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The New Zealand endemic *Menegazzia pulchra* has distinctive orange-red apothecial margins. The species usually colonizes the bark of mountain beech (*Nothofagus solandri* var. *cliffortioides*), mostly in the Craigieburn Range of Canterbury Province in the South Island.

1 mm

CONTENTS

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New taxa and new records of *Amandinea* (Physciaceae, Ascomycota) in Australia

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Abstract: *Amandinea conglomerata* Elix & Kantvilas, *A. devilliersiana* Elix & Kantvilas, *A. dudleyensis* Kantvilas & Elix, *A. lignicola* var. *australis* Elix & Kantvilas, *A. occidentalis* Elix & Kantvilas, *A. pillagaensis* Elix & Kantvilas and *A. stajsicii* Elix & Kantvilas are described as new to science. The new combination *Amandinea fouquieriensis* (Bungartz) Elix & Kantvilas is proposed. *Amandinea isabellina* (Hue) Søchting & Øvstedal, *A. montana* (H.Magn.) Marbach and *A. otagoensis* (Zahlbr.) Blaha & H.Mayrhofer are reported for the first time for Australia. In addition, *Amandinea pelidna* (Ach.) Fryday & L.Arcadia is reported as new to New South Wales and Victoria. A key to *Amandinea* and *Orcularia* in Australia is given.

Amandinea is one of several segregates of the genus *Buellia*, a large heterogeneous assemblage of mostly crustose lichens with a chlorococcoid photobiont, lecideine to biatorine apothecia, and usually *Bacidia*-type asci with 1-septate, dark-pigmented ascospores. The genus was resurrected by C. Scheidegger and H. Mayrhofer (Scheidegger 1993), and is characterized chiefly by filiform conidia. To a large extent, other characters such as exciple structure, ascospore type and thallus chemistry are ignored, and consequently *Amandinea* as currently circumscribed is a heterogeneous group. Aspects of generic delimitation within *Buellia sens. lat.*, including *Amandinea*, were discussed by Bungartz *et al.* (2007), who did not accept the genus, and in their treatment of Sonoran species placed taxa with filiform conidia in *Buellia*. At the same time, *Amandinea* has been accepted by other writers of regional Floras, notably Galloway (2007) for New Zealand, Elix (2011) for Australia and Scheidegger (2009) for the British Isles. More recently, some taxa previously included within *Amandinea* have been transferred to the genus *Orcularia*, primarily on the basis of their ascospore ontogeny. In ascospores with *Physconia*-type ontogeny (i.e. in some *Amandinea* species), the septum is inserted before any inner wall thickening appears, whereas in true *Orcularia*-type ascospores, the septum is inserted after lateral inner wall thickenings have become distinct (Kalb & Giralt 2011). For illustrations of relevant spore types, see Mayrhofer & Moberg (2002a, b) and Kalb & Giralt (2011).

The publication of the first account of the genus for Australia (Elix 2011) inspired a re-examination of large numbers of herbarium holdings, as well as increased collection of *Buellia*-type lichens. Consequently, several additions to the genus have been discovered in Australia, and these are described below. Eighteen species of *Amandinea* are now known from Australia.

Material and methods

The study is based on herbarium holdings, chiefly in the Tasmanian Herbarium (HO) and the Australian National Herbarium (CANB), and on recent collections by the authors. Chemical constituents were identified by thin-layer chromatography (Elix & Ernst-Russell 1993), high-performance liquid chromatography (Elix *et al.* 2003) and comparison with authentic samples. Calcium oxalate was detected by treatment of medullary tissue with a 10% aqueous solution of sulfuric acid. It forms colourless, needle-shaped crystals that are readily observed under a stereo microscope.

The new taxa

1. Amandinea conglomerata Elix & Kantvilas, sp. nov. Fig. 1
Mycobank No. **MB 803077**

Amandineae pelidnae similis sed thallo immerso vel fragmentato, apotheciis agglomerescentis, hymenio guttis olei valde insperso et ascosporis paulo angustioribus, 10–17 µm longis, 5–7 µm latis, primo *Pachysporariae*-typis, tandem *Buelliae*-typis differt.

Type: Australia, Jervis Bay Territory, Bristol Point, 35°08′S, 150°44′E, 1 m alt., on coastal rocks, *G. Kantvilas 599/12*, lacking lichen substances, 17.xi.2012 (holotype – HO; isotype – CANB).

Thallus crustose, forming extensive patches to *c.* 10 cm wide, endolithic and inapparent, or epilithic, fragmentary and comprised of discontinuous white flecks 0.2–0.5 mm wide and up to 0.6 mm thick; prothallus absent; photobiont cells 8–15 µm wide. *Apothecia* 0.2–0.7 mm wide, lecideine, sessile, scattered or crowded, rounded or irregular through mutual pressure; disc black, epruinose, weakly concave to plane, or becoming convex and tuberculate with age and forming dense clusters up to 1.2 mm wide consisting of as many as 10 satellite discs; proper excipulum distinct, persistent or excluded in older, convex apothecia, in section 60–100 µm thick, with outer zone deep red-brown to black-brown, K–, paler red-brown within. *Epihymenium* 12–20 µm thick, dark olive-brown to olive-black, K–, N+ purple-brown. *Hypothecium* 40–80 µm thick, red-brown, K–, N+ intense red-brown. *Hymenium* 60–100 µm thick, colourless, densely inspersed with oil droplets; paraphyses 1.2–1.5 µm wide, simple to moderately branched, capitate, with apices 3–4 µm wide, brown; asci of the *Bacidia*-type, 8-spored. *Ascospores* at first of the *Pachysporaria*-type, later of the *Buellia*-type, 1-septate, pale olive-green to brown, ellipsoid, (10–)11–*13.1*–16(–17) × 5–*5.8*–7 µm, ±constricted at the septum; outer spore wall weakly ornamented. *Pycnidia* pyriform, not immersed, black; conidia filiform, curved, 15–23 × 0.8–1 µm.
Chemistry: Apothecial sections K– (lacking lichen substances) or rarely K+ yellow and soon forming red, needle-like crystals (traces of norstictic acid).

Etymology: The specific epithet refers to the apothecia, which form clusters when old.

Remarks
This new species is characterized by the numerous, black, sessile apothecia that form clusters of satellite discs when old, by the *Pachysporaria*- to *Buellia*-type ascospores, 10–17 × 5–7 µm, by the densely inspersed hymenium and by the filiform conidia, 15–23 µm long. It resembles some depauperate forms of the common *A. pelidna* (Ach.) Fryday & L.Arcadia, in that both generally lack lichen substances and have similar-sized ascospores [10–*12.3*–15(–16) µm long in *A. pelidna*]. However, in *A. pelidna*, the spores are 5–*6.8*–8(–9) µm wide, i.e. slightly broader than those of *A. conglomerata*; furthermore, they are initially *Physconia*-type and then *Buellia*-type and are not constricted at the septum. The conidia of *A. pelidna* are also slightly longer (15–30 µm). Although both species can have a reduced thallus, that of *A. pelidna* is usually continuous and obvious. The hymenium of *A. pelidna* is almost invariably not inspersed, or at most it has a few scattered oil droplets in the subhymenium.

Amandinea conglomerata is a coastal species known from southern New South Wales, where it is associated with typical littoral species such as *Buellia aeruginosa* A.Nordin, Owe-Larsson & Elix, *B. halonia* (Ach.) Tuck., *B. mammillana* (Tuck.) W.A.Weber, *Caloplaca cribrosa* (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.

SPECIMENS EXAMINED
New South Wales: • Shell Beach, 2 km N of Kioloa, 35°32′41″S, 150°22′50″E, 1 m alt., on exposed coastal rocks, *J.A. Elix 45639 pr.p.* (lacking lichen substances), 16.ix.2008 (CANB).
Jervis Bay Territory: • type locality, *G. Kantvilas 598/12*, 17.xi.2012 (with norstictic acid) (HO); • *loc. id., G. Kantvilas 600/12* (lacking lichen substances), 17.xi.2012 (HO).

2. Amandinea devilliersiana Elix & Kantvilas, sp. nov. Fig. 2
Mycobank No. **MB 803078**

Amandineae latemarginatae similis sed ascosporis parvioribus, 10–15 µm longis, 5–8 µm latis, conidiis longioribus, 15–30 µm longis, et margine thallino effigurato destituto differt.

Type: Australia, South Australia, Kangaroo Island, Windmill Bay, 35°51′S, 138°07′E, 1 m alt., on granite boulders by seashore, *G. Kantvilas 494/12*, 17.ix.2012 (holotype – HO; isotypes – AD, CANB).

Thallus crustose, smooth, continuous to rimose-areolate or verrucose, pale brownish grey to dark grey, esorediate, 0.5–6.0 cm wide, to 0.5 mm thick; areolae 0.2–0.4 mm wide, convex, subangular; prothallus black, marginal, prominent; cortex 12–15 µm thick; medulla white, lacking calcium oxalate (H_2SO_4–), I–. *Apothecia* 0.3–0.8 mm wide, lecideine, sessile, solitary or crowded, rounded or irregular through mutual pressure; disc black, plane to weakly convex, epruinose; proper excipulum distinct, persistent, in section 60–100 µm thick, with outer zone black-brown to dark brown, K+ orange and soon forming red crystals, N+ orange-brown, pale red-brown to ±colourless within. *Epihymenium* 8–17 µm thick, brown to dilute dark brown, K–, N–. *Hypothecium* 40–70 µm thick, red-brown to dark brown, K–. *Hymenium* 50–80 µm thick, colourless, not inspersed; paraphyses 1.5–2.0 µm wide, simple to moderately branched, capitate, with apices 4–5 µm wide, brown; asci of the *Bacidia*-type, 8-spored. *Ascospores* at first of the *Physconia*-type, later of the *Buellia*-type, 1-septate, pale olive-green to brown, ellipsoid, 10–15 × 5–8 µm, not constricted at the septum; outer spore wall weakly ornamented. *Pycnidia* immersed, black, *c.* 0.08 mm wide; conidia filiform, curved, 15–30 × 0.8–1 µm.
Chemistry: Thallus K+ yellow then red, C–, P+ yellow-orange, UV–; containing norstictic acid (major), connorstictic acid (trace).

Etymology: This species is named after Brigitte de Villiers, frequent companion of the second author in quest of interesting lichens.

Remarks
Amandinea devilliersiana is characterized by a pale brownish grey to dark grey, areolate thallus with a non-effigurate margin, a black marginal prothallus, *Physconia*- to *Buellia*-type ascospores, 10–15 × 5–8 µm, filiform conidia, 15–30 µm long, and the presence of norstictic acid. It is similar to the Antarctic species *A. latemarginata* (Darb.) Søchting & Øvstedal, which likewise contains norstictic acid, but has slightly larger ascospores (12–18 × 7–10 µm), shorter conidia (10–21 µm long) and a prominent, effigurate, thalline margin. The new species also resembles some forms of the common *A. pelidna* (Ach.) Fryday & L.Arcadia, a species that lacks lichen substances and has a thicker hymenium (75–100 µm) and hypothecium (70–100 µm).

Amandinea devilliersiana is a coastal species known from eastern Kangaroo Island (South Australia) and north-western Tasmania, where it occurs on hard, crystalline, siliceous rocks such as granite and quartzite, associated with typical littoral species such as *Caloplaca cribrosa* (Hue) Zahlbr., *C. gallowayi* S.Y.Kondr., Kärnefelt & Filson, *Lecanora subcoarctata* (C.Knight) Hertel, *Rinodina blastidiata* Matzer & H.Mayrhofer, *Tylothallia pahiensis* (Zahlbr.) Hertel & Kilias and *Xanthoria ligulata* (Körb.) P.James.

SPECIMENS EXAMINED
South Australia: • Kangaroo Island, Lesueur Conservation Park, *c.* 3.5 km SW of Cape Willoughby, 35°51′S, 138°06′E, 10 m alt., in sheltered underhangs of a granite boulder overlooking the sea, *G. Kantvilas 359/09, 360/09*, 12.ix.2009 (AD, HO).

Tasmania: • Devonport, Lighthouse Bluff, 41°11′S, 146°21′E, on dolerite cliff subject to salt spray, *R.G. Blackman 12*, 31.i.1981 (CANB); • West Ulverstone Beach, 41°09′S, 146°10′E, on quartz, *G.C. Bratt 969, 972, 973*, 18.xii.1963 (HO); • Slaves Bay, 40°55′S, 144°39′E, 15 m alt., on coastal rocks above splash zone, *G. Kantvilas 534/03*, 13.x.2003 (HO); • West Point, 40°57′S, 144°37′E, 10 m alt., on quartzite boulders in coastal heathland, *G. Kantvilas 490/11*, 30.xi.2011 (HO).

