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Further additions to the lichen genus *Ramboldia* (Lecanoraceae) from Australia

Gintaras Kantvilas

Tasmanian Herbarium, Tasmanian Museum and Art Gallery, P.O. Box 5058, UTAS LPO, Sandy Bay, Tasmania 7005, Australia; email: Gintaras.Kantvilas@tmag.tas.gov.au

Introduction

The genus *Ramboldia* was first introduced by Kantvilas & Elix (1994) to accommodate five species of saxicolous, lignicolous or corticolous Australasian species of lecideoid crustose lichens. These authors (*loc. cit.*) noted the apparent close relationship of *Ramboldia* to the genus *Pyrrhospora* (*sensu* Hafellner 1993), in particular with respect to the structure of the ascus and the size and shape of the ascospores. The two genera differed primarily in the absence of anthraquinone pigments in the former (Kantvilas & Elix 1994; Elix & Kantvilas 2005). Subsequently further species were added to *Ramboldia*, not only from Australasia (Kalb 2001, 2004; Kantvilas & Elix 2007) but also from other parts of the world; for example, Thailand (Kalb *et al.* 2009), India (Upreti *et al.* 2009) and North America (Lendemer & Harris 2011). Whereas some represented discoveries of species new to science, others were examples of rather well-known species that were transferred from other genera; for example, *R. elabens* (Fr.) Kantvilas & Elix (Kantvilas & Elix 2007) and *R. insidiosa* (Th.Fr.) Hafellner (Hafellner & Türk 1995). A major advance in the understanding of the limits and relationships of the genus came with the study of Kalb *et al.* (2008) who, on the basis of DNA sequence data, demonstrated that *Pyrrhospora* was heterogeneous, and transferred most species ascribed to that genus to *Ramboldia*. Thus *Ramboldia* today includes species either with or without anthraquinones, all united essentially by having a crustose thallus with a unicellular, green photobiont, biatorine apothecia with a mostly internally unpigmented excipulum composed of radiating, branched and anastomosing prosoplectechymatous hyphae, eight-spored *Lecanora*-type asci with

Abstract

Two lichens new to science are described and illustrated: *Ramboldia atromarginata* Kantvilas is corticolous in wet sclerophyll forest in Victoria, and *R. greeniana* Kantvilas is a saxicolous species found chiefly in upland areas of Tasmania. The New Zealand endemic taxon, *Lecidea subsericea* Zahlbr., is found to be a synonym of *Ramboldia Stuartii* (Hampe) Kantvilas & Elix.

Key words: anthraquinone pigments, biodiversity, lichenised ascomycetes, New Zealand, Tasmania, taxonomy, Victoria

a masse axiale with parallel or diverging flanks that penetrates the tholus completely, simple or sparsely branched and anastomosing paraphyses, relatively small, hyaline, non-halonate, simple ascospores and filiform conidia (Kantvilas & Elix 2007; Elix 2009). The species may be saxicolous, lignicolous, corticolous or lichenicolous. Thallus chemistry is diverse and includes fatty acids, depsidones, depsides and xanthenes (Kalb *et al.* 2008); some species, particularly the red-fruited taxa, may contain no substances, apart from the apothecial pigment, russulone. Today the genus is estimated to comprise 32 species (Mycobank website, January 2016), and is widely distributed in both hemispheres. Sixteen species are known from Australasia (McCarthy 2015). In this paper, two further red-fruited taxa are described and some collections from New Zealand are discussed.

Materials and methods

The study is based on collections of the author, housed in the Tasmanian Herbarium (HO) with duplicates distributed to other herbaria as stated. Hand-cut sections of the thallus and ascomata were mounted in water, 15% KOH (K), Lugols Iodine after pretreatment with K (KI), ammoniacal erythrosin and lactophenol cotton blue for examination by high-power light microscopy. Dimensions of asci and ascospores are based on at least 20 and 60 observations respectively. The latter are presented in the format: 5th percentile–average–95th percentile; outlying extreme values are given in parentheses. Routine chemical investigations were conducted using thin-layer chromatography following standard methods (Orange *et al.* 2001). The occurrence of russulone was established by Prof. J.A. Elix (Canberra).

