed in part of much smaller squamules, 0.1–0.4 mm wide, and an amyloid medulla that contains calcium oxalate (Elix & Mayrhofer 2020). The subsquamulose thallus of *A. wagoorooensis* can resemble some free-living forms of *Monerolechia badia* (Fr.) Kalb, but that species has smaller ascospores, 10–15 × 6–8 µm, and bacilliform conidia, 3–5 µm long (Elix 2011).

At present *A. wagoorooensis* is only known from the type collection. Associated species include *Dirinaria flava* (Müll.Arg.) C.W.Dodge, *Lecidella buelliastrum* (Nyl.) Knoph & Rambold, *Ramboldia sanguinolenta* (Kremp.) Kalb, Lumbsch & Elix and *Xanthoparmelia incerta* (Kurok. & Filson) Elix & J.Johnst.

3. Buellia gaahnabulensis Elix, sp. nov. Fig. 3
MycoBank No.: **MB 840961**

Similar to *Buellia poimenae* Elix & Kantvilas, but differs in having much smaller ascospores, 6–11 × 3–6 µm.

Type: Australia. New South Wales, Mt Canobolas, summit area, 13 km SW of Orange, 33°20'40"S, 148°58'56"E, 1390–1395 m alt., on volcanic rocks in area with scattered *Eucalyptus* and *Acacia*, *J.A. Elix 23458 pr.p.*, 6.xii.1989 (holotype – CANB).

Thallus crustose, to 25 mm wide and 0.5 mm thick, dark brown, chinky, areolate, the individual areoles irregular, angular, columnar, 0.4–1 mm wide; prothallus absent; medulla lacking calcium oxalate (H_2SO_4–), I– or I+ pale pink in part; photobiont cells 8–16 µm diam. *Apothecia* 0.1–0.5 mm wide, scattered, lecideine, immersed to broadly adnate; disc black, epruinose, weakly concave to plane. *Excipulum* distinct, elevated above the disc, persistent, in section 40–50 µm thick; outer zone dark brown to brown-black, K–, N+ orange-brown, inner zone paler brown. *Epihymenium* 8–12 µm thick, dark brown to brown-black, K–, N–. *Hypothecium* 45–55 µm thick, brown to dark brown, with a dark brown to brown-black central stipe, 140–150 µm thick, N+ intense red-brown. *Hymenium* 50–60 µm thick, colourless, not inspersed; subhymenium 10–15 µm thick, pale brown, not inspersed. *Paraphyses* 1.5–2 µm wide, simple to branched, with apices 5–6.5 µm wide and dark brown caps. *Asci Bacidia*-type, 8-spored. *Ascospores Buellia*-type, 1-septate, brown, broadly ellipsoid, 6–[*8.6*]–11× 3–[*4.6*]–6 µm, becoming constricted at the septum; outer spore-wall smooth to faintly ornamented when old. *Pycnidia* rare, punctiform, immersed; ostiole black. *Conidia* bacilliform, 5–7 × 0.7–1 µm.
Chemistry: Thallus K–, P–, C+ pink, UV–; containing gyrophoric acid.

Etymology: The species is named after the type locality, Gaahna-bula, the traditional name for Mount Canobolas. The name comes from two words in the local Wiradjuri language "gaahna" and "bula". This means "two shoulders" which refers to the summits of Mount Canobolas itself, and the subsidiary peak, Young Man Canobolas.

Remarks
The new species is characterized by the thick, dark brown, chinky-areolate crustose thallus, the non-amyloid medulla, the immersed to adnate lecideine apothecia, small broadly ellipsoid ascospores, 6–11× 3–6 µm, bacilliform conidia, 5–7 µm long, and the presence of gyrophoric acid. The Australasian *B. poimenae* also contains gyrophoric acid, but differs in having much larger *Physconia*- then *Buellia*-type ascospores, 11–[*15.1*]–20 × 6–[*8.4*]–11 µm, and elongate-bacilliform conidia, 5–15 µm long (Elix & Kantvilas 2013).

At present the new species is known only from the type locality, where associated species include *Amandinea montanensis* Elix & H.Mayrhofer, *Buellia aethalea* (Ach.) Th.Fr., *B. canobolasensis* Elix & P.M.McCarthy, *Lecanora farinacea* Fée, *Lecidella sublapicida* (C.Knight) Hertel and various *Xanthoparmelia* species.

4. Buellia purdieae Elix, sp. nov. Fig. 4
MycoBank No.: **MB 840962**

Similar to *Buellia suttonensis* Elix & A.Knight, but differs in having longer ascospores, 11–16 µm long.

Type: Australia, Northern Territory, West McDonnell National Park, Heavitree Range, Larapinta Trail section 9, base of hill area, 23°40'05"S, 134°47'17"E, 769 m alt., on rock, *R.W. Purdie 1589A*, 24.vi.2019 (holotype – CANB).