3. Amandinea dudleyensis Kantvilas & Elix, sp. nov. Fig. 3
Mycobank No. **MB 803079**

Apotheciis nigris, lecideinis, ascosporis uniseptatis, brunneis, *Orculariae*-typo accedentibus juvenibus, 20–28 µm longis, 9–14 µm latis, et conidiis filiformibus, 20–30 µm longis recognita, a *Amandinea stajsicii* ascosporis valde maioribus differt.

Type: Australia, South Australia, Kangaroo Island, Creek Bay Farm, headwaters of Lubra Creek, 35°49′S, 138°06′E, 40 m alt., on young branches of eucalypts in mallee woodland, *G. Kantvilas 383/11*, 19.ix.2011 (holotype – HO; isotypes – AD, CANB).

Thallus crustose, smooth and continuous to rimose-areolate or verruculose, white to pale grey, esorediate, 0.5–6.0 cm wide, to 0.5 mm thick; prothallus absent; cortex 12–25 µm thick; medulla white, lacking calcium oxalate (H_2SO_4–), I–. *Apothecia* 0.2–0.7 mm wide, scattered or crowded, lecideine from the outset, broadly adnate, rarely becoming sessile; disc black, epruinose, plane to weakly convex; proper excipulum distinct, persistent, in section 90–130 µm thick, with the outer zone black-brown to dark brown, K–, ±hyaline within. *Epihymenium* 12–25 µm thick, dark brown to black or greenish brown, K–, N–. *Hypothecium* 75–100 µm thick, red-brown. *Hymenium* 75–100 µm thick, colourless, mostly inspersed with very fine oil droplets; paraphyses 2–3 µm wide, simple to branched, capitate, with apices 5–7 µm wide, dark brown; asci of the *Bacidia*-type, 8-spored. *Ascospores* at first ±of the *Orcularia*-type, later of the *Physconia*-type, 1-septate, pale olive-green to brown, ellipsoid, 20–28 × 9–14 µm, slightly constricted at the septum; locules of immature spores connected by an elongate narrow channel; outer spore wall smooth. *Pycnidia* immersed, black, *c.* 0.08 mm wide; conidia filiform, curved, 20–30 × 1 µm.
Chemistry: Thallus K–, KC–, P–, C–, UV–; no lichen substances detected.

Etymology: The species epithet refers to the Dudley Peninsula on Kangaroo Island where the first specimens of the taxon were collected.

Remarks
Amandinea dudleyensis is characterized by ±continuous, weakly rimose-areolate, verruculose, white to pale grey crustose thallus, 1-septate ascospores with a smooth outer wall that at first approximate the *Orcularia*-type, and are then of the *Physconia*-type, and by the lack of lichen substances. It closely resembles *A. stajsicii* (see below), but that species has smaller ascospores (12–18 × 6–10 µm) and a much thinner excipulum (20–30 µm thick) and hypothecium (40–80 µm thick). Also superficially similar is *Buellia dissa* (Stirt.) Zahlbr., which occurs in the same habitats and has ±identical lecideine apothecia on a whitish thallus. That species is readily distinguished from *A. dudleyensis* by its 2-spored asci, ascospores of the *Callispora*-type and by the presence of atranorin and diploicin.

At present, *A. dudleyensis* is recorded only on Kangaroo Island (South Australia), where it has been found more commonly on the twigs of eucalypts in the avenues of mallee than fringe roadsides and paddocks. There it occurs in association with *Austroparmelina pruinata* (Müll.Arg.) A.Crespo, Divakar & Elix, *Buellia dissa* (Stirt.) Zahlbr., *Caloplaca maccarthyi* S.Y.Kondr., Kärnefelt & Elix, *Hyperphyscia adglutinata* (Flörke) H.Mayrhofer & Poelt, *Physcia neonubila* Elix, *P. poncinsii* Hue, *Ramalina fissa* (Müll.Arg.) Vain. and *Teloschistes chrysophthalmus* (L.) Th.Fr. Less commonly it has also been found on twigs in coastal *Melaleuca*-dominated swampy woodland. In contrast, the related *A. stajsicii* is widespread in coastal areas of southern Australia.

SPECIMENS EXAMINED
South Australia: • Kangaroo Island, Chapman River Estuary, 35°50′S, 138°05′E, 3 m alt., on *Melaleuca* in coastal scrub, *J.A. Elix 19693 & L.H. Elix*, 28.x.1985 (CANB); Kangaroo Island, Stars Road, 35°47′S, 137°33′E, 65 m alt., on eucalypt twigs in roadside avenue of mallee, *G. Kantvilas 397/12*, 23.ix.2012 (AD, HO); Ravine des Casoars, 35°48′S, 136°35′E, 15 m alt., on remnant living *Melaleuca* in a badly burnt, degraded strip of woodland, *G. Kantvilas 484/12 & B. de Villiers*, 24.ix.2012 (AD, HO).

4. Amandinea lignicola var. **australis** Elix & Kantvilas, var. nov. Fig. 4
Mycobank No. **MB 803084**

Amandineae lignicoli Tønsberg & A.Nordin similis sed ascosporis maioribus, 11–20 µm longis, 5–8 µm latis, pariete laevi vel subtiliter scaberulo, conidiis longioribus, 12–26 µm longis differt.

Type: Australia, South Australia, Kangaroo Island, Lashmar Lagoon, 35°49′S, 138°04′E, 10 m alt., on *Melaleuca* in swampy *Melaleuca*-dominated woodland, *G. Kantvilas 270/11 & B. de Villiers*, 30.ix.2011 (holotype – HO; isotype – AD).

Thallus crustose, areolate to distinctly subsquamulose, continuous to dispersed, smooth and generally esorediate, or in part scurfy-granulose, eroded and ±sorediate, or with the granules becoming elongate, corticate and resembling gnarled isidia, pale grey to blue-grey or olive-brown, 2–5 cm wide, up to 0.5 mm thick; individual areoles 0.1–0.2 mm wide; prothallus absent; cortex 10–20 µm thick; medulla white, lacking calcium oxalate (H_2SO_4–), I–; photobiont cells 10–20 µm diam. *Apothecia* 0.1–0.6 mm wide, scattered or crowded, lecideine, immersed at first, soon emergent and broadly adnate; disc black, epruinose, plane to weakly convex; proper excipulum distinct, persistent, in section 75–150 µm thick, outer zone dark brown, K–, inner zone pale brownish. *Epihymenium* 10–14 µm thick, brown, K–, N–. *Hypothecium* 40–75 µm thick, dark brown to dark olive-brown. *Hymenium* 60–75 µm thick, colourless, not inspersed; paraphyses 1.5–2.5 µm wide, simple to branched, capitate, with apices 4–5 µm wide, dark brown; asci of the *Bacidia*-type, 8-spored. *Ascospores* at first of the *Physconia*-type, then the *Buellia*-type, 1-septate, olive-green to brown, ellipsoid, (11–)13–20 × (5–)6–8 µm, not constricted at the septum; outer spore wall smooth to minutely roughened. *Pycnidia* immersed, black, *c.* 0.08 mm wide; conidia filiform, curved, (12–)18–26 × 0.5–1 µm.
Chemistry: Thallus K–, P–, C–, UV–; no lichen substances detected.

Etymology: The varietal name reflects the Australian distribution of this taxon.

Remarks
Amandinea lignicola var. *australis* is a very distinctive taxon in the Australian flora, readily recognized by its typically conspicuous, well-developed thallus. The new lichen closely resembles *A. lignicola* var. *lignicola*, recently described from coastal British Columbia (Tønsberg *et al.* 2012). However, whereas var. *lignicola* is sorediate, var. *australis* displays a far more variable thallus morphology, ranging from esorediate, smooth and areolate, to ±squamulose, granular, eroded and becoming ±sorediate, or even granular and ±isidiate. The size of ascospores of the two varieties overlaps, but in general those of var. *australis* are larger [(11–)13–20 × (5–)6–8 µm compared to 11–16 × 4.5–7 µm]. The situation with conidia is similar, those of var. *australis* being generally longer [(12–)18–26 × 0.5–1 µm compared to 12–18 × 0.5–1 µm]. *Amandinea lignicola* var. *lignicola* contains oil droplets in the subhymenium, whereas some oil droplets can

be observed in var. *australe*, they are very few. Perhaps more significantly, the ascospores of *A. lignicola* var. *lignicola* are rugulate, whereas those of var. *australis* are predominantly smooth or at most minutely roughened.

In many respects, this new taxon resembles *Amandinea fouquieriensis* (Bungartz) Elix & Kantvilas comb. nov. [Basionym: *Buellia fouquieriensis* Bungartz, in F. Bungartz, A. Nordin and U. Grube, *Lichen Flora of the Greater Sonoran Desert Region* **3**, 143 (2007); Mycobank No. MB 803083], but the two taxa differ in the development of their apothecia and in the size of their ascospores and conidia. In *A. fouquieriensis,* the immersed then adnate to sessile apothecia are lecanorine at first but soon become lecideine, the pseudolecanorine thalline margin, initially prominent and concolorous with the thallus, is excluded at maturity, and the initially non-carbonized proper excipulum becomes carbonized at maturity. In contrast, in *A. lignicola* var. *australis,* the apothecia are invariably lecideine, albeit initially immersed and then broadly adnate, and the proper excipulum remains non-carbonized throughout. The ascospores and conidia of the two taxa are superficially similar. However, the ascospores of *A. lignicola* var. *australis* are larger (9–15 × 5–7 µm in *A. fouquierensis*), and the conidia are longer [12–18(–20) µm in *A. fouquierensis*]. The new variety also resembles some forms of the common *A. punctata* (Hoffm.) Coppins & Scheid., but its spores are somewhat longer (10–15 µm in the latter) as are the conidia (14–22.5 µm in *A. punctata*). Furthermore, the thallus of *A. punctata* does not become scurfy-granulose. Also similar is the Western Australian endemic *A. occidentalis* Elix & Kantvilas (described below), which differs chiefly in having larger ascospores, 22–30 × 9–14 µm.

This new taxon is widespread in southern Australia, and is known from South Australia (including Kangaroo Island), Victoria, New South Wales, the Australian Capital Territory, Western Australia and Tasmania. It occurs on trees, shrubs and dead wood. At the type locality, a degraded *Melaleuca*-dominated swampy woodland fringing a coastal lagoon, the lichen is extremely abundant on bark and wood, associated with *Austroparmelina conlabrosa* (Hale) A.Crespo, Divakar & Elix, *Flavoparmelia rutidota* (Hook.f. & Taylor) Hale, *Hertelidea aspera* (Müll.Arg.) Kantvilas & Elix, *Heterodermia tremulans* (Müll.Arg.) W.L.Culb., *Pannaria obscura* Müll.Arg., *Parmotrema cooperi* (J.Steiner & Zahlbr.) Sérus., *Punctelia pseudocoralloidea* (Gyeln.) Elix & Kantvilas, *Ramboldia crassithallina* Kalb, *Rinodina australiensis* Müll.Arg. and *Tephromela bullata* Elix. More commonly it is found in open, dry habitats such as degraded woodland and pasture, especially in lowland or coastal areas, where it colonizes dead wood, and is associated with species of *Caloplaca* and *Candelariella*.

SPECIMENS EXAMINED

South Australia: • Mount Lofty Ranges, Corrynton Park Road, 8 km W of Eden Valley, 34°38′37″S, 139°00′33″E, 520 m alt., on dead *Eucalyptus* log in remnant *Eucalyptus* woodland, *J.A. Elix 37229*, 5.xii.2006 (CANB); • 3 km E of Callington, 35°06′41″S, 139°03′31″E, 25 m alt., on *Callitris* in remnant *Callitris* woodland, *J.A. Elix 37613*, 4. vi.2007 (CANB); • Kangaroo Island, Antechamber Bay near the Kona, 35°49′S, 138°05′E, 20 m alt., on wood of dead *Eucalyptus* in pasture, *G. Kantvilas 205/10*, 26.ix.2010 (CANB, HO); • type locality, on *Melaleuca* in swampy, *Melaleuca*-dominated woodland, *G. Kantvilas 265/11, 272/11 & B. de Villiers*, 30.ix.2011 (AD, HO); • Kangaroo Island, Pelican Lagoon, 35°49′S, 137°48′E, 10 m alt., on *Melaleuca* trunks in *Melaleuca*-dominated, swampy woodland, *G. Kantvilas 410/12 & B. de Villiers*, 27.ix.2012 (AD, HO); • Kangaroo Island, Chapman River, 35°48′S, 138°04′E, 10 m alt., on dead, bleached *Melaleuca* wood in *Melaleuca*-dominated, swampy woodland, *G. Kantvilas 400/12 & B. de Villiers*, 22.ix.2012 (HO); • Kangaroo Island, slopes above Red House Bay, 35°49′S, 138°07′E, 50 m alt., on loose mallee roots in rough pasture, *G. Kantvilas 591/12*, 17.ix.2012 (AD, HO).