Taxonomy

1. *Ramboldia atromarginata* Kantvilas *sp. nov.*

Mycobank no.: MB 816238

Ad aggregatum *Ramboldiam russulam* pertinens sed ab omnibus his speciebus margine apotheciae atro-fusco, interne rubro-brunneo, in KOH non-reagenti differt.

Type: AUSTRALIA, VICTORIA. Errinundra National Park, Tea Tree Flat Picnic Area, 37°14'33"S 148°50'06"E, 880 m alt., on *Tasmannia* in wet forest, 27 October 2010, G. Kantvilas 262/10, J.A. Elix & P.M. McCarthy (holotype: HO 559266; isotype: MEL).

Thallus crustose, pale glaucous grey, continuous, smooth, relatively even and following the contours of the substratum, sometimes becoming minutely rimose-verruculose, not delimited by a prothallus, forming irregularly roundish thalli to c. 15 mm wide and 30–60 µm thick, in section ecorticate, or with a weakly defined cortex of interwoven, periclinal hyphae c. 2 µm thick. *Photobiont* a unicellular green alga with cells ± globose, 6–14 µm wide. *Apothecia* 0.3–1.2 mm wide, biatorine, roundish, scattered, sessile and basally constricted; disc rusty red-brown, matt, epruinose, persistently plane to slightly undulate; proper excipulum blackish, persistent, entire to crenulate, evident even in the oldest apothecia as a thin, dark rim, in section 50–80(–120) µm wide, dark red-brown, unchanged or intensifying in KOH, sometimes a little paler at the outer edge, continuous beneath the hypothecium (cupular) or almost so (annular), composed of radiating, branched and anastomosing hyphae 5–8 µm wide with narrow (c. 2 µm), often brown-pigmented lumina. *Hypothecium* 50–90 µm thick, pale yellowish or yellow-orange, colour intensifying in KOH. *Hymenium* 50–70 µm thick, coherent in water and KOH, interspersed with and overlain in the upper part by a layer c. 10 µm thick of minute red-brown crystals, K+ magenta and not dissolving; asci narrowly clavate, 35–45(–50) × 9–14 µm, approximating the *Lecanora*-type but with the flanks of the amyloid masse axiale usually widely divergent and the ocular chamber rather poorly developed; paraphyses 1.5–2 µm thick, sparsely branched, with occasional anastomoses in the lower part, with apices neither pigmented nor expanded. *Ascospores* hyaline, simple, fusiform, mostly with rather truncate apices, or oblong, rarely slightly dumb-bell-shaped, (8.5–)9–11.4–14(–15) × (2–)2.5–3.0–3.5 µm. *Pycnidia* not found. *Chemistry*: thallus containing no substances detectable by t.l.c.; apothecia containing russulone. (Fig. 1)

Etymology: The specific epithet refers to the diagnostic blackish brown margin of the apothecia.

Distribution and ecology: This new species is known only from the type collection, from the smooth bark of the shrub *Tasmannia* (Winteraceae) in the understorey of wet eucalypt forest. This is a relatively rich habitat for lichens and associated species included *Fuscidea australis* Kantvilas var. *australis*, *Japewiella pruinosula* (Müll.Arg.) Kantvilas, *Loxospora solenopsora* (Müll.Arg.)

Kantvilas, *Mycoblastus campbellianus* (Nyl.) Zahlbr., *Ochrolechia blandior* (Nyl.) Darb., *Phlyctis subuncinata* Stirt. and species of *Menegazzia*, *Usnea* and *Hypogymnia*.

Remarks: There are 18 species of *Ramboldia* that belong to the so-called *R. russula* (Ach.) Kalb *et al.* group, characterised by apothecia with red, K+ magenta anthraquinone pigments (Kalb *et al.* 2008). None display the very distinctive blackish brown apothecial margin that characterises *R. atromarginata*. The new species is characterised further by lacking any thalline secondary compounds: most species of the group contain fatty acids or other substances (Kalb *et al.* 2008; Elix 2009).

