The lichen genera *Japewia* and *Japewiella* in Australia

Gintaras Kantvilas

Tasmanian Herbarium, Private Bag 4, Hobart, Tasmania 7001, Australia

Introduction

The genus *Japewia* was introduced by Tønsberg (1990) to accommodate three corticolous crustose taxa from the cool temperate Northern Hemisphere, characterised principally by their biatorine apothecia and unusually thick-walled, simple ascospores. Other salient features included eight-spored asci with a conspicuous masse axiale (± pertaining to the *Lecidella*-type of Hafellner 1984), the hamathecium and excipulum both comprised of highly similar, branched and anastomosing, gelatinised hyphae, and capitate, brown-pigmented paraphysis tips (Printzen 1999). As pointed out by Printzen (1999), *Japewia* as thus defined, and with only three constituent species, was already heterogeneous, because one species, *J. carrollii* (Coppins & P.James) Tønsberg, had a well-developed excipulum unlike that of *J. tornoensis* (Nyl.) Tønsberg (the type species) and *J. subaurifera* Muhr & Tønsberg. Consequently (*loc. cit.*), he introduced the genus *Japewiella* to accommodate not only *J. carrollii* but also two additional species from more temperate to subtropical latitudes.

Neither genus has been recorded for Australasia, but as is so often the case, this is more a result of lack of knowledge and collections, than a true reflection of biogeographical patterns. Ongoing study of crustose lichens in Tasmania has revealed that both genera are indeed present there. These findings are reported below.

Material and Methods

The study is based on specimens housed in the Tasmanian Herbarium (HO), and comparative reference material in the Natural History Museum (BM).

Descriptions are based on hand-cut sections of the thallus and ascomata, mounted in water, 15% KOH, Lugols Iodine and Lactophenol Cotton Blue, and examined with high-power, light microscopy. Dimensions of asci and ascospores are based on 25 and 50 observations respectively. The latter are presented in the format: smallest measurement–*mean*–largest measurement; single outlying values are given in parentheses. Chemical analyses using thin-layer chromatography follow standard methods (Orange *et al.* 2001) and comparison with a range of reliable reference specimens. High-performance liquid chromatography (Elix

Abstract

The genera *Japewia* and *Japewiella* (lichenised Ascomycetes) are recorded for Australia for the first time, based on collections from Tasmania. The species *Japewia subaurifera* Muhr & Tønsberg and *Japewiella pruinosula* (Müll.Arg.) Kantvilas *comb. nov.* are described and discussed. The latter is also known from New South Wales and Victoria.

Keywords: lichenised Ascomycota, Tasmania.

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et al. 2003) of selected specimens was undertaken by Prof. J.A. Elix in Canberra. Nomenclature of ascus types follows Hafellner (1984).

Taxonomy

Japewia subaurifera Muhr & Tønsberg

Lichenologist 22: 206 (1990); ***Type:*** Norway: Nord-Trøndelag, Namsskogan, N of river Namsen, along Åsbekken S of hill Smalåsenden, 200–300 m alt., 8 April 1982, *T. Tønsberg 6590* (isotype – BM!).

Thallus crustose, areolate, dull chestnut brown, sorediate; areoles 0.15–0.3 mm wide, ecorticate, rather gnarled, dispersed or crowded and fusing together to form an irregular, rather granular, irregularly spreading crust to *c.* 3 mm wide and 1 mm thick; soredia erumpent, rather coarse, pale yellowish green at first, discoloring brownish with age. *Photobiont* a unicellular green alga with ± globose cells 6–15 µm wide. *Apothecia* very infrequent, 0.3–0.6 mm wide, biatorine, sessile, immarginate; disc plane to strongly convex, chestnut brown, glossy, epruinose. *Proper excipulum* very thin and reduced, becoming indistinct and excluded with age, in section ± annular, poorly differentiated from the hymenium, hyaline within, reddish brown, K+ dirty brown at the outer edge due to the pigmentation of the outermost cells, composed of entangled, branched and anastomosing, gelatinised hyphae 1.5–2 µm thick, similar to the paraphyses. *Hypothecium* to *c.* 75 µm thick, hyaline to dilutely yellowish brown. *Hymenium* 60–75 µm thick, not inspersed, KI+ blue but with the amyloid reaction confined to the asci, hyaline to dilutely yellowish to reddish brown, overlain by a reddish brown, K+ dirty brown epithecial layer composed of the pigmented apices of the paraphyses. *Asci* broadly ellipsoid, 45–55 × 18–30 µm, (1–)2–6(–8)-spored, approximating the *Lecidella*-type: tholus well-developed, intensely amyloid, almost but not entirely pierced by a conical to barrel-shaped, weakly amyloid masse axiale with a rounded apex; ocular chamber poorly developed. *Paraphyses* 1–1.5 µm thick, branched and anastomosing, gelatinised, ± identical to the excipular hyphae; apices 3–5 µm wide, pigmented, typically also with a gelatinous sheath. *Ascospores* simple, hyaline, broadly ellipsoid to ovate, non-halonate, (13–)15–*19.0*–22(–23) x (10–)12–*13.9*–17(–18) µm; wall 2–4 µm thick, clearly two-layered. *Conidia* not seen.