New South Wales: • Cookamidgera State Forest, 3.5 km SSW of Cookamidgera, 33°13′43″S, 148°16′54″E, 345 m alt., on dead stump in *Eucalyptus* woodland, *J.A. Elix 39073*, 4.viii.2008 (CANB).

Australian Capital Territory: • Aranda Primary School, 5 km W of Canberra, 35°16′S, 149°05′E, 650 m alt., on old pine wood in cultivated park, *J.A. Elix 38833*, 28.vi.2008 (CANB, HO).

Victoria: • Lake Roulton, Pink Lakes State Park, 17 km NW of Underbool, 35°04′S, 141°41′E, 40 m alt., on shaded, rotting log in *Leptospermum* and saltbush lakeside scrub, *J.A. Curnow 2746*, 24.iii.1989 (CANB); • Cocoroc, Western Treatment Plant, 37°59′52″S, 144°38′48″E, on trunk of planted, living *Melaleuca lanceolata*, *V. Stajsic 5101*, 1.viii.2009 (HO, MEL); • Neds Corner Station, SE corner of property, *c.* 20 km SE of Neds Corner homestead, 34°14′34″S, 141°30′14″E, 45 m alt., on *Callitris gracilis* in open shrubland, *V. Stajsic 5836*, 22.xi.2011 (HO, MEL).

Tasmania: • Royal George mine area, 41°50′S, 147°54′E, 225 m alt., on dead *Eucalyptus*, *G.C. Bratt 353*, 13.vii.1963 (HO); • Droughty Point, 52°57′S, 147°25′E, on *Casuarina* on exposed estuary shore, *G.C. Bratt 68/421*, 26.v.1968 (HO); • Cape Contrariety, 43°01′S, 147°31′E, 50 m alt., on dead *Allocasuarina verticillata* on cliff edge overlooking the sea, *G. Kantvilas 181/98*, 25.ix.1998 (HO); • above Black Gully Creek, 1 km NE of Hamilton, 42°33′S, 146°51′E, 140 m alt., on fragment of old leather on ground in open degraded *Eucalyptus pauciflora* woodland, *G. Kantvilas 229/99,* 3.vi.1999 (HO); • Pontville Small Arms Range Complex, 42°40′S, 147°17′E, 70 m alt., on decorticated eucalypt wood in degraded pasture, *G. Kantvilas 222/03*, 12.vi.2003 (HO); • Slaves Bay, 40°55′S, 144°39′E, 15 m alt., on twigs of *Melaleuca ericifolia* in disturbed coastal scrub at edge of pasture, *G. Kantvilas 542/03C*, 13.x.2003 (HO); • Earlham, 42°40′S, 147°57′E, 20 m alt., on loose piece of dead wood in a sheep paddock, *G. Kantvilas 156/07*, 9.iv.2007, (HO).

Western Australia: • Porongorup Range, northern foothills, Castle Rock Road, 34°41′S, 117°55′E, on decorticated eucalypt log in dry sclerophyll forest, *G. Kantvilas 390/92 & J. Jarman*, 14.x.1992 (HO).

5. Amandinea occidentalis Elix & Kantvilas, sp. nov. Fig. 5
Mycobank No. **MB 803080**

Amandineae lignicolae var. *australi* similis sed ascis plerumque tetrasporis, hymenio sparse insperso et ascosporis maioribus, 22–30 mm longis, 9–14 mm latis differt.

Type: Australia, Western Australia, unnamed Nature Park, 20 km S of Moora along Gingin Road, 3 km E on Bullbarnet Road, 30°41′38″S, 116°12′19″E, 225 m alt., on base of dead *Acacia* in remnant *Eucalyptus*-*Acacia* woodland along seasonal creek, *J.A. Elix 37169*, 2.iv.2006 (holotype – CANB; isotype – PERTH).

Thallus crustose, thin, areolate, continuous to dispersed, smooth and generally esorediate, or in part scurfy-granulose, eroded and ±sorediate, or with the granules becoming elongate, corticate and resembling gnarled isidia, pale grey to greenish grey or olive-brown, 1–5 cm wide; prothallus not apparent; cortex *c.* 10 µm thick; photobiont cells 8–18 µm wide. *Apothecia* 0.2–1.2 mm wide, lecideine, broadly adnate to sessile; disc black, epruinose, weakly concave at first, then ±plane to convex, scattered or crowded; proper excipulum distinct, persistent, black, in section 100–125 µm thick, dark brown to black-brown, N+ red-brown, paler within. *Epihymenium* 10–15 µm thick, dark brown to dark olive-brown, K–. *Hypothecium* 50–100 µm thick, dark brown, K–. *Hymenium* 85–105 µm thick, colourless, sparsely inspersed; paraphyses 1.5–2.0 µm wide, simple to weakly branched, capitate, with apices 4–5 µm wide, dark brown; asci of the *Bacidia*-type, (2–)4(–8)-spored. *Ascospores* at first of the *Physconia*-type, then of the *Buellia*-type, 1-septate, grey-green to brown, ellipsoid to broadly fusiform, 22–30 × 9–14 µm, ±constricted at the septum, often pointed at the apices, ±curved, with weak to moderate medial wall-thickenings when immature; outer spore wall smooth to finely ornamented. *Pycnidia* immersed, pyriform; conidia filiform, curved, 18–28 × 1 µm.

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

Etymology: The specific epithet refers to the occurrence of this species in Western (Latin, *occidentalis*) Australia.

Remarks
This new species is characterized by the crustose, pale grey to greenish grey or olive-brown thallus that is smooth to granulose-sorediate or isidiate, asci typically containing fewer than 8-ascospores, the 1-septate, *Physconia*- to *Buellia*-type ascospores with a smooth to finely ornamented outer wall, the hymenium sparingly inspersed with oil droplets and the absence of lichen substances. The morphology of this new species resembles that of *A. lignicola* var. *australis*, but the latter differs in often having a subsquamulose thallus, 8-spored asci with smaller ascospores (11–20 × 5–8 μm) and a non-inspersed hymenium.

Amandinea occidentalis is known only from Western Australia, where it occurs on the bark of trees in open *Eucalyptus-Acacia* woodland in the south-west. Associated species include *Austroparmelina macrospora* (Elix & J.Johnst.) A.Crespo, Divakar & Elix, *A. subarida* (Elix) A.Crespo, Divakar & Elix, *Buellia tetrapla* Nyl., *Flavoparmelia rutidota* (Hook.f. & Taylor) Hale, *Haematomma eremaeum* R.W.Rogers, *Pertusaria pertractata* Stirt., *Physcia jackii* Moberg, *Ramalina inflata* G.N.Stevens subsp. *inflata*, *Ramboldia brunneocarpa* Kantvilas & Elix and *Usnea scabrida* Taylor subsp. *scabrida*.

SPECIMEN EXAMINED
Western Australia: • Walebing, Quarrell Range, Moora-New Norcia Road, 22 km S of Moora, 30°41′38″S, 116°12′20″E, 275 m alt., on base of *Allocasuarina* in remnant *Eucalyptus-Acacia* woodland along seasonal creek, *J.A. Elix 37565*, 2.iv.2006 (CANB, HO).

6. Amandinea pillagaensis Elix & Kantvilas, sp. nov. Fig. 6
Mycobank No. **MB 803082**

Amandineae subduplicatae (Vain.) Marbach similis sed ascosporis maioribus, 17–25 μm longis, 7–12 μm latis, ellipoideis vel fusiformibus, pariete exteriore laevi, conidiis longioribus, 25–38 μm longis, et atranorinum destituto differt.

Type: Australia, New South Wales, junction of Pillaga Forest Way and Reedy Creek Road, 37 km W of Newell Highway, 30°32′18″S, 149°35′36″E, 252 m alt., on Ericaceae in *Eucalyptus-Callitris-Allocasuarina* woodland, *J.A. Elix 45388*, 11.v.2005 (holotype – CANB; isotype – NSW).

Thallus crustose, continuous, smooth to indistinctly areolate, thin, uneven to occasionally verruculose, white to pale grey or greenish grey, esorediate, 0.5–6.5 cm wide; prothallus marginal, black or not apparent; cortex *c.* 10 μm thick; medulla white, lacking calcium oxalate (H_2SO_4–), I–; photobiont cells 8–16 μm wide. *Apothecia* 0.1–0.7 mm wide, lecideine, broadly adnate; disc black, epruinose, weakly concave at first, then ±plane to weakly convex, scattered or crowded; proper excipulum distinct, ±persistent, excluded in older, convex apothecia, black, in section 75–150 μm thick, dark red-brown to black-brown, N– or N+ weak red-brown, paler within. *Epihymenium* 8–20 μm thick, dark olive-brown to dark brown, K–, N–. *Hypothecium* 30–75 μm thick, dark brown to dark red-brown. *Hymenium* 50–100 μm thick, colourless, inspersed with scattered oil droplets; paraphyses 1.8–2.0 μm wide, simple to weakly branched, capitate, with dark red-brown apices, 3–5 μm wide; asci of the *Bacidia*-type, 4–8-spored. *Ascospores* of the *Buellia*-type, 1-septate, grey-green to brown, ellipsoid then broadly fusiform, 17–25 × 7–12 μm, ±constricted at the septum, ±curved, often pointed at the apices, with weak subapical wall-thickenings when immature, more rarely with apical wall thickenings pronounced (as in *Cratiria*); outer spore wall smooth. *Pycnidia* immersed, pyriform; conidia filiform, curved, 25–38 × 0.4–0.6 μm.
Chemistry: Thallus K–, KC–, P–, C–, UV–; lacking lichen substances or containing traces of atranorin.

Etymology: The specific epithet is derived from the type locality of the species.

Remarks
This new species is characterized by the thin, crustose, white to pale grey thallus, the 4–8-spored asci, the 1-septate, ellipsoid then broadly fusiform, *Buellia*-type ascospores with a smooth outer wall, the hymenium with scattered oil droplets, and by the absence of lichen substances or rarely with traces of atranorin. *Amandinea subduplicata* (Vain.) Marbach differs in containing substantial amounts of atranorin (thallus K+ yellow), in having 8-spored asci, slightly smaller, ellipsoid ascospores (17–23 × 7–9 μm) with a strongly ornamented outer wall, and shorter conidia (24–27 μm). In addition, the ascospores of *A. subduplicata* are not constricted at the septum, and they lack subapical and apical wall thickenings.

Amandinea pillagaensis is known from branches and twigs of shrubs and trees and dead wood in hinterland forests of northern New South Wales and southern Queensland. Associated species include *Cratiria lauricassiae* (Fée) Marbach, *Chrysothrix xanthina* (Vain.) Kalb, *Hyperphyscia adglutinata* (Flörke) H.Mayrhofer & Poelt, *Lecanora flavidomarginata* de Lesd., *Parmotrema subsumptum* (Nyl.) Hale, *Punctelia subflava* (Taylor) Elix & J.Johnst., *Tephromela alectoronica* Kalb and *Usnea scabrida* subsp. *elegans* (Stirt.) G.N.Stevens.

SPECIMENS EXAMINED
Queensland: • Bunya Mountains State Forest, Nanango Road, 64 km NE of Dalby, 26°51′49″S, 151°38′51″E, 670 m alt., on dead branch in mixed *Eucalyptus-Araucaria* forest, *J.A. Elix 37925*, 7.v.2005 (CANB); • Bunya Mountains State Forest, 46 km S of Kingaroy, 26°48′13″S, 151°33′44″E, 765 m alt., on dead wood in mixed *Eucalyptus-Araucaria* forest, *J.A. Elix 38639*, 7.v.2005 (CANB).
New South Wales: • type locality, on *Allocasuarina*, *J.A. Elix 45366*, 11.v.2005 (CANB); *loc. id.*, on *Callitris*, *J.A. Elix 45378*, 11.v.2005 (HO); *loc. id.*, *J.A. Elix 45379*, 11.v.2005 (CANB).

7. Amandinea stajsicii Elix & Kantvilas, sp. nov. Fig. 7
Mycobank No. **MB 803081**

Orculariae insperatae similis sed apotheciis ab initio et persistente lecideinis et ascosporis primo *Orculariae*-typo accedentibus tandem *Physconiae*-typi differt.