Thallus to 20 mm wide, endolithic and not apparent or epilithic, fragmentary and comprised of discontinuous corticate patches 0.2–0.5 mm wide and 100–200 µm thick at the base of apothecia, or in rock crevices; upper surface off-white, matt; prothallus not apparent; photobiont cells 8–19 µm wide; medulla when present lacking calcium oxalate (H_2SO_4–), I–. *Apothecia* 0.1–0.4 mm wide, abundant, lecideine, roundish, scattered, broadly adnate then sessile; disc black, epruinose, plane to markedly convex. *Excipulum* thin, excluded in older, convex apothecia, in section 25–40 µm thick; outer part brown-black, K–, N+ orange-brown, inner part brown. *Epihymenium* 10–13 µm thick, dark brown to olive-brown, N–. *Hypothecium* 80–150 µm thick, brown to dark brown. *Hymenium* 50–65 µm thick, colourless, not inspersed; subhymenium 15–20 µm thick, pale brown, not inspersed. *Paraphyses* 1–2 µm wide, sparingly branched, with apices 4–7 µm wide and brown caps. *Asci* 8-spored, *Bacidia*-type. *Ascospores Buellia*-type, 1-septate, pale brown then dark brown, ellipsoid, 11–[*13.4*]–16 × 5–[*6.3*]–9 µm, straight, rarely constricted at the septum; outer wall finely ornamented. *Pycnidia* rare, punctiform, superficial; ostiole black. *Conidia* bacilliform, 4–6 × 0.7–1 µm. *Chemistry*: Thallus K–, P–, C–, UV–; no lichen substances detected.

Etymology: The species is named after the botanist Dr Rosemary Purdie (Canberra), the collector of the type specimen.

Remarks
The endolithic or poorly developed, very thin, discontinuous thallus resembles the Australasian *B. suttonensis*, in that both species are dominated by abundant, broadly adnate to sessile apothecia, although the latter has shorter ascospores, 10–[*11.6*]–13 µm long (Elix & Knight 2017). Superficially, the species could also be confused with saxicolous specimens of *Amandinea punctata* (Hoffm.) Coppins & Schied., as they often have poorly developed thalli and similar-sized *Buellia*-type ascospores. However, in *A. punctata* the ascospores are commonly curved and the conidia are filiform, curved and 14–20 × 0.5–1 µm (Elix 2011).

The new species is known only from northern South Australia and southern parts of the Northern Territory, where it occurs on siliceous rocks in arid shrubland, in association with various *Caloplaca* and *Xanthoparmelia* species.

ADDITIONAL SPECIMENS EXAMINED
Northern Territory. ● Chandler Range, Henbury Station, near Rockhole Bore, 24°30’59”S, 133°27’08”E, 442 m alt., on rock overhang near base of steep rocky slope with a southerly aspect, *V. Stajsic 6646 pr.p.*, 22.v.2013 (CANB). *South Australia*. ● Flinders Ranges district, 2–3 km NW of Arkaroola Village, 30°18’S, 139°19’E, on siliceous rock, *W.H. Ewers 6969 pr.p.*, 9.iv.1990 (CANB); ● *loc. id*., *W.H. Ewers 6975 pr.p.*, 18.vi.1990 (CANB).

Correction

Buellia ecclesensis Elix, *Australas. Lichenol.* **81**, 33 (2017)

Type: Australia, Victoria, Victorian Volcanic Plain region, Mount Eccles, on rim near dry crater, 38°04’S, 141°56’E, on basalt, *W.H. Ewers 11*, 11.x.1986 (CANB – holotype).

Remarks
In the description of this species, I stated that it was characterized by the presence of atranorin and 2’-*O*-methylperlatolic acid, but that is incorrect. The type specimen has now been shown to contain atranorin and 2,5,7-trichloro-3-*O*-methylnorlichexanthone, and exhibits medullary reactions K+ pale yellow, C+ orange, P+ pale yellow and UV+ pale orange. This species would appear to be closely related to *Buellia subarenaria* Müll.Arg., but the latter differs in lacking calcium oxalate in the medulla.

SPECIMENS EXAMINED
Victoria. ● Volcanic Plain region, Pomborneit East Road, 2–4 km from main Warrnambool–Melbourne Hwy, 38°77’30”S, 143°21’E, *W.H. Ewers 1412*, 30.viii.1987 (CANB); ● Volcanic Plain region, Mount Eccles, near Natural Bridge, 38°04’S, 141°56’E, on basalt, *W.H. Ewers 38, 48, 49*, 11.x.1986 (CANB).

