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Additions to the genus *Lecidella* (lichenised Ascomycetes: Lecanoraceae)

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Abstract

Two new taxa in *Lecidella* Körb. are described: *L. leucomarginata* Kantvilas & Elix, from Kangaroo Island (South Australia) and south-western Western Australia and *L. granulosula* var. *lecanorina* Kantvilas & Elix, from Kangaroo Island (South Australia) and the coast of southern New South Wales. Both display the unusual feature of an unpigmented proper excipulum, densely inspersed with crystals. A key to *Lecidella* in temperate Australia is presented.

Keywords: biodiversity, Kangaroo Island, *Lecidea*, lichens, temperate Australia.

Introduction

Lecidella Körb. is a genus of lichens characterised by a crustose thallus containing a trebouxioid photobiont, biatorine, typically dark coloured apothecia with a persistent proper excipulum composed of radiating thick-walled hyphae, clavate, amyloid, eight-spored asci referred to as *Lecidella*-type (Hafellner 1984; Fig. 2), an hymenium that typically separates readily in KOH, simple, hyaline, non-halonate ascospores, and curved, filiform conidia; thallus chemistry is dominated by xanthones in the majority of species (Fletcher et al. 2009; Kantvilas & Elix 2013). With 12 species (McCarthy 2014), *Lecidella* is well-represented in the Australian lichen flora, occurring mostly in temperate latitudes on rock, bark or wood. The eight Tasmanian species were recently revised by Kantvilas & Elix (2013), who also studied comparative material from elsewhere in southern Australia. Morphological and anatomical relationships with superficially similar genera, such as *Japewiella* Printzen, *Carbonea* (Hertel) Hertel, *Tasmidella* Kantvilas, Hafellner & Elix and others, were discussed therein and are not repeated here. In this paper, we describe two further taxa from temperate latitudes.

Methods

The study is based chiefly on collections of the authors, housed in the Tasmanian Herbarium (HO) and the Australian National Herbarium (CANB). Descriptions are based on hand-cut sections of the thallus and ascomata examined with high-power light microscopy. Mounting media included water, 15% KOH (K), Lugols Iodine after pretreatment with K (IKI), ammoniacal erythrosin and 50% HNO_3 (N). Dimensions of asci and ascospores are based on 30 and 70 observations respectively. The latter are presented in the format: 5th percentile–*average*–95th percentile; outlying extreme values are given in parentheses. Chemical constituents were identified by thin layer chromatography (Elix & Ernst-Russell 1993) and comparison with authentic samples. Nomenclature of pigments follows Meyer & Printzen (2000).

Taxonomy

Lecidella leucomarginata* Kantvilas & Elix, *sp. nov.

Lecidellae flavovirenti *Kantvilas & Elix fortasse similissima, sed sorediis destitutis, excipulo proprio hyalino vel pallide griseo, pigmentum deficienti, sed crystallis insperso, et ascosporis aliquantum parvioribus, 10–15 µm longis, 6–8 µm latis, differt.*
Mycobank No.: MB810540.
Typus: South Australia. Kangaroo Island, Western Cove, 35°44'S 137°35'E, 0.5 m alt., on bleached dead wood of *Melaleuca* in salt marsh, 27 Sep. 2013, *G. Kantvilas 234/13* (holo: HO; iso: AD, BM).

Thallus crustose, effuse, bright lemon-yellow, rimose-areolate, esorediate, lacking a prothallus, forming irregular, undelimited patches to 12 cm wide or more, 0.25–1 mm thick; individual areoles with upper surface unevenly verruculose and with edges mostly lifting from the substrate; photobiont cells globose, 6–18 µm diam. *Apothecia* biatorine, abundant, 0.5–1.3 mm wide, sessile, basally constricted to adnate, sometimes sunken in the thallus surface, scattered and roundish, or crowded, misshapen and fused together; disc plane at first, soon becoming convex, grey-black