Type: Australia, Victoria, Gippsland Plain region, Black Rock-Beaumaris boundary, beach opposite McGregor Avenue, near the pedestrian ramp, 37°59′01″S, 145°01′21″E, 1 m alt., on twigs and small branches of *Banksia integrifolia* in remnant vegetation along beach, *V. Stajsic 4675*, 20.vii.2007 (holotype – MEL; isotypes – CANB, HO).

Thallus crustose, smooth, 0.5–5.0 cm wide, to 0.5 mm thick, continuous to rimose-areolate or verrucose, dirty white to pale brown, yellow-grey or pale grey, esorediate; prothallus absent; cortex 10–20 μm thick; medulla white, lacking calcium oxalate (H_2SO_4–), I–. *Apothecia* 0.1–0.5 mm wide, scattered or crowded, lecideine from the outset, broadly adnate; disc black, epruinose, plane to weakly convex; proper excipulum distinct, persistent, in section 20–30 μm thick, with outer zone dark brown to dark red-brown, K–, ±hyaline within. *Epihymenium* 8–13 μm thick, dark brown to dark olive-brown, K–, N–. *Hypothecium* 40–80 μm thick, pale brown. *Hymenium* 40–75 μm thick, colourless, not inspersed; paraphyses 1–2 μm wide, simple to branched, capitate, with apices 4–6 μm wide, dark brown; asci of the *Bacidia*-type, 8-spored. *Ascospores* at first of the *Orcularia*-type, later of the *Physconia*-type, 1-septate, pale olive-green to brown, ellipsoid, 12–18 × 6–10 μm, constricted at the septum; locules of immature spores connected by an elongate narrow channel; outer spore wall smooth. *Pycnidia* immersed, black, *c.* 0.08 mm wide; conidia filiform, curved, 14–30 × 1 μm.
Chemistry: Thallus K–, KC–, P–, C–, UV–; no lichen substances detected.

Etymology: This species is named after our friend and lichen collector Val Stajsic.

Remarks
The new species closely resembles *O. insperata* (Nyl.) Kalb & Giralt, but differs in the development of its apothecia and ascospores. In *O. insperata,* the immersed and then adnate apothecia are lecanorine at first, then biatorine and finally lecideine, and the thalline exciple, which is initially prominent and concolorous with the thallus, is soon reduced or excluded. In contrast, in *A. stajsicii* the apothecia are invariably broadly adnate and lecideine throughout all stages of development. At certain stages of their ontogeny, the ascospores of the two species are superficially very similar. However, in *O. insperata* the medial spore wall thickenings occur before insertion of the septum (Kalb & Giralt 2011), whereas in *A. stajsicii* the septum is inserted prior to the spore wall thickenings becoming apparent. Furthermore, whilst the mature ascospores of *A. stajsicii* soon become *Physconia*-type, those of *O. insperata* remain persistently of the *Orcularia*-type. More similar is *Amandinea dudleyensis* (see above), which displays apothecial and spore morphology identical to that of *A. stajsicii*, but it differs in having incrementally larger ascospores. The common and widespread *A. punctata* sometimes occurs in the same habitats as *A. stajsicii,* but differs in having ascospores that are initially of the *Physconia*-type and ultimately of the *Buellia*-type.

Amandinea stajsicii is widespread in coastal areas of south-eastern Australia, including Tasmania, Victoria, the Bass Strait islands and Kangaroo Island (South Australia). Most collections are from the twigs and small trunks of various shrubs and small trees, usually in rather windswept, exposed habitats or occasionally in denser scrubby woodland. *Allocasuarina verticillata*, species of *Melaleuca* and *Leptospermum*, and *Acacia sophorae* are typical hosts. There the new species is usually a component of a rich assemblage of lichens, including *Flavoparmelia rutidota* (Hook.f. & Taylor) Hale, *Halegrapha mucronata* (Stirt.) Lücking, *Lecanora flavopallida* Stirt., *Lecidea xylogena* Müll.Arg., *Ramalina fissa* (Müll.Arg.) Vain. and species of *Caloplaca*.

SPECIMENS EXAMINED
Tasmania: • Granville Harbour, 41°49′S, 145°02′E, 20 m alt., on dead twigs in *Melaleuca squarrosa* wet, closed woodland, *G. Kantvilas 252/84 & P.James*, 7.ii.1984 (BM, HO); • Granville Harbour, 41°49′S, 145°02′E, 5 m alt., on *Cyathodes abietina* shrubs along foreshore, *G. Kantvilas 168/97*, 8.v.1997 (HO); • Stanley Highway, 40°47′S, 145°16′E, 5 m alt., on fallen log in *Melaleuca ericifolia* swamp, *A.M. Gray*, 27.ii.1998 (HO); • The Nut, 40°46′S, 145°18′E, 140 m alt., on dead twigs of *Melaleuca ericifolia* in degraded, coastal heathland, *G. Kantvilas 279/99*, 28.vi.1999 (HO); • Rocky Cape, Burgess Cove, 40°52′S, 145°30′E, on twigs of *Acacia sophorae* in coastal scrub, *G. Kantvilas 295/99*, 28.vi.1999 (HO); Bruny Island, The Neck, 43°16′S, 147°21′E, on dead shrubs in coastal heathland, *G. Kantvilas 384/99*, 27.xi.1999 (HO); • Cape Deslacs, 42°59′S, 147°33′E, 40 m alt., on *Allocasuarina verticillata* in coastal woodland, *G. Kantvilas 103/11*, 16.ii.2011 (HO).
Bass Strait: • Deal Island, Lighthouse Gully, 39°29′S, 147°19′E, 118 m alt., on wood and branches of *Leptospermum scoparium*, *J.S. Whinray*, 11.xii.1971 (HO, MEL); • Boxen Island, *c.* 10 m N of the summit, 40°22′S, 147°54′E, 6 m alt., on dead bush, *J.S. Whinray 1168*, 22.i.1979 (HO, MEL).
Victoria: • Seaford, foreshore reserve, 38°06′21″S, 145°07′32″E, on dead branchlets of a living *Allocasuarina verticillata*, *V. Stajsic 4941*, 17.i.2009 (HO, MEL); • Brighton, Jim Willis Reserve, 37°55′23″S, 144°59′14″E, on peeling bark on the trunk of a dead *Allocasuarina verticillata*, *V. Stajsic 4060*, 6.vi.2006 (HO, MEL); • same locality, on dead twigs of *Lycium ferocissimum, V. Stajsic 4061*, 6.vi.2006 (HO, MEL).
South Australia: • Kangaroo Island, Cape Borda, 35°45′S, 136°35′E, 100 m alt., in dense, heathy vegetation, *H.T. Lumbsch 1094, A. Dickhäuser & H. Streimann*, 28.ix.1994 (CANB); • Kangaroo Island, northern end of Antechamber Bay, 35°47′S, 138°04′E, 10 m alt., on twigs of eucalypts bordering coastal scrub, *G. Kantvilas 509/12*, 18.ix.2012 (AD, HO).

New records for Australia

1. Amandinea isabellina (Hue) Søchting & Øvstedal, *Biblioth. Lichenol.* **88**, 615 (2004)

This species was previously known from Antarctica and South Georgia (Lamb 1968, Øvstedal & Lewis Smith 2001). It is characterized by the grey-white, pale brown to brown thallus composed of congested verruculae, the thin black to brown-black marginal prothallus, straight to slightly curved, ellipsoid, *Physconia*-type ascospores (12–)14–18(–20) × 7–10 µm, filiform conidia 10–23 × 0.7–1.0 µm, and by the absence of lichen substances. A detailed description is given in Lamb (1968, as *Buellia isabellina*). This species has been recorded from highland areas in Tasmania, where it grows on exposed rocks, typically forming small, well-separated thalli amongst other crustose lichens.

SPECIMENS EXAMINED
Tasmania: • Lake Kaye, 41°54′S, 146°31′E, 1140 m alt., on basalt boulders in alpine heathland, *G. Kantvilas 127/09 pr.p.,* 11.iii.2009 (HO); • Bisdee Tier, 42°26′S, 147°17′E, 640 m alt., on dolerite boulder in rocky grassland, *G. Kantvilas 127/09 pr.p.,* 11.iii.2009 (HO); • Espies Craig, 42°34′S, 147°01′E, 600 m alt., on vertical dolerite tor in open, eucalypt forest, *G. Kantvilas 366/12,* 14.viii.2012 (HO).

2. Amandinea montana (H.Magn.) Marbach, *Biblioth. Lichenol.* **74**, 93 (2000)

This species was known previously from India and Kenya (Marbach 2000). It is characterized by the thick, off-white to olive-brown, crustose thallus with a smooth upper surface, the immersed to sessile apothecia, the *Buellia*-type, often slightly bent ascospores, 17–26 × 9–13 µm with a strongly ornamented outer surface and by the absence of lichen substances. *Amandinea submontana* Marbach is very similar, but has smaller ascospores (14–16 × 7–9 µm). A detailed description is given in Marbach (2000).

SPECIMEN EXAMINED
Queensland: • Isla Gorge National Park, 27 km NNE of Taroom, 25°10′S, 149°59′E, 220 m alt., on dead wood in dry monsoon scrub with *Brachychiton* on gently sloping terrace above stream, *J.A. Elix 35160*, 31.viii.1993 (B, CANB).

3. Amandinea otagoensis (Zahlbr.) Blaha & H.Mayrhofer, in J.Blaha, *Taxonomische Studien an saxicolen Arten der Flechtengattung Amandinea (lichenisierte Ascomyceten, Physciaceae) von Neuseeland*: 46 (2002)

This species was known previously from New Zealand (Galloway 2007). It is characterized by the whitish to grey or greyish brown, crustose thallus, the immersed or rarely adnate apothecia, the *Physconia*-type ascospores 12–16 × 8–10 µm, the curved, filiform conidia 15–30 × 1 µm and by the absence of lichen substances. *Amandinea pelidna* is rather similar, but differs in having sessile apothecia and slightly smaller ascospores 10–15 × 6.5–8 µm. A detailed description is given in Galloway (1985, as *Buellia otagoensis*). The species is recorded here from Tasmania, where it grows on highly weathered coastal rocks.

SPECIMENS EXAMINED
Tasmania: • Mortimer Bay, S of Gorringes Beach, 43°00′S, 147°28′E, 0 m, on Permian mudstone rock shelf, immediately above high tide mark, *G. Kantvilas 175/00*, 24. iv.2000 (CANB, HO); • Earlham Estate, *c.* 0.75 km SW of Point des Galets, 42°41′S, 147°57′E, 10 m, on highly weathered dolerite coastal rocks, *G. Kantvilas 301/12*, 27. v.2012 (HO).

New state records

1. Amandinea pelidna (Ach.) Fryday & L.Arcadia, *Graphis Scripta* **24**, 43 (2012)
Syn. *Amandinea lecideina* (H.Mayrhofer & Poelt) Scheid. & H.Mayrhofer, *in* C. Scheidegger, *Lichenologist* **25**, 342 (1993).

In Australia this species was known from siliceous coastal rocks in South Australia and Tasmania (Elix 2011; McCarthy 2012). It is also known from Europe, North and Central America, North Africa, Asia and New Zealand (Elix 2011).

SPECIMENS EXAMINED
New South Wales: • Sawtell, 30°21'S, 153°06'E, on rock, *R.C. Carruthers 68/408*, iv.1968 (HO); • Bare Bluff, 20 km N of Coffs Harbour, 30°09'S, 153°12'E, 4 m alt., on rocks along the foreshore, *J.A. Elix 3534*, 1.vii.1977 (CANB).
Victoria: • South Yarra, Royal Botanic Gardens, Plant Craft Cottage, 37°49'38"S, 144°58'46"E, on mudstone in artificial, E-facing cutting, *V. Stajsic 6205*, 24.iv.2012 (HO, MEL).