An enigmatic specimen from New Zealand (Kantvilas 353/10; HO), collected from a fallen canopy branch of *Nothofagus solandri* var. *cliffortioides*, deserves some discussion. Superficially this specimen is \pm identical with the type specimen of *R. atromarginata* as described above, with orange-brown apothecia with a thin blackish brown margin, and concomitant apothecial anatomy. Yet apothecial sections consistently reveal at least some asci with narrowly ellipsoid, clearly 1-septate ascospores ($7\text{--}10 \times 3\text{--}4 \mu\text{m}$), whereas other asci contain fusiform, simple ascospores, $8\text{--}11 \times 2.5\text{--}4 \mu\text{m}$. More

collections from New Zealand are required to clarify this curious situation. If the 1-septate ascospores are consistently present, then this represents a significant modification of the anatomy of the genus as currently understood. Other species of *Ramboldia* frequently have pseudo-septate ascospores with plasma bridges that show up clearly when stained with, for example, lactophenol cotton blue, but the ascospores of the New Zealand collection seem to be truly septate. The asci and excipular anatomy of this specimen are consistent with *Ramboldia*.

2. *Ramboldia greeniana* Kantvilas sp. nov.

Mycobank No.: MB 816239

Ramboldiae laetae similis sed thallo minute papillato vel isidiato et habitu saxicola differt.

Type: AUSTRALIA, TASMANIA. Mersey Crag, $41^{\circ}46'S$ $146^{\circ}20'E$, 1420 m altitude, on alpine dolerite boulders, 3 February 2010, G. Kantvilas 71/10 (holotype: HO).

Thallus crustose, dull grey, grey-brown to olive-brown, frequently in part overgrown by blackish cyanobacteria, verruculose to papillate to \pm isidiate, mostly rather

Figure 1. *Ramboldia atromarginata* (holotype) habit, showing biatorine apothecia with a red-brown disc and diagnostic blackish margin. Scale = 1 mm.



loosely attached to the substratum, not delimited by a prothallus, forming irregular, usually deeply cracked thalli to c. 100 mm wide and to 0.6(–1) mm thick, usually as islands surrounded by other crustose lichens, in section \pm ecorticate; isidia when well developed rather knob-like, 0.06–0.08 mm wide, erect or decumbent, with pale grey tips, more frequently abraded or fractured and rather inapparent. *Photobiont* a unicellular green alga with cells \pm globose, 5–12 μm wide. *Apothecia* 0.3–1 mm wide, biatorine, roundish or rather irregularly rhomboidal or lobed, scattered or clustered, sessile and basally constricted; disc bright scarlet red to brownish red, waxy, matt, epruinose, plane at first, soon convex; proper excipulum concolorous with the disc, entire, crenulate or flexuose, becoming excluded or inapparent in older apothecia, in section 40–120 μm wide, deflexed, colourless to pale yellow, densely interspersed with chains of minute orange crystals that turn magenta in KOH but do not dissolve, open beneath the hypothecium (annular), composed of radiating, branched and anastomosing hyphae 4–6 μm wide with thread-like lumina c. 1 μm wide. *Hypothecium* 40–60(–100) μm thick, pale yellowish, likewise interspersed. *Hymenium* 55–70 μm

thick, usually highly coherent in water and KOH, pale yellowish to colourless, interspersed as in the excipulum and hypothecium with minute orange, K+ magenta crystals forming chains between the asci and paraphyses; asci narrowly clavate, 35–50 \times 11–14 μm , approximating the *Lecanora*-type but with the flanks of the amyloid masse axiale usually widely divergent and the ocular chamber rather poorly developed; paraphyses 1.5–2.5 μm thick, rather robust, simple to sparsely branched and anastomosed, with apices neither pigmented nor expanded. *Ascospores* hyaline, simple, fusiform to ellipsoid, (7–)8–9.7–12(–14) \times (2.5–)3–3.5–4(–4.5) μm . *Pycnidia* uncommon, immersed in the thallus surface and evident as minute black specks; conidia thread-like, curved, 20–30 \times 0.5 μm . *Chemistry*: thallus containing no substances detectable by t.l.c.; russulone present in the apothecia (K+ magenta). (Figs 2, 3A–B, 4)

Etymology: The specific epithet honours Sir Guy Green, AC, KBE, CVO, who, as Chairman of the Board of Trustees on the Tasmanian Museum and Art Gallery (2003–2015), was a stalwart champion of the natural sciences, particularly taxonomy.