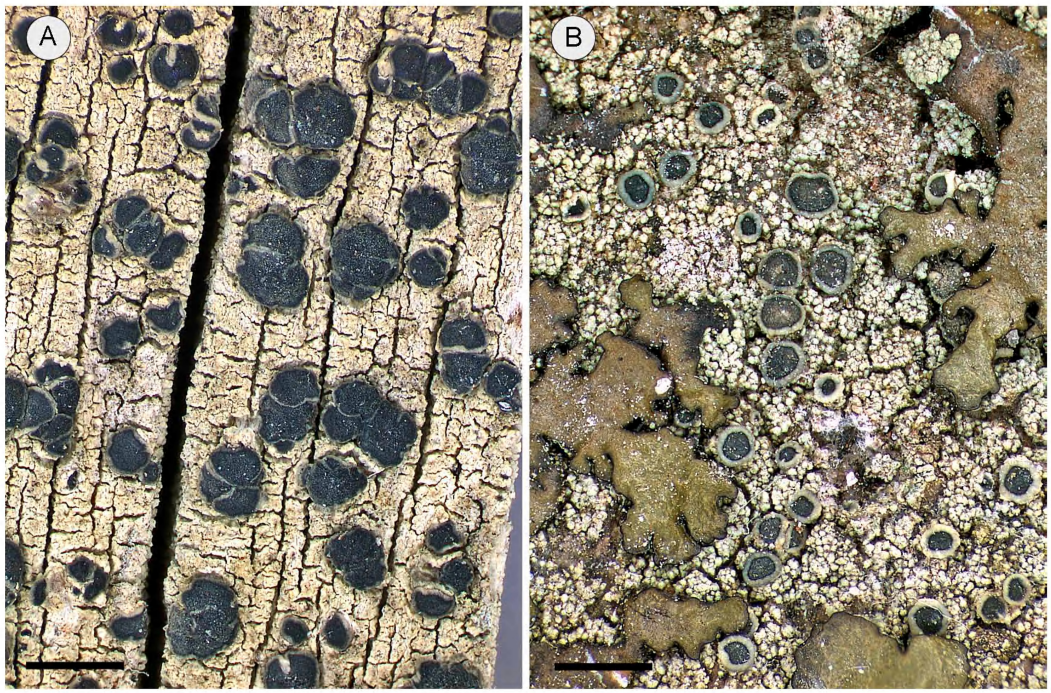

Fig. 1. Habit of new *Lecidella* taxa. **A *L. leucomarginata***; **B *L. granulosula*** var. ***lecanorina***. Scale bar: 1 mm. — **A** *G. Kantvilas 234/13* (holotype), **B** *G. Kantvilas 375/13* (holotype).

to bluish black to jet black, sometimes a little mottled, matt, epruinose. *Proper excipulum* colourless to pale grey or yellowish grey, rarely dark grey, sometimes piebald, glossy, sometimes a little flexuose, persistent but increasingly less obvious in older, more convex apothecia, sometimes with adhering thallus fragments, in section 25–60 µm thick, lacking blue-green pigments, composed of radiating, branched hyphae 3–5 µm thick, densely inspersed, especially towards the outer edge, with minute, yellowish brown to reddish brown crystals that fluoresce yellow in polarised light and dissolve fleetingly yellowish in K. *Hypothecium* 80–150 µm thick, colourless to pale yellow-brown, occasionally yellowish orange, more intensely coloured towards the base, intensifying yellow-orange in K and N, sometimes inspersed with scattered oil droplets. *Hymenium* 60–70 µm thick, separating readily in K, in the upper part usually dilutely greenish blue, K ± grey-green, N+ crimson and overlain by yellowish brown crystals that dissolve in K, towards the base mostly colourless. *Asci* 45–55 × 12–20 µm, of the *Lecidella*-type. *Paraphyses* 1.5–2 µm thick, sparsely branched; apices not markedly capitate, sometimes expanded to 2.5–4 µm, unpigmented or with a thin internal cap and a faint external blush of blue-green, N+ crimson pigment. *Ascospores* hyaline, (9–) 10–*12.4*–15 (–16) × (5.5–) 6–*6.8*–8 µm, broadly ellipsoid to oblong. *Conidiomata* pycnidia, black, emergent, resembling apothecial initials, in section with wall blue-green, N+ crimson; conidia thread-like, curved, 15–20 × 1 µm. **Fig. 1A.**

Chemical composition. Thiophanic acid (major), 3-*O*-methylthiophanic acid (± minor), atranorin (± minor), chloroatranorin (± minor), arthothelin (± minor or trace); thallus K–, C+ orange, KC–, P–, UV+ orange.