Key to *Amandinea* and *Orcularia* in Australia

1 Thallus growing on rock 2
1: Thallus growing on bark or wood 9

2 Ascospores *Buellia*-type ..... **A. punctata**
2: Ascospores *Physconia*-type, *Pachysporaria*- to *Buellia*-type, *Physconia*- to *Buellia*-type, or *Orcularia*- to *Physconia*-type 3

3 Ascospores *Orcularia*- to *Physconia*-type, 15–24 × 10–15 µm; apothecia usually greyish white-pruinose ..... **A. decedens**
3: Ascospores *Physconia*-type, *Physconia*- to *Buellia*-type or *Pachysporaria*- to *Buellia*-type; apothecia always epruinose 4

4 Norstictic acid present; thallus K+ yellow then red ..... **A. devilliersiana**
4: Norstictic acid absent; thallus K– 5

5 Apothecia usually immersed; ascospores 12–16 × 8–10 µm, not constricted at the septum ..... **A. otagoensis**
5: Apothecia adnate to sessile 6

6 Apothecia adnate; ascospores 12–20 × 7–10 µm 7
6: Apothecia sessile; ascospores 10–16 × 5–8 µm 8

7 Conidia 15–30 µm long; thallus areolate; areoles 0.1–0.3 mm wide; coastal Tasmania ..... **A. coniops**
7: Conidia 10–23 µm long; thallus verruculose; congested verruculae 0.2–0.5 mm wide; montane Tasmania ..... **A. isabellina**

8 Hymenium inspersed; ascospores *Pachysporaria*- to *Buellia*-type, 5–7 µm wide; often constricted at the septum ..... **A. conglomerata**
8: Hymenium not inspersed; ascospores *Physconia*- to *Buellia*-type, 6.5–8 µm wide; not constricted at the septum ..... **A. pelidna**

9 Ascospores *Orcularia*-type or *Orcularia*- then *Physconia*-type 10
9: Ascospores *Buellia*- or *Physconia*-type then *Buellia*-type 13

10 Ascospores persistently *Orcularia*-type 11
10: Ascospores initially *Orcularia*-type then *Physconia*-type 12

11 Ascospores (11–)13–18(–22) × (6.5–)7–9(–10) µm ..... **O. insperata**
11: Ascospores (10–)12–15(–16.5) × (5–)6–7.5(–8.5) µm ..... **O. elixii**

12 Ascospores 12–18 × 6–10 µm ..... **A. stajsicii**
12: Ascospores 20–28 × 9–14 µm ..... **A. dudleyensis**

13 Ascospores *Physconia*- then *Buellia*-type; thallus granular, subsorediate or subisidiate 14
13: Ascospores *Buellia*-type; thallus sorediate or not 15

14 Asci 8-spored; ascospores 11–20 × 5–8 µm; thallus often subsquamulose ..... **A. lignicola** var. **australis**
14: Asci 2–8-spored; ascospores 22–30 × 9–14 µm; thallus crustose .... **A. occidentalis**

15 Thallus yellow; medulla C+ orange, UV+ orange ... **A. diorista** var. **hypopelidna**
15: Thallus white, grey or brown; medulla C–, UV– 16

16 Thallus sorediate; thallus UV+ orange; soralia UV+ turquoise; lobaric acid and 4,5-dichlorolichexanthone present ..... **A. efflorescens**
16: Thallus not sorediate; thallus UV–; lichen substances absent or atranorin present 17

17 Thallus white, K+ yellow; atranorin present ..... **A. subduplicata**
17: Thallus white, grey or brown, K–; atranorin absent or trace only 18

18 Ascospores 8–20 × 5–9 µm; outer spore wall smooth to weakly ornamented ..... **A. punctata**
18: Ascospores 17–26 × 7–13 µm; outer spore wall smooth to strongly ornamented .. 19

19 Ascospores ellipsoid, not constricted; outer spore wall strongly ornamented ..... **A. montana**
19: Ascospores ellipsoid then broadly fusiform, ±constricted; outer spore wall smooth ..... **A. pillagaensis**

Acknowledgements
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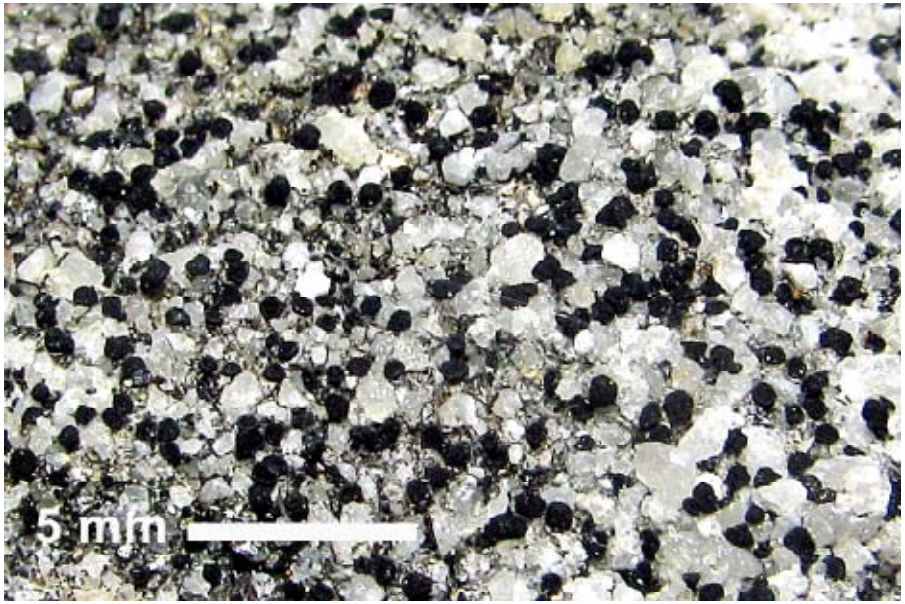
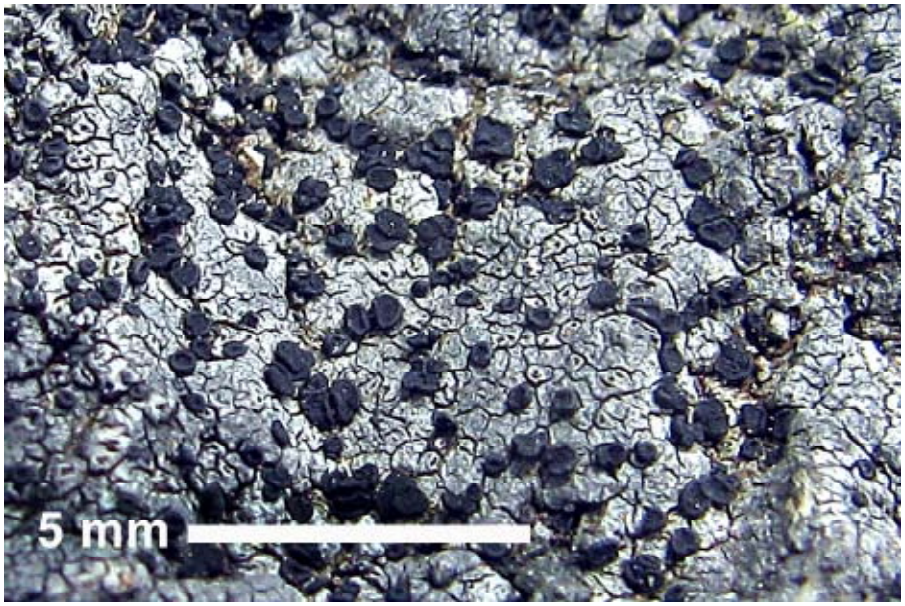


1. *Amandinea conglomerata* (holotype in HO).



2. *Amandinea devilliersiana* (isotype in CANB).

3. *Amandinea dudleyensis* (holotype in HO).

4. *Amandinea lignicola* var. *australis* (holotype in HO).

5. *Amandinea occidentalis* (holotype in CANB).

6. *Amandinea pillagaensis* (*J.A. Elix 38639* in CANB).

7. *Amandinea stajsicii* (isotype in CANB).

Further new species and new records of *Tephromela* (lichenized Ascomycota) from Australia

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Abstract: *Tephromela erosa* Elix, *T. neobunyana* Elix and *T. nothofagi* Elix are described as new to science. In addition, *Tephromela americana* (Fée) Kalb and *T. promontorii* (Zahlbr.) Kalb are recorded for the first time from Australia, new state records are reported for another eight species, and an updated key to *Tephromela* in Australia is provided.

The publication of the first comprehensive account of the genus *Tephromela* in Australia (Elix 2009) inspired a re-examination of large numbers of herbarium holdings, and several new species have subsequently been described (Elix 2012). However, I have since encountered further new taxa, three of which are described in the present paper. Chemical constituents were identified by thin-layer chromatography (Elix & Ernst-Russell 1993), high-performance liquid chromatography (Elix *et al.* 2003) and comparison with authentic samples.

The new species

1. Tephromela erosa Elix, sp. nov. Fig. 1
Mycobank No. **MB 802401**

Similar to *Tephromela grumosa,* but differs in having a white prothallus and in containing α-collatolic acid as the major medullary constituent.

Type: Australia. *South Australia*: Nullarbor district: Eyre Highway, Nullarbor Plain, 168 km W of Nullarbor, 31°35′S, 129°20′E, on shrubs in chenopod shrubland, *M.F. Day 85/23,* 25.viii.1985 (holotype – CANB).

Thallus crustose, corticolous, continuous or becoming cracked, areolate to rimose, 0.1–0.25 mm thick, up to 5 cm wide; *areoles* angular to irregularly shaped or rounded, 0.2–0.4 mm wide; *upper surface* whitish, creamy white or grey-white, verrucose or often distinctly bullate, white-maculate, lacking isidia, with erose soredia; margins of areoles becoming ecorticate, eroded and sparsely sorediate, soredia blue-grey, coarsely granular. *Prothallus* white. *Apothecia* common, scattered to crowded, innate then adnate to sessile, ±constricted at the base, 0.8–2.0 mm wide; disc ±flat, undulate or convex, roundish, black, glossy, epruinose; thalline exciple usually prominent, thin, persistent, smooth, rarely reduced or not developed; proper exciple poorly defined; epihymenium dark reddish violet to violet-brown, 5–10 μm thick; hymenium violet to violet-red in the upper part, 75–100 μm thick, not inspersed; hypothecium yellow-brown, 50–70 μm thick, K+ orange-brown. *Paraphyses* 3.0–5.0 μm wide, simple or sparingly branched, thick-walled; apices swollen or not. *Asci* clavate, *Bacidia*-type, 8-spored. *Ascospores* simple, ellipsoid, thick-walled, 11–15 × 5–7 μm. *Pycnidia* not seen.
Chemistry: Cortex K+ yellow, C–, KC–, P– or P+ pale yellow; medulla K–, C–, KC+ pink, P–, UV+ blue-white; containing atranorin [major], α-collatolic acid [major], alectoronic acid [trace], 4-*O*-methylphysodic acid [trace].

Etymology: The specific epithet is derived from the erose-sorediate upper surface of the thallus.

Notes. This new species is characterized by the whitish to creamy white or grey-white thallus, the distinctly verrucose to bullate upper surface, the diffusely sorediate upper surface formed by breakdown of the upper cortex and the presence of atranorin and

α-collatolic acid. It differs from the morphologically similar *T. grumosa* (Pers.) Hafellner & Cl. Roux by its preference for corticolous substrata (*T. grumosa* is primarily saxicolous), in having a white prothallus (blue-black in *T. grumosa*), and in containing α-collatolic acid (*T. grumosa* contains atranorin, lichesterinic and protolichesterinic acids).

This species is rare on bark in the Nullarbor Plain region of far western South Australia. Associated species include *Austroparmelina pruinata* (Müll.Arg.) A.Crespo, Divakar & Elix, *Buellia dissa* (Stirt.) Zahlbr., *Caloplaca dahlii* (Nyl.) Elix, S.Y.Kondr. & Kärnefelt, *Flavoparmelia rutidota* (Hook.f. & Taylor) Hale, *Lecanora flavidomarginata* de Lesd., *Ramalina inflata* subsp. *australis* G.N.Stevens, *Physcia rolandii* Elix, *P. verrucosa* Moberg and *Usnea scabrida* Taylor subsp. *scabrida*.

SPECIMEN EXAMINED
South Australia: • Eyre Highway near Conderla Tank, 37 km E of Penong, 31°56′S, 133°24′E, 90 m, on *Leptospermum* in low, dry sclerophyll forest, *J.A. Elix 41681*, 20. ix.1994 (CANB).

2. Tephromela neobunyana Elix, sp. nov. Fig. 2
Mycobank No. **MB 802402**

Similar to *Tephromela bunyana,* but containing physodic acid as the major secondary metabolite, and having shorter conidia.

Type: Australia. *Queensland*: Bunya Mountains State Forest, Nanango Road, 64 km NE of Dalby, 26°51′49″S, 151°38′51″E, 670 m, on dead wood in mixed *Eucalyptus-Araucaria* forest, *J.A. Elix 3797,* 7.v.2005 (holotype – CANB).