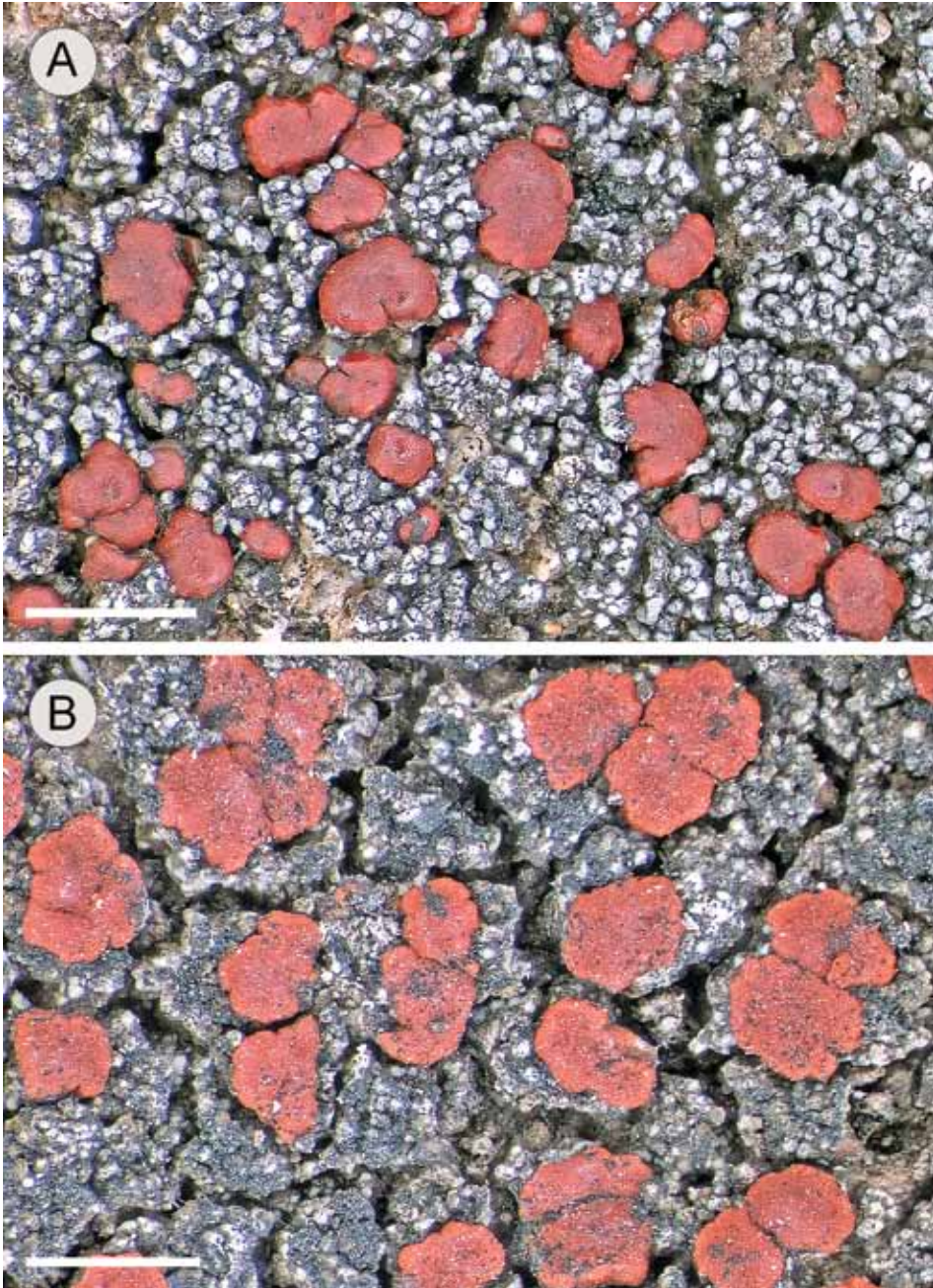
Figure 2. *Ramboldia greeniana* (red apothecia) habitat on dolerite boulders, associated with numerous other crustose lichens.



Distribution and ecology: *Ramboldia greeniana* is known only from Tasmania, where it has been recorded exclusively from Jurassic dolerite. Although most commonly collected from highland situations, it has a wide ecological range that extends from lowland dry eucalypt forest to the alpine summits of the highest peaks.