Etymology. The specific epithet refers to the distinctive colourless proper excipulum of the apothecia of this species.

Remarks. This is a distinctive and remarkable species on account of its colourless proper excipulum, a feature also seen in *L. granulosula* var. *lecanorina* (described below). One of the defining generic characters of *Lecidella* is the black apothecial margin, comprised of radiating, thick hyphae coated in dark pigments and becoming swollen and almost parenchymatous towards the outer edge (Kantvilas & Elix 2013). In that regard, *L. leucomarginata* might appear to be misplaced in *Lecidella*. Yet, all the other salient characters, notably the anatomy of the thallus, its chemical composition consisting of xanthones, the distinctive ascus type, the hymenium that separates readily in KOH, the hyaline, broadly ellipsoid ascopores and the thread-like, curved condia, are consistent with *Lecidella*. Indeed, on close inspection, the anatomy of the excipulum can also be interpreted as being of the *Lecidella*-type, except that instead of being swollen with pigment, the hyphae are densely inspersed with crystals. However, there is no hint of any development of a parenchyma at the outer edge. Traces of blue-green (*cinereorufa*-green) pigment, characterisitic of most *Lecidella* species, can be detected in the hymenium by the application of HNO_3

which yields a crimson reaction. Perhaps the most likely alternative generic placement for this species that was considered was *Japewiella*. However, this genus has a very distinctive excipulum composed of a loose reticulum of radiating, branched and anastomosing hyphae c. 1 µm thick in a gelatinous matrix (Printzen 1999; Kantvilas 2011).

In the Australian flora, this new species appears to be most closely related to *L. flavovirens* Kantvilas & Elix, a corticolous species that likewise has a bright lemon-yellow thallus containing thiophanic acid as the major constituent, but which differs chiefly in becoming entirely sorediate. These species differ further in that *L. flavovirens* has unequivocally black apothecia, and although the proper excipulum lacks blue-green pigment, it is constructed in the typical *Lecidella* way, with the hyphae instead swollen with a dark brown pigment. In addition, the ascospores of *L. flavovirens* are also slightly longer and broader: (12–) 13–17 (–18) × (6–) 7–10 µm (Kantvilas & Elix 2013).

Ecology and distribution. On Kangaroo Island, this new species is known only from the type locality, where it was collected from remnant, fire-killed, bleached *Melaleuca* stags (several metres tall) in a salt marsh. The site is extremely degraded by draining, burning, some clearing and stock grazing. The habitat of this *Lecidella* is very species poor with respect to lichens and the only other species with which it was associated was *Ramboldia crassithallina* Kalb, a common lignicolous lichen on Kangaroo Island. In the near vicinity of the type locality where living individuals of *Melaleuca* remain, the epiphytic flora is richer and includes species of *Ramalina, Usnea, Lecanora* and *Parmotrema*, but no *Lecidella* was encountered. *Lecidella leucomarginata* also occurs in south-western Western Australia where it grows on the bark of *Acacia* and *Melaleuca* in open, dry sclerophyll woodland. Here associated species included *Austroparmelina pruinata* (Müll. Arg.) A.Crespo, Divakar & Elix, *Baculifera xylophila* (Malme) Marbach, *Buellia reagenella* Elix, *Flavoparmelia rutidota* (Hook.f. & Taylor) Hale, *Haematomma eremaeum* R.W.Rogers, *Lecanora caesiorubella* Ach., *Pertusaria subarida* A.W.Archer & Elix, *Punctelia subalbicans* (Stirt.) D.J.Galloway & Elix and *Ramalina inflata* subsp. *australis* G.N.Stevens.