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References
Elix, JA (2011): *Australian Physciaceae* (*Lichenised Ascomycota*). Australian Biological Resources Study, Canberra. Version 18 October 2011. http://www.anbg.gov.au/abrs/lichenlist/PHYSCIACEAE.html
Elix, JA (2020): Ten new species and two new records of buellioid lichens (Physciaceae, Ascomycota) from Australia and Norfolk Island. *Australasian Lichenology* **87**, 3–19.
Elix, JA; Kantvilas, G (2013): New taxa and new records of *Buellia sensu lato* (Physciaceae, Ascomycota) in Australia. *Australasian Lichenology* **73**, 24–44.
Elix, JA; Kantvilas, G (2020): Three new species and a new record of buellioid lichens (Caliciaceae, Ascomycota) from Tasmania. *Australasian Lichenology* **87**, 20–25.
Elix, JA; Knight, A (2017): Three new species of buellioid lichens (Caliciaceae, Ascomycota) from Otago, South Island, New Zealand. *Australasian Lichenology* **81**, 86–92.
Elix, JA; Mayrhofer, H (2020): Four new species and a new record of buellioid lichens (Caliciaceae, Ascomycota) from Australia. *Australasian Lichenology* **86**, 62–69.
Elix, JA; Mayrhofer, H (2021): Two new species and four new records of buellioid lichens (Caliciaceae, Ascomycota) from Australia. *Australasian Lichenology* **89**, 16–26.

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

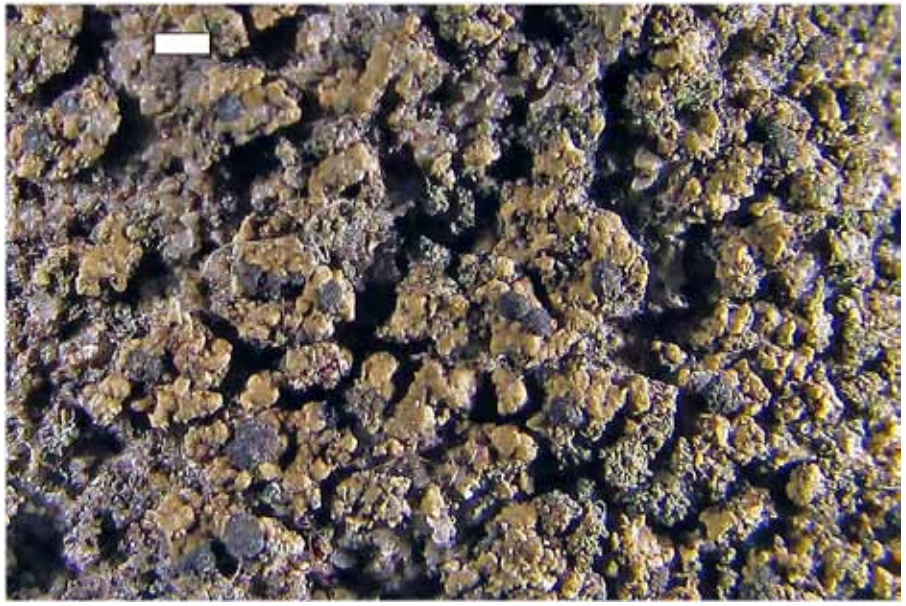

Figure 2. *Amandinea wagoorooensis* (holotype in CANB). Scale = 1 mm.

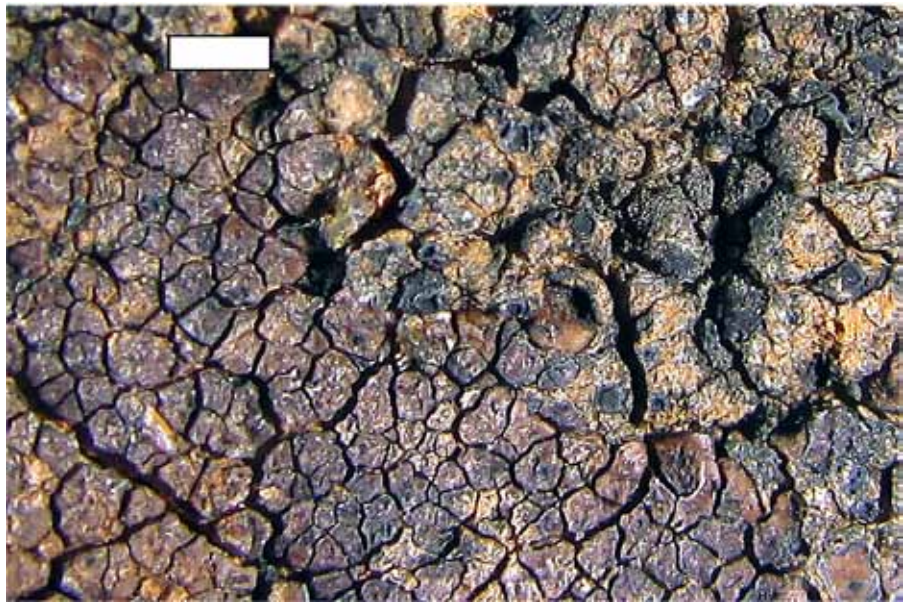

Figure 3. *Buellia gaahnabulensis* (holotype in CANB). Scale = 1 mm.

Figure 4. *Buellia purdieae* (holotype in CANB). Scale = 1 mm.