Thallus corticolous, crustose, creamy white or pale grey, continuous or becoming cracked, areolate and rugulose with age, *c.* 0.1 mm thick, up to 3 cm wide; *areoles* angular to irregularly shaped, 0.4–1.0 mm wide, upper surface flat and smooth to weakly convex, lacking isidia and soredia. *Prothallus* not apparent. *Apothecia* common, dispersed, sessile, constricted at the base, 0.1–0.6 mm wide; disc flat or ±undulate, roundish, black, shiny, epruinose; thalline exciple prominent, persistent, smooth; proper exciple colourless, 100–200 μm thick; epihymenium dark violet-brown; hymenium pale violet to violet-brown, 40–50 μm tall; hypothecium orange-brown to yellow-brown, 75–100 μm thick. *Paraphyses* 3.0–5.0 μm wide, simple or sparingly branched, thick-walled; apices swollen or not, often pigmented green to violet-black. *Asci* clavate, *Bacidia*-type, 8-spored. *Ascospores* simple, broadly ellipsoid to subglobose, thick-walled, 8–15 × 6–8 μm. *Pycnidia* rare, immersed; conidia filiform, 7–15 × 1 μm.
Chemistry: Cortex K+ yellow, C–, KC–, P– or P+ pale yellow; medulla K–, C–, KC+ pink, P–, UV+ blue-white; containing atranorin [minor], colensoic acid [minor], norcolensoic acid [minor], physodic acid [major], 4-*O*-methylphysodic acid [minor].

Etymology: The specific epithet is derived from the similarity of this species to *Tephromela bunyana* Kalb & Elix.

Notes. The growth habit, apothecial anatomy and ascospores of this species closely resemble those of *Tephromela bunyana*, but *T. bunyana* can be distinguished by its longer conidia (17–28 μm *versus* 7–15 μm) and its chemistry (Kalb 2004). Thus, whereas *T. bunyana* contains norglomelliferonic acid as the major secondary metabolite together with colensoic acid [minor], norcolensoic acid [submajor] and stenosporonic acid [minor], *T. neobunyana* contains physodic acid as the major component.

At present this species is known only from the Bunya Mountains in south-eastern Queensland. Associated species include *Heterodermia albicans* (Pers.) Swinscow & Krog, *H. boryi* (Fée) K.P.Singh & S.R.Singh, *H. comosa* (Eschw.) Follmann & Redón, *H. subcitrina* Moberg, *Hypotrachyna osseoalba* (Vain.) Y.S.Park & Hale, *Lecanora achroa* Nyl., *Megalospora melanodermia* (Müll.Arg.) Zahlbr., *Pannaria fulvescens* (Mont.) Nyl., *Parmo-*

trema mellissii (C.W.Dodge) Hale, *Physcia poncinsii* Hue, *Parmelinopsis subfatiscens* (Kurok.) Elix & Hale, *Phyllopsora buettneri* (Müll.Arg.) Zahlbr., *Tephromela bunyana*, *Relicina sydneyensis* (Gyeln.) Hale and *Usnea dasaea* Stirt.

SPECIMENS EXAMINED
Queensland: • Bunya Mountains National Park, summit of Mt Kiangarow, 68 km N of Dalby, 26°50′17″S, 151°33′12″E, 1146 m, on *Xanthorrhoea* at margin of rainforest, *J.A. Elix 37648*, 6.v.2005 (CANB); • Bunya Mountains State Forest, 46 km S of Kingaroy, 26°48′13″S, 151°33′44″E, 765 m, on dead wood in mixed *Eucalyptus*-*Araucaria* forest, *J.A. Elix 38645*, 7.v.2005 (CANB); • Ellinjaa Falls, *c.* 5 km ENE of Millaa Millaa, 17°29′38″S, 145°39′20″E, 705 m, on fallen branch in remnant rainforest near falls, *J.A. Elix 39620A*, 29.viii.2006 (CANB).

3. Tephromela nothofagi Elix, sp. nov. Fig. 3
Mycobank No. **MB 802403**

Similar to *Tephromela bullata*, but with a smooth thallus and shorter conidia, and containing alectoronic acid as the major component.

Type: Australia. *New South Wales*: New England National Park, Weeping Rocks Track, 72 km E of Armidale, 30°30′S, 152°24′E, 1400 m, on canopy twigs of *Nothofagus moorei* in *Nothofagus*-*Elaeocarpus*-dominated forest at base of escarpment, *J.A. Elix 33885*, 17. viii.1993 (holotype – CANB; isotype – B).

Thallus corticolous, crustose, creamy white to pale grey-white or greenish grey, continuous or becoming cracked and ±areolate with age, *c.* 0.1 mm thick, up to 6 cm wide; *areoles* angular to irregularly shaped, 0.4–2.0 mm wide, upper surface smooth to weakly wrinkled, lacking isidia and soredia. *Prothallus* not apparent. *Apothecia* common, dispersed, immersed then adnate, not constricted at the base, 0.5–1.4 mm wide; disc flat or ±weakly concave, roundish, black, shiny, epruinose; thalline exciple prominent, persistent, smooth then crenulate; proper exciple poorly developed; epihymenium intense violet-brown, 12–16 μm thick; hymenium to violet-brown to pale violet-brown in the lower part, 75–125 μm thick; hypothecium purple-brown to yellow-brown, 70–85 μm thick. *Paraphyses* 3.0–5.0 μm wide, simple or sparingly branched, thick-walled; apices swollen or not, often pigmented green to violet-black. *Asci* clavate, *Bacidia*-type, 8-spored. *Ascospores* simple, broadly ellipsoid to subglobose, thick-walled, 12–15 × 7–9 μm. *Pycnidia* rare, immersed; conidia filiform, 10–14 × 1 μm. *Chemistry*: Cortex K+ yellow, C–, KC–, P– or P+ pale yellow; medulla K–, C–, KC+ pink, P–, UV+ blue-white; containing atranorin [minor], α-collatolic acid [minor], alectoronic acid [major], 4-*O*-methylphysodic acid [trace], physodic acid [trace].

Etymology: The specific epithet refers to *Nothofagus*, the most common phorophyte of this species.

Notes. This new species is characterized by the whitish to creamy white to grey-white or greenish grey thallus, the ±smooth upper surface, the absence of soredia and isidia and the presence of atranorin, alectoronic and α-collatolic acids. It differs from the chemically similar *T. atra* (Huds.) Hafellner by its preference for corticolous or lignicolous substrata (*T. atra* is primarily saxicolous), in lacking a prothallus (black in *T. atra*), having a thinner hypothecium (70–85 μm *versus* 100–150 μm), larger ascospores (12–15 × 7–9 μm *versus* 10–14 × 6–8 μm) and shorter conidia (10–14 μm *versus* 12–24 μm). Another similar species, *T. bullata* Elix, has a bullate to verrucose upper surface and longer conidia (15–23 μm), and contains α-collatolic acid as the major secondary substance.

At present *T. nothofagi* is known only from areas of rainforest in the mountains of eastern New South Wales. Associated species include *Coccocarpia palmicola* (Spreng.) Arv. & D.J.Galloway, *Erioderma sorediatum* D.J.Galloway & P.M.Jørg., *Fuscoderma amphibolum* (C.Knight) P.M.Jørg. & D.J.Galloway, *Hypotrachyna osseoalba* (Vain.) Y.S.Park & Hale, *Leptogium biloculare* F.Wilson, *L. cochleatum* (Dickson) P.M.Jørg. & P.James, *Menegazzia eperforata* P.James & D.J.Galloway, *M. grandis* P.James, *M. nothofagi* (Zahlbr.) P.James & D.J.Galloway, *Pannaria sphinctrina* (Mont.) Hue, *Parmotrema mellissii* (C.W.Dodge) Hale, *Parmelinopsis subfatiscens* (Kurok.) Elix & Hale, *Phyllopsora buettneri* (Müll.Arg.) Zahlbr., *Ramboldia brunneocarpa* Kantvilas & Elix and *Usnea dasaea* Stirt.

SPECIMENS EXAMINED
New South Wales: • Moppy Lookout, Barrington Tops State Forest, 40 km WNW of Gloucester, 31°53′S, 151°32′E, 1200 m, on canopy branches of *Nothofagus* in *Nothofagus*-dominated forest, *J.A. Elix 24804, 24823*, 26.iv.1990 (CANB); • Barrington Tops Forest Road, Barrington Tops State Forest, 42 km WNW of Gloucester, 31°55′S, 151°30′E, 1340 m, on *Tasmannia* in disturbed *Nothofagus* forest bordering *Eucalyptus* forest, *J.A. Elix 24858, 24867*, 26.iv.1990 (CANB); • type locality, on canopy twigs of *Nothofagus* in *Nothofagus*-*Elaeocarpus*-dominated forest at base of escarpment, *J.A. Elix 33896*, 17.viii.1993 (CANB); • *loc. id. H. Streimann 65178*, 11.ix.1999 (CANB); • track to Wrights Lookout, New England National Park, 72 km E of Armidale, 30°31′S, 152°24′E, 1000 m, on canopy twigs of *Nothofagus* at edge of *Nothofagus*-*Elaeocarpus*-dominated forest and wet sclerophyll forest, *J.A. Elix 33929*, 17.viii.1993 (CANB); • Mt William, Barrington Tops National Park, 32°04′30″S, 151°28′E, 1400 m, on canopy branches of *Nothofagus moorei* in rainforest, *G. Kantvilas 293/88*, 30.vi.1988 (HO, NSW); • Point Lookout, New England National Park, 30°29′S, 152°24′E, 1560 m, on *Banksia integrifolia* in wet scrub, *G. Kantvilas 508/02*, 4.x.2002 (HO); • Tianjara Falls, Tianjara Creek, 30 km NW of Ulladulla, 35°08′S, 150°20′E, 350 m, on tree trunk in remnant cool-temperate rainforest, *H. Streimann 7841*, 21.vi.1979 (CANB); • Duck Creek Road, 22 km WNW of Buladelah, 32°21′S, 151°58′E, 140 m, on dead tree branch in *Acmena smithii*-dominated creekside, *H. Streimann 43998*, 22.iv.1990 (CANB); • Noonan Creek to Gloucester Road, Barrington Tops National Park, 44 km WNW of Gloucester, 31°55′S, 151°30′E, 1380 m, on dead *Nothofagus* branch in *Nothofagus* forest near ridge top, *H. Streimann 65203*, 12.ix.1999 (CANB).

New records for Australia

1. Tephromela americana (Fée) Kalb, *Lichenes Neotropici* Fasc. **8**, 16, no. 348 (1984) Fig. 4
The growth habit, apothecial anatomy and ascospores of this species closely resemble those of *T. bunyana*, but *T. bunyana* can be distinguished by its typically larger thalli (3–10 cm *versus* 2–3 cm), larger apothecia (0.2–2.0 mm *versus* 0.1–0.6 mm) and its chemistry. *Tephromela bunyana* contains norglomelliferonic acid as the major secondary metabolite together with atranorin [minor], colensoic acid [minor], norcolensoic acid [submajor] and stenosporonic acid [minor], whereas *T. americana* contains only atranorin and colensoic and norcolensoic acids.
Chemistry: Cortex K+ yellow, C–, KC–, P– or P+ pale yellow; medulla K–, C–, KC+ pink, P–, UV+ blue-white; containing atranorin [minor], colensoic acid [major] and norcolensoic acid [major].

SPECIMENS EXAMINED
Queensland: • Mt Windsor Tableland, 45 km NW of Mossman, 16°15′S, 145°01′E, 1200 m, in *Flindersia* canopy in stunted, open rainforest, *J.A. Elix 16472 & H. Streimann*, 26.vi.1984 (CANB).
New South Wales: • Bruxner Park, 9 km NW of Coffs Harbour, 30°15′S, 153°07′E, 180 m, on tree branch in rainforest, *J.A. Elix 3497*, 1.vii.1977 (CANB).

2. Tephromela promontorii (Zahlbr.) Kalb, *Biblioth. Lichenol.* **95**, 315 (2007) Fig. 5
This saxicolous species is characterized by immersed or rarely adnate apothecia with a very poorly developed or no thalline margin and a dark brown to purple-brown epihymenium. Its prothallus is whitish or not apparent. Chemically, it resembles

some saxicolous specimens of *T. atra*, but the latter can be distinguished by its sessile apothecia with a prominent, swollen, thalline margin and an intense violet-brown epihymenium, somewhat larger ascospores (10–14 × 6–8 µm *versus* 7–13 × 5.5–7 µm) and much longer conidia (12–24 µm *versus* 7–13 µm). Previously, this taxon was synonymized with *T. atra* by Rambold (1989). A detailed description was provided by Schneider (1979, as *Lecidea promontorii*). It was previously known from South Africa.
Chemistry: Cortex K+ yellow, C–, KC–, P– or P+ pale yellow; medulla K–, C–, KC+ pink, P–, UV+ blue-white; containing atranorin [minor], α-collatolic acid [major], alectoronic acid [major or minor], 4-*O*-methylphysodic acid [minor or trace] and physodic acid [trace].