Additional specimens examined

Western Australia. Wotto Nature Reserve, First North Road, 21 km NE of Eneabba, 29°42'29"S 115°24'37"E, 275 m alt., 5 May 2004, *J.A. Elix 28868* (CANB, HO, PERTH); same locality, 5 May 2004, *J.A. Elix 28875* (CANB); Gwambygine Nature Reserve, 11 km S of York, 31°58'24"S 116°48'38"E, 245 m alt., 4 Apr. 2006, *J.A. Elix 31756*, *37406* (CANB); Walebing, Quarrell Range, Moora-New Norcia Road, 22 km S of Moora, 30°41'38"S 116°12'20"E, 275 m alt., 2 Apr. 2006, *J.A. Elix 37549* (CANB); Fourteen Mile Brook Nature Reserve, 13 km NW of Narrogin along Wandering Road, 32°50'08"S 117°06'07"E, 335 m alt., 6 Apr. 2006, *J.A. Elix 43229* (CANB).

Lecidella granulosula* var. *lecanorina* Kantvilas & Elix, *var. nov.

Respectu praesentiam chodatini, hypothecium incoloratum et ascosporas 9.5–14.5 µm longas, 5–7.5 µm latas, varietati granulosulae *similis, sed excipulo proprio hyalino vel pallide griseo, pigmentum destituto, crystallis flavo-brunneis dense insperso differt.*

Mycobank no.: MB810541.

Typus: South Australia. Kangaroo Island, Creek Bay Farm, 35°50'S 138°06'E, 85 m alt., on rock in mallee woodland, 12 Sep. 2013, *G. Kantvilas 375/13* (holo: HO).

Thallus crustose, pale yellowish grey to greyish green, minutely granular, esorediate, lacking a prothallus, forming small, irregular, undelimited "islands" 2–3 cm wide amongst other lichens; individual granules mostly 0.05–0.1 mm wide, dispersed or contiguous; photobiont cells globose, 6–18 µm diam. *Apothecia* biatorine, 0.4–0.7 mm wide, sessile, basally constricted, scattered, roundish; disc plane at first, soon becoming undulate or convex, grey to brownish grey to grey-black, sometimes a little mottled, matt, epruinose. *Proper excipulum* colourless to pale grey or yellowish grey, sometimes partly or wholly dark grey, glossy, persistent, in section 40–60 µm thick, lacking blue-green pigments, composed of radiating, branched hyphae 4–5 µm thick, densely inspersed, especially towards the outer edge, with minute, yellowish brown to reddish brown crystals that fluoresce yellow in polarised light and dissolve to form a pale yellow solution in K. *Hypothecium* 50–100 µm thick, colourless to pale yellow-orange especially at the base, intensifying yellow-orange in K and N, not inspersed. *Hymenium* 50–75 µm thick, mostly separating readily in K, in the upper part overlain by a thick layer of yellowish brown granules that dissolve in K, usually also with patches of greenish blue, K ± grey-green, N+ crimson pigment, especially adjacent to the excipulum, towards the base mostly colourless. *Asci* 50–60 × 12–20 µm, of the *Lecidella*-type. *Paraphyses* 1–2 µm thick, mainly simple, occasionally sparsely branched towards the apices; apices variable, not capitate or expanded to 3.5–4.5 µm, unpigmented or with the apical cell with an internal, blue-green cap, and the subterminal cell faintly blue-green, N+ crimson. *Ascospores* hyaline, (8–) 9.5–*11.8*–14.5 (–16) × 5–*6.4*–7.5 (–8) µm, broadly ellipsoid to oblong. *Conidiomata* not seen. **Fig. 1B, 2.**

Chemical composition. Chodatin (major), isoarthothelin (minor), thiophanic acid (minor), 2,5,7-trichlorolichexanthone (minor); thallus K–, C+ orange, KC–, P–, UV+ orange.

Etymology. The infraspecific epithet alludes to the fact that the apothecia, with their pale coloured proper exciple, somewhat resemble those of a *Lecanora*.