It inhabits the largest boulders and outcrops (where its collection can pose a challenge), typically in very exposed aspects such as rock screes and boulder fields, where it is part of a diverse assemblage of saxicolous lichens, the most common of which include *R. petraeoides* (Nyl. ex C.Bab. & Mitt.) Kantvilas & Elix, *Hymenelia gyalectoidea*

Figure 3. *Ramboldia greeniana* habit. A: holotype, showing a well-developed, isidiate thallus. B: *Kantvilas* 924/01, with the isidia abraded, fractured and eroded. Scale = 1 mm.



Kantvilas, *Lecanora farinacea* Fée, *L. galactiniza* Nyl., *Menegazzia aeneofusca* (Müll.Arg.) R.Sant., *Pertusaria lophocarpa* Körb., *Tephromela atra* (Huds.) Hafellner, *Trapelia lilacea* Kantvilas & Elix, *Xanthoparmelia mougeotina* (Nyl.) D.J.Galloway, *X. stygiodes* (Nyl. ex Cromb.) O.Blanco *et al.*, and species of *Lecidea*, *Porpidia* and *Rhizocarpon*.

Remarks: *Ramboldia greeniana* is a conspicuous, highly attractive, saxicolous crustose lichen, readily recognised by its vivid scarlet apothecia. It has no confusing species in that the only other known Tasmanian saxicolous taxa with red, K+ magenta fruiting bodies are inevitably species of *Caloplaca* and so differ by having *Teloschistes*-type asci, mostly polaribilocular ascospores and a frequently persistent and distinct zeorine or lecanorine apothecial margin.

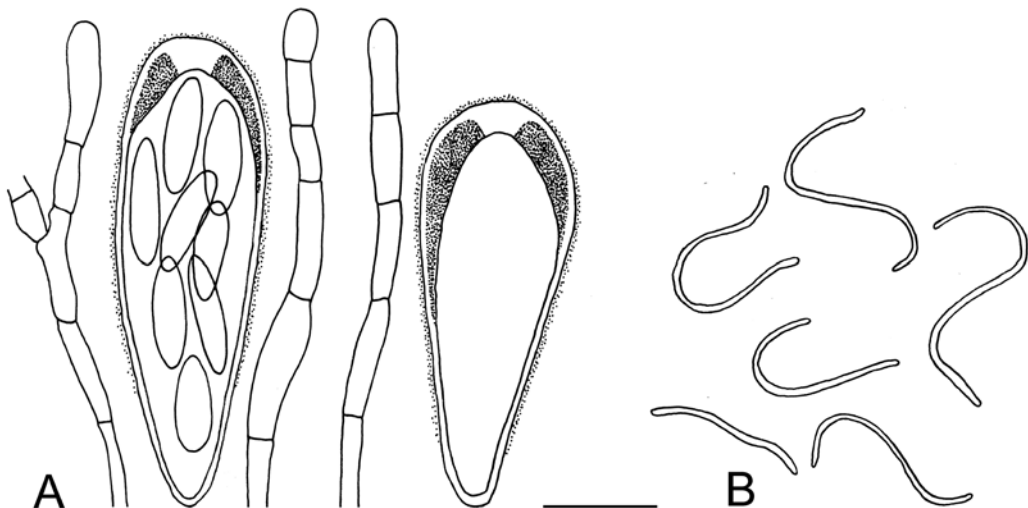
The new species is very similar to the corticolous *R. laeta* (Stirt.) Kalb and, in the past, all saxicolous collections now named *R. greeniana* were subsumed under that species. That the saxicolous material might represent a distinct taxon has been a matter of conjecture (and at times spirited discussion) in the past (Elix & Kantvilas 2005), and at that time (*loc. cit.*), I advocated that no consistent differences, morphological, anatomical or chemical, could be observed that might underpin the taxonomic separation of saxicolous and corticolous populations. An opportunity to collect and study many more specimens has changed my opinion. The character that unequivocally separates the two species, other than substratum, is thallus morphology:

when growing in ideal situations, the thallus of *R. greeniana* is distinctly isidiate (Fig. 3A). In more exposed situations, the thallus becomes increasingly abraded and overgrown by cyanobacterial and other growths, the isidia are fractured or eroded away, and the thallus is better described as papillate or verruculose (Fig. 3B). However, careful inspection of such specimens will usually reveal at least some isidia or at least short, cylindrical projections from the thallus surface. The availability of only such abraded material for previous studies (Elix & Kantvilas 2005) meant that this important character was overlooked.