SPECIMENS EXAMINED
South Australia: • Mt Lofty Ranges, 3 km E of Springton, 34°43′S, 139°05′E, 400 m, on exposed granite tors in pasture, *J.A. Elix 21784 & L.H. Elix*, 31.viii.1987 (CANB); • Mt Lofty Ranges, Talbots Reserve, 4.5 km W of Tepko, 34°57′02″S, 139°09′02″E, 200 m, on schist rocks in remnant *Eucalyptus-Callitris* woodland, *J.A. Elix 44236*, 20.v.2010 (CANB).
Northern Territory: • Tabletop Range, Litchfield National Park, 25 km SW of Batchelor, 13°11′S, 130°50′E, 180 m, on sandstone in *Eucalyptus* woodland with dense understorey of *Grevillea, Owenia* and Acacia, *J.A. Elix 27490, H.T. Lumbsch & H. Streimann*, 2.vii.1991 (CANB).

New state and territory records

1. Tephromela alectoronica Kalb, *Sauteria* **15**, 243 (2008)
This species occurs in Western Australia, Queensland, New South Wales, the Australian Capital Territory and Victoria. Also present in South America (Elix 2009, Kalb 2008, McCarthy 2012).

SPECIMENS EXAMINED
Northern Territory: • Tabletop Range, Litchfield Park, 25 km SW of Batchelor, 13°11′S, 130°50′E, 180 m, on dead wood in burnt *Eucalyptus* woodland with dense understorey of *Grevillea, Owenia* and *Acacia*, *J.A. Elix 27519, H.T. Lumbsch & H. Streimann*, 2.vii.1991 (CANB).
South Australia: • *c.* 5 km W of Yalata Mission Station, on dead wood in light forest, *G.C. Bratt 67/173,* 4.x.1967 (HO); Kangaroo Island, mouth of De Male River, 18 km SSE of Cape Borda, 35°43′S, 136°46′E, on shaded rotting wood in dry sclerophyll forest, *H. Streimann 55127,* 30.ix.1994 (AD, B, CANB, H, HO, NY).
Tasmania: • 4.8 km S of Rheban, 42°37′S, 147°56′E, 80 m, on burnt *Eucalyptus* light timber, *G.C. Bratt 68/586,* 4.viii.1968 (HO); • Mt Forestier, Forestier Peninsula, 27 km N of Port Arthur, 42°55′S, 147°51′E, 319 m, on decorticated *Eucalyptus* in exposed situation, *G.C. Bratt 70/1211 & M.H. Bratt,* 18.x.1970 (HO); • Lenah Valley, New Town Falls Track, 42°53′S, 147°15′E, 150–450 m, on dead *Eucalyptus* in the open, *G.C. Bratt 2323b & J.A. Cashin,* 23.v.1965 (HO); • cliffs near Bowen Park, 42°49′S, 147°20′E, 0–30 m, on *Casuarina* in the open, *G.C. Bratt 2877 & J.A. Cashin,* 27.xi.1965 (HO); • Sorell-Nugent Road, 42°45′S, 147°41′E, 180 m, on *Exocarpus cupressiformis* in the open, *G.C. Bratt 4124 & J.A. Cashin*, 15.vii.1967 (HO); • Orford Road, between Bust-me-Gall Hill and Break-me-Neck Hill, 42°37′S, 147°38′E, 300 m, on dead *Eucalyptus* in very open timber, *G.C. Bratt 68/837 & J.A. Cashin,* 31.viii.1968 (HO); • Randalls Bay, foreshore area, 43°15′S, 147°08′E, on dead *Eucalyptus* in shaded situation, *G.C. Bratt 70/618 & J.A. Cashin,* 18.iv.1970 (HO); • near Carlton turn-off on Port Arthur Road, 42°49′S, 147°39′E, on burnt *Eucalyptus* in the open, *G.C. Bratt 3844 & Matthews,* 7.iii.1967 (HO); • Prosser River Damsite, 42°34′S, 147°51′E, on dead *Casuarina* in light timber, *G.C. Bratt 68/575 & R.C. Weeks,* 4.viii.1968 (HO); • 1 km W of Orford, 42°34′S, 147°51′E, on bark, *W.H. Ewers 946,* 5.ii.1987 (CANB); • Little Fisher River, 41°45′S, 146°20′E, on *Nothofagus cunninghamii* in rainforest, *G. Kantvilas s.n.* (HO); • Cape Deslacs, 42°59′S, 147°33′E, on *Dodonaea viscosa* in dry coastal heath, *G. Kantvilas 235/80,* 1.vi.1980 (HO);

• Coles Bay Road, on *Spyridium obcordatum* in dry sclerophyll forest, *G. Kantvilas 490/80,* 25.x.1980 (HO); • *c.* 7 km E of Lake Leake, site E13, 42°01′30″S, 147°55′E, 400 m, on eucalypt wood in *Eucalyptus tenuiramis-E. obliqua* dry forest, *G. Kantvilas s.n.,* 24.iv.1996 (HO); • 2 km W of New Norfolk along Glenora Road, site EE22, 42°47′S, 147°02′E, 90 m, on *Allocasuarina littoralis* in dry sclerophyll forest, *G. Kantvilas 65/97,* 19.ii.1997 (HO); • Doherty's Cradle Mountain Hotel grounds, 41°34′S, 145°56′E, 830 m, on rotting eucalypt wood in open heathy woodland, *G. Kantvilas 421/03,* 21.vi.2003 (HO); • South Sister, near summit, 41°32′S, 148°10′E, 800 m, on bleached eucalypt wood on scree slope, *G. Kantvilas 291/04,* 11.xi.2004 (HO); • Daley Property, 'High Country', *c.* 2 km W of Long Point, 42°20′S, 147°48′E, 355 m, on bleached eucalypt lignin in open *Eucalyptus pulchella* woodland, *G. Kantvilas 2/06,* 1.i.2006 (HO); • summit of Mt Murray, 42°28′S, 147°59′E, 315 m, on *Acacia melanoxylon* in dry sclerophyll woodland, *G. Kantvilas 186/06,* 14.iv.2006 (HO); • Buxton River, in gorge near old weir, 42°15′S, 147°59′E, 30 m, on *Acacia mucronata* in riparian woodland, *G. Kantvilas 263/08,* 12.viii.2008 (HO); • N of Paradise Gorge, 42°33′S, 147°50′E, 180 m, on dead eucalypt log in open, grassy eucalypt forest, *G. Kantvilas 292/09,* 12.vii.2009 (HO); • MacGregor Peak, near fire tower, 42°59′S, 147°56′E, 455 m, on dead, decorticated eucalypt log in dry sclerophyll forest, *G. Kantvilas 18/10,* 1.i.2010 (HO); • *c.* 3 km SE of Broadmarsh, 42°41′S, 147°09′E, 90 m, on *Allocasuarina littoralis* in dry sclerophyll woodland, *G. Kantvilas 168/93 & J.A. Elix,* 11.xii.1993 (HO); • Trevallyn State Recreation Area, 41°27′S, 147°06′E, 200 m, *A.V. Ratkowsky s.n.,* 22.viii.1992 (HO); • Huon Road-Longley, 42°58′S, 147°11′E, on fence, *W.A. Weymouth 162,* 7.vi.1892 (HO); • Mount Stuart road near Hobart, 42°53′S, 147°18′E, on post and rail fence, *W.A. Weymouth s.n.,* 7.xii.1893 (HO).

2. Tephromela atra (Huds.) Hafellner, in K. Kalb, *Lich. Neotrop. Exs.* **8**, [279] (1983)
In Australia this cosmopolitan species occurs in Western Australia, South Australia, New South Wales, the Australian Capital Territory, Victoria and Tasmania (Elix 2009, McCarthy 2012).

SPECIMENS EXAMINED
Queensland: • just E of entrance to Carnarvon National Park, 90 km NNW of Injune, 25°04′S, 148°16′E, 460 m, on sandstone rocks in *Eucalyptus* woodland, *J.A. Elix 34175, 34206, 34213, 34235*, 21.viii.1993 (CANB); • Mt Archer Environmental Park, 8 km NE of Rockhampton, 23°20′S, 150°34′E, 780 m, on volcanic rocks in dry sclerophyll forest, *J.A. Elix 34474*, 24.viii.1993 (CANB); • Cabbagetree Creek, 42 km ENE of Taroom, 25°04′S, 148°16′E, 240 m, on sandstone rocks in *Eucalyptus-Callitris*-dominated woodland, *J.A. Elix 35369, 35375, 35376, 35388, 35392*, 2.ix.1993 (CANB) ; • Leichhardt Highway, Isla Gorge National Park, 26 km NNE of Taroom, 25°10′S, 15001′E, 320 m, on semi-shaded boulder in *Eucalyptus* woodland, *H. Streimann 52655*, 31.viii.1993 (CANB); • Mt Marley, 1 km NE of Stanthorpe, 25°04′S, 148°16′E, 460 m, on large boulder in *Eucalyptus-Callitris*-dominated woodland, *H. Streimann 52893*, 5.ix.1993 (CANB).
Lord Howe Island: • along ridge to Malabar Hill, 31°31′16″S, 159°03′50″E, 80 m, on basalt rock in dense shrubby vegetation, *J.A. Elix 32962, 32968, 32974*, 23.vi.1992 (CANB); • *loc. id., H. Streimann 49988,* 22.vi.1992 (B, CANB, H); • between Little Island and The Cross, 31°34′18″S, 159°04′30″E, 120 m, on basalt rocks among scattered large *Ficus*, small shrubs and ferns, *J.A. Elix 42289, 42330*, 7.ii.1995 (CANB); • Kims Lookout, 31°30′59″S, 159°03′12″E, 180 m, on basalt rock in sparse heathy vegetation at edge of stunted lowland forest, *J.A. Elix 42511, 42523*, 11.ii.1995 (CANB).

3. Tephromela buelliana (Müll.Arg.) Kalb, *Biblioth. Lichenol.* **88**, 319 (2004)
Previously known from South America (Kalb 2004) and in Australia from South Australia and Victoria (Elix 2012).

SPECIMEN EXAMINED
Tasmania: • Boat Harbour, 10 km NW of Wynyard, 40°57′S, 145°38′E, 2 m, on quartzite rocks along foreshore in coastal heath, *J.A. Elix 23788*, 11.i.1990 (CANB).

4. Tephromela bullata Elix, *Australas. Lichenol.* **71**, 3 (2012)
This Australian endemic was previously known from Western Australia, New South Wales and South Australia (Elix 2012).

SPECIMENS EXAMINED
Victoria: • Western Plains region, Backyards S of Gillear, S of Gillear, 38°26′S, 142°36′E, on old red gum fence post, *W.H. Ewers 204*, 16.xi.1986 (CANB); • Grampians region, Venus Baths, Halls Gap, 37°08′S, 142°31′E, on bark of twigs, *W.H. Ewers 290*, 25.xi.1986 (CANB); • Northern Plains region, top of Mt Arapiles, 36°45′S, 141°50′E, on *Eucalyptus* twigs, *W.H. Ewers 514*, 26.xi.1986 (CANB).
Tasmania: • Bridport, 41°00′S, 147°23′E, on *Banksia* in sheltered situation, *G.C. Bratt 4076*, 12.vi.1967 (HO); • Mt Barrow, 41°22′S, 147°25′E, 1080 m, on sheltered *Pomaderris apetala* in scree slope forest, *G.C. Bratt 3206 & M. H. Bratt*, 30.i.1966 (HO); • Cape Deslacs, 42°59′S, 147°33′E, 30 m, on trees in open, *G.C. Bratt & J.A. Cashin 2467*, 17. vii.1965 (HO); • camp on Mt Amos summit, 42°09′S, 148°17′E, 300 m, on wood slightly sheltered by bushes, *G.C. Bratt & J.A. Cashin 68/1238*, 19.x.1968 (HO); • Mt Raoul, Tasman Peninsula, 43°12′S, 147°47′E, 420 m, on *Cyathodes juniperina* in coastal heath, *G. Kantvilas 616/80*, 15.xi.1980 (HO); • Trowutta, 41°02′S, 145°05′E, 200 m, on solitary *Pyrrhus* tree in pasture, *G. Kantvilas 398/81*, 27.v.1981 (HO); • Victoria Valley road, 3.5 km E of Dee Lagoon, 42°17′S, 146°39′E, 680 m, on canopy branches of *Acacia dealbata* in wet sclerophyll forest, *G. Kantvilas 221/89*, 18.viii.1989 (HO); • Warra Creek, site S18, 43°05′S, 146°43′E, 250 m, on fallen canopy twig of *Eucalyptus obliqua* in oldgrowth wet forest, *G. Kantvilas s.n.*, 19.vi.1996 (HO).

5. Tephromela korundensis (Räsänen) Kalb, *Biblioth. Lichenol.* **88**, 322 (2004)
This endemic species was previously known from Queensland (Elix 2009, McCarthy 2012).