Remarks. The granular to areolate thallus containing chodatin as a major compound (an uncommon substance, not least in *Lecidella*), the predominantly colourless hypothecium and the relatively small ascospores indicate unequivocally that this new lichen is closely

Key to *Lecidella* in temperate Australia[1]

1. Growing on rock or on bryophytes overgrowing rock
  2. Hypothecium yellow-brown to dark brown, with the colour intensifying in K and N
    3. Vicanicin present; diploicin and thuringione absent ..... ***L. sublapicida***
    3: Vicanicin absent; diploicin and thuringione present ..... ***L. carpathica***
  2: Hypothecium colourless or at most pale yellowish brown at the base
    4. Thallus rimose-areolate, usually containing atranorin (K+ yellowish) together with other compounds
      5. Thallus areoles rather lumpy and verruculose, lacking a prothallus, containing atranorin and zeorin (sometimes only in trace amounts); apothecia 0.4–1.5 mm wide; mostly on calcareous or nutrient-enriched substrata ..... ***L. stigmatea***
      5: Thallus areoles ± plane, growing on a blackish, effuse prothallus; apothecia to 0.8 mm diam.; on siliceous substrata
        6. Diploicin and/or caloploicin, ± thiophanic acid present; arthothelin and thuringione absent ..... ***L. buelliastrum***
        6: Diploicin, caloploicin and thiophanic acid absent; arthothelin and thuringione present ..... ***L. enteroleucella***
    4: Thallus granular, lacking atranorin but containing chodatin
      7. Proper excipulum black, in section densely infused with blue-green pigment and lacking crystals .. .. ***L. granulosula*** var. ***granulosula***
      7: Proper excipulum colourless to pale yellowish grey or mottled dark grey, in section lacking blue-green pigment but densely inspersed with crystals that dissolve pale yellow in KOH . ***L. granulosula*** var. ***lecanorina***
1: Growing on bark or wood
  8. Thallus not sorediate
    9. Thallus containing atranorin only (C–); hymenium inspersed with oil droplets and crystals that do not dissolve in K ..... ***L. destituta***
    9: Thallus containing xanthones (C+ orange); hymenium not inspersed, or at most with an epihymenial layer of granules that dissolve in K
      10. Hypothecium colourless to pale brownish; apices of paraphyses with an *internal* cap of pigment ..... ***L. xylogena***
      10: Hypothecium pale yellow-brown to yellow-orange, colour intensifying in K; apices of paraphyses unpigmented or with an *external* cap of blue-green, N+ crimson pigment
        11. Ascospores 15–24 × 8–13 µm; excipulum in section mainly opaque brown, with blue-green, N+ crimson pigment at the edges ..... ***L. montana***
        11: Ascospores 9–15 × 5–8 µm; excipulum in section mainly colourless to dilute brown, with blue-green, N+ crimson pigment at the edges ..... ***L. elaeochroma***
  8: Thallus sorediate
    12. Proper excipulum colourless to pale yellowish grey or mottled dark grey, in section lacking blue-green pigment but densely inspersed with crystals that dissolve pale yellow in KOH ..... ***L. leucomarginata***
    12: Proper excipulum black, in section lacking crystals, opaque dark brown or with blue-green pigment.
      13. Ascospores 12–18 × 6–10 µm; apices of paraphyses unpigmented or with an *external* cap of blue-green, N+ crimson pigment; excipulum in section opaque dark brown, lacking blue-green pigment; soredia arising in discrete soralia ..... ***L. flavovirens***
      13: Ascospores 7–14 × 4.5–9 µm; apices of paraphyses with an *internal* cap of pigment; excipulum in section grey-green to pale brownish, usually with blue-green pigment towards the outer edge; soredia not in discrete soralia, arising from a dissolution of the thallus ..... ***L. xylogena***

[1] Australian records of *L. asema* (Nyl.) Knoph & Hertel (Elix 2008, 2010) are misdeterminations of *L. flavovirens*.