Chemical composition*:* no substances detected in Tasmanian material but lobaric acid has been reported occasionally in the Northern Hemisphere (Tønsberg 1990); secalonic acid has also been reported (Elix & Tønsberg 1999).

Specimen examined: **Australia: Tasmania:** summit of Wild Dog Tier, 41°47'S 146°35'E, 1390 m altitude, 2001, *G. Kantvilas 376/01* (HO).

Remarks: *Japewia subaurifera* is a small but nevertheless distinctive species, due to the brown granular thallus, pale yellowish soredia, glossy brown apothecia and thick-walled ascospores. It is widespread in cool to cold, boreal and oceanic regions of the Northern Hemisphere where it occurs on bark in woodland. The single Tasmanian collection is from a dead, decorticated, bleached twig, lying on the ground in a small (a few square metres), isolated pocket of unburnt alpine heathland. This highly localised site supports several additional lichen species which, in Tasmania, are either relatively uncommon (*Cetraria australiensis* W.A.Weber ex Kärnefelt) or extremely rare (*Umbilicaria decussata* (Vill.) Zahlbr., *Xylographa* sp.). The tiny collection of *Japewia* comprises a single fragmented thallus with just three fruiting bodies, hidden in a fissure in the twig. Persistent, targetted searches for the species at many similar locations on Tasmania's Central Plateau have been fruitless.

The Tasmanian specimen has ascospores that are somewhat larger (broader) than those reported in the original description [11–20 x (8–)12–13(–14) µm: Tønsberg (1990)]. However, the paucity of material available precludes inferring any taxonomic significance in this observation.

The taxonomic affinities of *Japewia* remain unclear, and at present, the species is included by Lumbsch & Huhndorf (2007) in the Ramalinaceae. On the basis of ascus structure and ascospore morphology, this position is certainly incorrect (Ekman 1996; Hertel & Rambold 1995). In the revision of Southern Hemisphere *Mycoblastus* based on anatomical, morphological and chemical data, Kantvilas (2009) noted that *Mycoblastus dissimulans* (Nyl.) Zahlbr. and its allies, which comprise the majority of Southern Hemisphere species, displayed noteworthy similarities to *Japewia*. In the present study, after an extensive examination of *Japewia*, this perception has been reinforced. The similarities in the

general appearance of the photobiont, and the anatomy of the asci, excipulum, paraphyses and ascospores are startling. The main difference is that species of the *Mycoblastus dissimulans* group have black (or at least dark) apothecia containing greenish or violet pigments that react in KOH and HNO_3, typically contain perlatolic acid and have incrementally larger ascospores.

Japewiella pruinosula (Müll. Arg.) Kantvilas comb. nov.

Lecidea pruinosula Müll.Arg., *Flora* 65: 486 (1882); *Lecidella pruinosula* (Müll. Arg.) Kantvilas & Elix, *Pap. & Proc. Roy. Soc. Tasmania* 142: 53 (2008).

Type: Australia, New South Wales, corticola ad Twofold Bay, *T. White* (holotype: G!).

Biatora cerarufa Shirley, *Pap. & Proc. Roy. Soc. Tasmania* 1893: 217 (1894); *Lecidea cerarufa* (Shirley) Zahlbr., *Cat. Lich. Univ.* 3: 746 (1925).

Type: Australia, Tasmania, on bark, Bower Track, Mt Wellington, *W.A. Weymouth 141* (holotype: BRI!).