There are few other consistent differences between the two taxa. The dimensions of apothecial tissues and ascospores are essentially the same. Conidia were found only in one specimen of *R. greeniana* and were significantly longer than the 10–20 µm long conidia recorded for *R. laeta* (Elix & Kantvilas 2005), but the rareness of pycnidia meant that these dimensions could not be confirmed. Chemical composition is also equivocal, although no substances have been detected in any specimen of *R. greeniana*, whereas *R. laeta* may sometimes contain lichesterinic and protolichesterinic acids.

Specimens examined: TASMANIA. Wombat Moor, 42°41'S 146°37'E, 1050 m alt., 13.x.1981, *G. Kantvilas* 767/81 (BM, HO); Ridge E of Ouse R, 7 km SE of Lake Augusta, 41°54'S 146°37'E, 1140 m alt., 7.xii.1993, *G. Kantvilas* 212/93 & *J.A. Elix* (HO); St Pauls Dome, 41°46'S 147°50'E, 23.xi.1997, *G. Kantvilas* 249/97 (HO); M. Road, c. 1 km E of Goat Hills,

Figure 4. *Ramboldia greeniana* anatomy. A: asci, paraphyses and ascospores, with amyloid tissues stippled. B: conidia. Scale = 10 µm.



42°19'S 147°54'E, 240 m alt., 7.i.1997, G. Kantvilas 19/97 (HO); summit of Mt St John, 41°47'S 148°05'E, 778 m alt., 31.vii.1999, G. Kantvilas 316/99 (HO); Mt Foster, 41°44'S 147°53'E, 1010 m alt., 17.v.1999, G. Kantvilas 198/99 (HO); western slope of Table Mtn, 42°14'S 147°08'E, 1050 m alt., 6.x.2001, G. Kantvilas 924/01 (HO); Paradise Gorge, 42°33'S 147°50'E, 150 m alt., 2.vi.2011, G. Kantvilas 196/11, 202/11 (HO); Three Thumbs, 42°36'S 147°52'E, 540 m alt., 2.vii.2012, G. Kantvilas 308/12 (HO); Woods Quoin summit, 42°17'S 147°06'E, 925 m alt., 5.v.2013, G. Kantvilas 52/13 (HO); summit of Brown Mtn, 42°36'S 147°32'E, 790 m alt., 16.v.2015, G. Kantvilas 180/15 (HO); Clemes Peak, 43°04'S 147°57'E, 410 m alt., 21.vi.2015, G. Kantvilas 189/15 (HO); Lost Falls Reserve, 42°03'S 147°53'E, 540 m alt., 12.viii.2015, G. Kantvilas 268/15 (HO); Mother Browns Bonnet summit, 42°48'S 147°44'E, 405 m alt., 23.viii.2015, G. Kantvilas 280/15 (HO); Roscaborough, Roscaborough Road 2, 42°04'S 146°29'E, 880 m alt., G. Kantvilas 449/15 (CANB, HO); Gowan Brae, S of Circular Marsh, 42°00'S 146°29'E, 900 m alt., 10.xii.2015, G. Kantvilas 448/15 & J. Jarman (CANB, HO, NY).

***Ramboldia stuartii* (Hampe) Kantvilas & Elix, *Bryologist* 97: 299 (1994).**

= *Lecidea subsericea* Zahlbr., *Denkschr. Akad. Wiss. Wien math-naturwiss. Kl.* 104: 308 (1941). Type: New Zealand, Nelson, Lead Hills, on dead twigs of *Dacrydium colensoi*, J.S. Thomson T1988 [ZA 664] (holotype W; isotypes BM!, CHR!, OTA).

The isotype specimens examined contain fragments of an unidentified species of *Lecidella* in addition to the *Ramboldia*. However, the original description (Zahlbruckner 1941) refers unequivocally to *R. stuartii*, citing such characteristic features as the K⁺ violet inclusions in the hypothecium that signify the presence of diagnostic hypothamnolic acid.

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