related to *L. granulosula* (Nyl.) Knoph & Leuckert as delimited and described by Kantvilas & Elix (2013), and by Knoph (1990) and Rambold (1989) (under its synonym *L. chodati*). Yet the pale, unpigmented proper excipulum of the specimens studied is so distinctive and visually striking, and unusual for the genus as a whole (see also discussion under *L. leucomarginata* above) that we feel that they deserve taxonomic recognition. Specimens of var. *granulosula* invariably contain *cinereorufa*-green pigment in their excipulum, which is constructed of radiating, swollen hyphae typical of *Lecidella*. The new variety instead has a totally unpigmented excipulum which is densely inspersed with crystals, identical to what is displayed by *L. leucomarginata*. In his discussion of *L. granulosula* (as *L. chodati*), Knoph (1990) mentions that crystals are seen "occasionally", but he makes no mention of crystals being correlated with an absence of pigment or that he saw any specimens with an unpigmented excipulum. No crystals were observed in any Australian specimens of var. *granulosula* studied; we were unable to study any non-Australian material. In several species of *Lecidella*, specimens from exposed habitats tend to have more intensely pigmented apothecia. In the case of var. *lecanorina*, specimens from exposed habitats certainly have darker apothecial discs, but this does not translate into a higher concentration of blue-green pigment; the amount of pigmentation tends to be ± constant across all specimens, with most of the darker coloration of the disc deriving from crystals, and the blue-green pigment being very dilute and located mainly in that part of the epihymenium adajcent to the excipulum.

In Tasmania, there is a further, undescribed saxicolous taxon with an unpigmented excipulum.

This species has a well-developed, yellowish, areolate thallus containing atranorin, 2,5,7-trichloro-3-*O*-methylnorlichexanthone (both major) plus zeorin and isoarthothelin (minor). It grows in sheltered underhangs in dry sclerophyll forest. We have excluded it from this study pending further collections.

Ecology and distribution. This new variety is known from South Australia (Kangaroo Island) and the coast of southern New South Wales, and this widely disjunct distribution suggests that it is probably more widespread, albeit inconspicuous and overlooked. It has been recorded from sheltered aspects on coastal rocks (chiefly sandstone and laterite) where it grew in rather nutrient-enriched conditions, together with *Buellia aeruginosa* A.Nordin, Owe-Larsson & Elix, *Candelariella vitellina* (Hoffm.) Müll.Arg., *Halecania subsquamosa* (Müll. Arg.) van den Boom & Mayrhofer, *Lecanora dispersa* (Pers.) Sommerf., *Verrucaria fusconigrescens* Nyl., *Xanthoria ligulata* (Körb.) P.James and species of *Caloplaca* and *Amandinea*. The type specimen is from a more inland locality in dry lowland woodland, where it grew beneath a canopy of mallee eucalypts, associated with *Xanthoparmelia subprolixa* (Nyl. ex Kremp.) O. Blanco et al. and species of *Caloplaca*.

Additonal specimens examined

South Australia. Kangaroo Island, northern end of Antechamber Bay, 35°46'S 138°04'E, 5 m alt., 22 Sep 2013, *G. Kantvilas 264/13* (HO).

Jervis Bay Territory. Bristol Point, 35°08'S 159°44'E, 1 m alt., 17 Nov 2012, *G. Kantvilas 606/12* (HO).

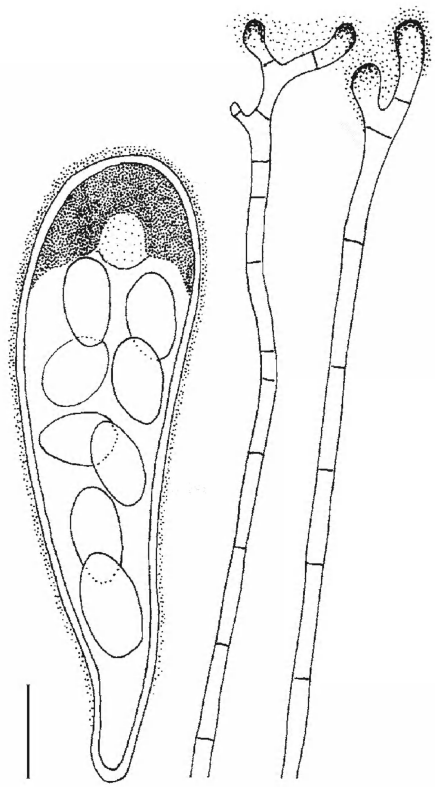

Fig. 2. The *Lecidella*-type ascus (with amyloid portions stippled), ascospores and paraphyses (with pigmented areas stippled), as exemplified by ***Lecidella granulosula*** var. ***lecanorina***. Scale bar: 10 µm. — *G. Kantvilas 375/13* (holotype).

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