Thallus crustose, effuse, creamish white, smooth, cracked or somewhat scurfy, ecorticate, continuous or rather patchy, 30–100(–200) µm thick, forming irregular, undelimited patches to *c.* 4 cm wide. *Photobiont* a unicellular green alga with ± globose cells 5–12 µm wide. *Apothecia* biatorine, sessile, basally constricted, 0.3–1 mm wide; disc pale pink, orange or reddish brown, occasionally dark brown, often whitish grey pruinose, at least when young, typically persistently plane. *Proper excipulum* well developed, persistent, mostly elevated above the level of the disc, with the rim pale orange-brown to brown and the sides much paler, sometimes appearing almost lecanorine, in section cupular (or almost so), 30–100 µm thick, hyaline within, diffusely pale red-brown, K± dirty brown near the outer edge, usually densely inspersed with crystals that fluoresce in polarised light but do not dissolve in KOH, composed of radiating, branched and anastomosing hyphae *c.* 1 µm thick in a gelatinous matrix. *Hypothecium* (30–)40–110 µm thick, hyaline to pale yellowish. *Hymenium* 70–110 µm thick, hyaline, KI+ blue, overlain by a diffusely reddish brown, K+ dirty brown epithecial layer 5–10 µm thick, composed chiefly of granules that do not dissolve in KOH. *Asci* clavate, 55–70 × 14–24 µm, eight-spored but frequently with up to 4 spores aborted, approximating the *Lecidella*-type: tholus well-developed, intensely amyloid, with a ± barrel-shaped, rather fuzzy, weakly amyloid masse axiale with a rounded apex; ocular chamber poorly developed. *Paraphyses* simple to sparingly branched, 1–2 µm thick, sometimes with swollen, oily vacuoles to 5 µm wide ('oil paraphyses'); apices unpigmented and only occasionally swollen to 2.5 µm. *Ascospores* simple, hyaline, broadly ellipsoid, ovate to subglobose, often squashed and deformed when in the ascus, (10–)12–*15.4*–20(–21) × 8–*10.6*–14 µm; wall single-layered, to 0.8 µm thick. *Conidiomata* unknown. Fig 1 A-B.

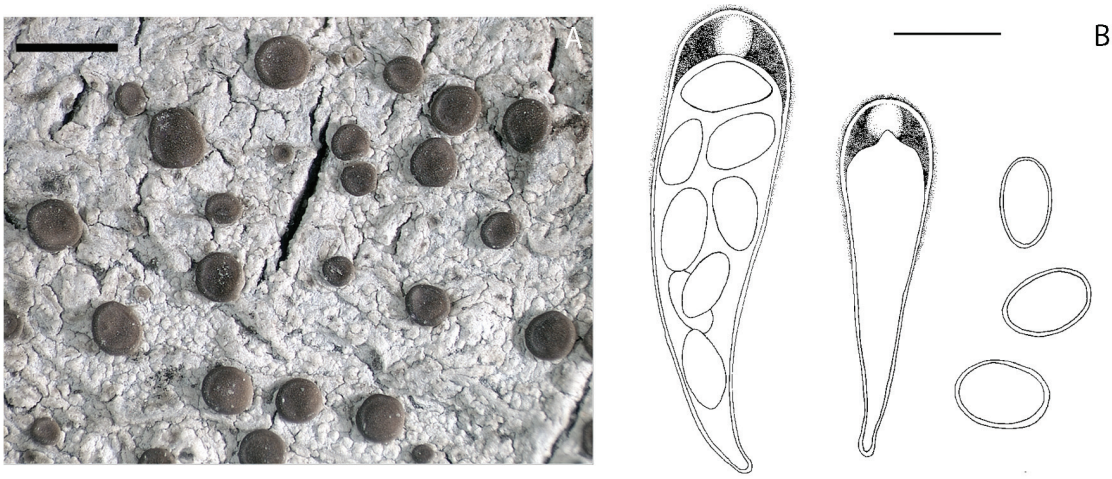

Figure 1. A. *Japewiella pruinosula* habit (*Bratt et al. 76/444*). Scale = 1 mm; B. *Japewiella pruinosula* anatomy: asci with amyloid parts stippled and ascospores (*Kantvilas 114/86*). Scale = 20 µm.

***Chemical composition**:* pannarin (± minor), dechloropannarin (± minor), norpannarin (± trace), 3-*O*-methylthiophaninic acid (±), 2,5,7-trichloro-3-*O*-methylnorlichexanthone, 5,7-dichloro-3-*O*-methylnorlichexanthone (± minor), thiophaninic acid (± minor), isoarthothelin (± minor), 3-*O*-methylthiophaninic acid (± trace). These substances are rarely in sufficient concentrations to offer reliable spot or UV tests, although the grey pruina of young apothecia may give a P+ orange reaction. The complex and variable chemistry of this taxon was determined using h.p.l.c. by J.A. Elix in Kantvilas *et al.* (2008). With simple t.l.c, few of the substances can be detected, with the exception of two fast-moving xanthones (3-*O*-methylthiophaninic acid (±), 2,5,7-trichloro-3-*O*-methylnorlichexanthone) that appear as pale UV+ spots on developed t.l.c. plates.

Selected specimens examined: **Australia: Tasmania:** Huon Road, Watchorns Hill, 42°57′S 147°14′E, 480 m alt., 1899, *W.A. Weymouth 674* (HO); Dee Lagoon, 42°16′S 146° 36′E, 690 m alt., 1964, *G.C. Bratt & J.A. Cashin 1800b* (HO); near Lynchford Siding, 42°07′S 145°32′E, 1976, *G.C. Bratt 76/44 et al.* (HO); Queenstown, 42°05′S 145° 33′E, 200 m alt., 1984, *G. Kantvilas 189/84 & P.W. James* (BM, HO); Rapid River Road, 41°07′S 145°07′E, 170 m alt., 1986, *G. Kantvilas 114/86* (BM, HO); Sandspit River, 42°42′S 147°50′E, 180 m alt., 1988, *A. Moscal 16846* (HO). **Victoria:** Brighton, Jim Willis Reserve, 37°55′23″ 144°59′14″, *V. Stajsic 4061 p.p.* (HO); Drummer Rainforest Walk, 10 km E of Cann River township, 37°34′08″S 149°16′21″E, 145 m alt., 2010, *G. Kantvilas 249/10* (HO); Errinundra NP, Tea Tree Flat, 37°14′33″S 148°50′06″E, 880 m alt., 2010, *G. Kantvilas 264/10* (HO, MEL).

Remarks: *Japewiella pruinosula* is a distinctive species, both macroscopically because of the persistently marginate, often pruinose apothecia, and microscopically due to the internally unpigmented apothecia with *Lecidella*-type asci and large, broad ascospores. Perhaps the most similar species in the Tasmanian flora is the corticolous *Lecidea immarginata* R.Br., which also has reddish brown apothecia and large simple ascospores. However, this species never has a pruinose apothecial disc, the apothecia frequently become immarginate, the asci approximate the *Porpidia*-type (showing a well developed, deeply amyloid, divergent ring structure in the tholus) and the thallus lacks any substances detectable by t.l.c. Also sometimes similar are some forms of the coastal epiphyte *Lecanora flavopallida* Stirt., which has similar-looking apothecia but differs by having a thallus with a yellowish tinge, containing thiophaninic acid, and distinctly *Lecanora*-type asci.

Japewiella pruinosula is common and widespread in Tasmania in wet eucalypt forest, wet scrub and rainforest, where it occurs on trunks and twigs with smooth bark, typically in well-lit conditions but also sometimes beneath a sparse forest canopy. Tiny thalli are commonly found on dead canopy twigs of eucalypts. It is also known from the south-eastern Australian mainland (Victoria and New South Wales).

The taxonomic placement of this species has taken several iterations. Interestingly, its affinities were first correctly interpreted almost 25 years ago by the British lichenologist Peter James (*in litt.*), who examined a specimen and suggested it was 'reminiscent of *Lecidea carrolli* Coppins & P. James'; that taxon is now known as *Japewiella tavaresiana* (H. Magn.) Printzen. In the meantime, it remained classified in *Lecidea* (Kantvilas 1988) before being transferred to *Lecidella* in Kantvilas *et al.* (2008) on account of the thallus containing xanthones and the *Lecidella*-type asci. However, *Lecidella* differs by having an excipulum composed of parallel, radiating, relatively thick hyphae with dark greenish or bluish, N+ crimson pigments.

Within the genus *Japewiella*, *J. pruinosula* is well separated from the other known species as described in Printzen (1999) and James (2009) by the combination of the persistent proper exciple inspersed with crystals, the persistently plane, pruinose apothecial disc, the relatively long and broad ascospores and thallus chemistry; oil paraphyses, although not present in every section studied, also appear to be unique to this species. *Japewiella tavaresiana* differs from *J. pruinosula* chiefly by its smaller apothecia (to 0.5 mm wide) and by containing atranorin only. *Japewiella djagensis* (Zahlbr.) Printzen also differs by its chemistry (atranorin plus two unidentified xanthones and one unidentified depside), as well as by its areolate thallus, its apothecia with convex disc and indistinct excipulum, and by its smaller ascospores (11.5–13.5 × 7–8 µm) (Printzen 1999). The most similar species to *J. pruinosula* appears to be *J. pacifica* Printzen, which like *J. pruinosula* has crystalline inclusions in the thallus and apothecia (Printzen 1999, 2004). However, these granules are soluble in KOH whereas those of *J. pruinosula* are not, and the species differs further by its warted thallus,

apically brown paraphyses and different chemistry (atranorin, chloroatranorin, 3-chlorostenosporic acid, 3-chloroperlatolic acid and 3-chlorodivaricatic acid; Printzen 2004).

Filson (1996) erroneously considered *Buellia rimulata* (Nyl.) Zahlbr., based on an Australian type, to be a synonym of *Lecidea pruinosula* (now *Japewiella pruinosula*), and this synonymy has persisted in subsequent Australian lists. The original description of this species (as *Lecidea rimulata* Nyl.) specifically mentions a saxicolous habitat, black apothecia, a brown to black-brown hypothecium and brown, 1-septate ascospores (Nylander 1864), all characters consistent with its combination in *Buellia* and completely inappropriate for *Japewiella*. Indeed, Bungartz *et al.* (2007) considered *Buellia rimulata* to be a synonym of the widely distributed species *B. stellulata* (Taylor) Mudd.

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