SPECIMENS EXAMINED
Lord Howe Island: • Goat House Cave, at base of Mt Lidgbird escarpment, 31°33′50″S, 159°05′15″E, 420 m, on basalt in moist subtropical rainforest with *Dracophyllum* and *Cathea*, *J.A. Elix 42156*, 7.ii.1995 (B, CANB); • *loc. id., J.A. Elix 42151, 42162*, 7.ii.1995 (CANB); • Mt Eliza, 31°30′52″S, 159°02′20″E, 130 m, on exposed boulder in steeply SE sloping grassland, *H. Streimann 55774*, 6.ii.1995 (B, CANB); • *loc. id. H. Streimann 55775*, 6.ii.1995 (CANB).

6. Tephromela lillipillensis Elix, *Australas. Lichenol.* **71**, 5 (2012)
This endemic species was previously known from New South Wales (Elix 2012).

SPECIMENS EXAMINED
Queensland: • Great Dividing Range, Hughenden-Townsville Hwy, 28 km SW of Pentland, 20°43′S, 145°14′E, 460 m, on sandstone rocks in *Eucalyptus*-dominated sandstone gorge, *J.A. Elix 20764 & H. Streimann*, 26.vi.1986 (CANB); • Boolimba Bluff, Carnarvon National Park, 93 km NNW of Injune, 25°03′S, 148°14′E, 580 m, on sandstone rocks below steep escarpment with moist *Eucalyptus* woodland, *J.A. Elix 34251*, 23.viii.1993 (B, CANB); • Leichhardt Highway, Isla Gorge National Park, 26 km NNE of Taroom, 25°10′S, 150°01′E, 320 m, on sandstone rocks in disturbed *Eucalyptus* woodland, *J.A. Elix 35201*, 31.viii.1993 (CANB).

7. Tephromela sorediata Kalb & Elix, in J.A. Elix & K. Kalb, *Australas. Lichenol.* **58**, 27 (2006)
This endemic species was previously known from New South Wales, the Australian Capital Territory and Tasmania (Elix 2009, McCarthy 2012).

SPECIMENS EXAMINED
Western Australia. • trail to Toolbrunup Peak, Stirling Range National Park, 40 km SW of Borden, 34°23′S, 118°03′E, 700 m, on charred wood in dry sclerophyll forest with pockets of denser shrub vegetation, *J.A. Elix 41459*, 17.ix.1994 (CANB).
Victoria: • Mt Delegate, 8 km SSW of Delegate (NSW), 37°07′S, 148°54′E, 1300 m, on *Acacia* and dead wood in *Eucalyptus pauciflora*-dominated woodland, *J.A. Elix 19340, 19343 & H. Streimann*, 26.ix.1986 (CANB); • Grampians region, Flat Rock Crossing, 37°09′S, 146°26′E, on *Eucalyptus* twigs, *W.H. Ewers 438*, 24.xi.1986 (CANB).

8. Tephromela territoriensis Elix & Kalb, *Australas. Lichenol.* **63**, 32 (2008)
This rare endemic species was previously known from the Northern Territory (Elix 2009, McCarthy 2012).

SPECIMENS EXAMINED
New South Wales: • South Coast, below Tianjara Falls, 33 km NNW of Ulladulla, 35°06′S, 150°20′E, 380 m, on mossy sandstone rocks along the river bed in wet, forested gully, *J.A. Elix 5982*, 21.vi.1979 (CANB); • Whoota Whoota Hill, Wallingat State Forest, 13 km SSW of Forster, 32°18′S, 152°28′E, 200 m, on sandstone rocks at edge of dry sclerophyll forest and *Cryptocarya*-dominated regrowth on ridge, *J.A. Elix 24649*, 24.iv.1990 (CANB).

Key to *Tephromela* in Australia

1 Thallus lichenicolous on *Dirinaria* spp. ..... **T. cerasina**
1: Thallus independent, not lichenicolous 2

2 Thallus sorediate or isidiate 3
2: Thallus lacking soredia and isidia 6

3 Thallus sorediate 4
3: Thallus isidiate 5

4 Thallus with discrete, scattered soralia; containing alectoronic acid (major)....
.....**T. sorediata**
4: Thallus erose-sorediate, lacking discrete soralia; containing α-collatolic acid (major), alectoronic acid (trace) .....**T. erosa**

5 Medulla UV–, KC–; only atranorin present ..... **T. isidiosa**
5: Medulla UV+ blue-white, KC+ pink or red; alectoronic acid present.....
.....**T. disjuncta**

6 Medulla UV– 7
6: Medulla UV+ blue-white. 8

7 Thallus saxicolous; ascospores ovoid to subglobose, 6.5–12.0 × 6–9 μm .....
.....**T. korundensis**
7: Thallus corticolous; ascospores ellipsoid, 9–11 × 6.0–6.5 μm ... **T. brisbanensis**

8 Medulla KC–; pannaric acid and pannaric acid 6-methyl ester present .....
.....**T. connivens**
8: Medulla KC+ pink or red; pannaric acid, pannaric acid 6-methyl ester absent....9

9 Medulla C+ red; olivetoric acid present..... **T. olivetorica**
9: Medulla C–; olivetoric acid absent 10

10 Perlatolic and glomelliferic acids (major); thallus saxicolous... **T. arafurensis**
10: Stenosporonic, colensoic, alectoronic, physodic or α-collatolic acids (major); thallus corticolous, lignicolous or saxicolous 11

11 Physodic, colensoic or norcolensoic acids present (major)..... 12
11: Stenosporonic, alectoronic or α-collatolic acids present (major) 16

12 Colensoic and norcolensoic acids present; thallus corticolous 13
12: Colensoic and norcolensoic acid absent; thallus corticolous, lignicolous or saxicolous 15

13 Norglomelliferonic and physodic acids absent ..... **T. americana**
13: Norglomelliferonic or physodic acids present (major) 14

14 Conidia 17–28 μm long; norglomelliferonic acid present (major), physodic acid absent ..... **T. bunyana**
14: Conidia 7–15 μm long; norglomelliferonic acid absent, physodic acid present (major) ..... **T. neobunyana**

15 Thallus corticolous or lignicolous; ascospores 8–12 × 6.0–8.5 μm... **T. physodica**
15: Thallus saxicolous; ascospores 7.5–8.0 × 5.0–6.5 μm ..... **T. territoriensis**

16 Stenosporonic acid present (major); thallus saxicolous; thalline exciple thick ..... **T. stenosporonica**
16: Alectoronic or α-collatolic acids present (major); thallus corticolous, lignicolous or saxicolous; thalline exciple thin 17

17 Alectoronic acid (major), α-collatolic acid (minor) or absent..... 18
17: Alectoronic acid (minor or trace), α-collatolic acid (major) 20

18 Thallus saxicolous ..... **T. lillipillensis**
18: Thallus corticolous or lignicolous..... 19

19 Conidia 10–14 μm long; α-collatolic acid present (minor) ..... **T. nothofagi**
19: Conidia 14–24 μm long; α-collatolic acid absent ..... **T. alectoronica**

20 Hymenium inspersed; thallus saxicolous ..... **T. skottsbergii**
20: Hymenium not inspersed; thallus corticolous or saxicolous 21

21 Thallus corticolous; prothallus white; ascospores 12–17 × 6–9 μm... **T. bullata**
21: Thallus saxicolous; prothallus black or white; ascospores 7–14 × 5.5–8 μm.... 22

22 Apothecia sessile; thalline exciple prominent; conidia 12–24 μm long ... **T. atra**
22: Apothecia immersed to adnate; thalline exciple obscure or absent; conidia 7–14 μm long..... 23

23 Prothallus black, conspicuous; apothecia 0.3–1 mm wide ..... **T. buelliana**
23: Prothallus white or not apparent; apothecia 1–3.5 mm wide.. **T. promontorii**

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Fig. 1. *Tephromela erosa* (holotype in CANB).

Fig. 2. *Tephromela neobunyana* (holotype in CANB).

Fig. 3. *Tephromela nothofagi* (*J.A. Elix 24858* in CANB).

Fig. 4. *Tephromela americana* (*J.A. Elix 16472 & H. Streimann* in CANB).

Fig. 5. *Tephromela promontorii* (*J.A. Elix 21784* in CANB).

Reinstatement of *Crocodia* Link (Lobariaceae: Ascomycota) for five species formerly included in *Pseudocyphellaria* Vain.

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Abstract: *Crocodia* Link is reinstated to accommodate five species, formerly included in *Pseudocyphellaria* Vain., having a yellow medulla, yellow pseudocyphellae on the lower surface, distinctively pedicellate apothecia with a green photobiont present in the thalline margin tissues, a colourless hymenium, ellipsoidal red-brown 3-septate ascospores, colourless bacilliform conidia, and fernene or lupane triterpenoids as characteristic chemical signatures. The genus comprises *C. aurata* (the generitype based on *Sticta aurata* Ach.), *C. clathrata, C. rubella* and two new combinations proposed here, viz. *C. arvidssonii* and *C. poculifera*. A key to species is provided together with distribution data and relevant remarks.

Introduction

In 1890, Vainio established the genus *Pseudocyphellaria* (based on taxa originally described in *Sticta*) for two Brazilian species, *P. aurata* (Ach.) Vain. and *P. clathrata* (De Not.) Vain., with *P. aurata* selected as generitype (Vainio 1890). Acharius had described *Sticta aurata* (Acharius 1803; Galloway & James 1980: 292, fig. 1) from material sent to him by Sir James Edward Smith (described in a letter to Acharius as *Lichen auratus* Sm. *ined.*), purporting to come from Devon and distinct from *Sticta crocata,* a species that Acharius already knew from Linnaeus's type specimen from India (see Galloway & James 1980: 296, fig. 2; Jørgensen *et al.* 1994: 299).

Prior to that, Hoffmann (1794) mistakenly figured (in colour) a Jamaican specimen of *Sticta aurata*, collected by Olof Swartz in the 18th century, as part of his plate illustrating *Platysma crocatum* (= *Pseudocyphellaria crocata*). The confusion was pointed out by both Acharius (1803) and Delise (1825). In that regard, in his account of *Lichen auratus* (Ach.) Sm., in *English Botany*, James Edward Smith made the following observations that are worth recording here: "…Part of a specimen communicated by Mr. Lambert from the remains of Mr. Hudson's herbarium… If British, of which we have no positive evidence, it was probably gathered in the woody part of Devonshire, which its collector often visited; and as Professor Acharius has mentioned this in his *Methodus*, where, on our authority, he first separated the present magnificent species from *crocatus, t*. 2110, we would not leave our work imperfect by omitting it… The plant is known to be a native of St. Helena and the West Indies; nor dare we deny the possibility of Mr. Hudson's having put into his collection of foreign specimens, as an exhibition of *crocatus*, known in his time to have been found in Scotland. Some Devonshire botanist must clear up these uncertainties…"(Smith & Sowerby 1811: 2359; see also Laundon 2005: 487).

Although *Sticta aurata* was widely taken up in the 19th and the early 20th centuries (Delise 1825; Nylander 1860; Leighton 1869; Zahlbruckner 1925 [see for earlier references]), it was twice given independent generic status, firstly by Link (1833: 177) as *Crocodia*, and later by Nylander (1875) as *Parmosticta*, but neither of those names was widely used (Galloway & Laundon 1988). In 1890 Vainio described *Pseudocyphellaria,* with *Sticta aurata* as generitype (Vainio 1890; Galloway & Laundon 1988), his genus name enjoying wide and common use subsequently, and especially in the Southern Hemisphere where its diversity is highest (Magnusson 1940; Galloway 1986, 1988, 1998, 1992, 1993, 1994; Galloway & James 1980, 1986; Galloway *et al.* 1983, 2001).

Molecular work on a range of species of *Pseudocyphellaria* in its currently accepted broad sense (Thomas *et al.* 2000, 2002; Stenroos *et al.* 2006; Högnabba *et al.* 2009; Magain *et al.* 2012; Moncada *et al.* 2013) together with additional unpublished work on a wide range of Southern Hemisphere taxa, clearly show the genus to be heterogeneous, with the type, *P. aurata,* and four related species being taxonomically distinct from the majority of taxa currently included in *Pseudocyphellaria*. A proposal to conserve *Pseudocyphellaria* with another type (*P. crocata* (L.) Vain.) was recently advanced to stabilize names in *Pseudocyphellaria* (Jørgensen & Galloway 2011). If that proposal is accepted, then *Pseudocyphellaria sens. str*. will refer to species that are characterized by a white medulla, white or yellow pseudocyphellae on the lower surface, hopane triterpenoids and a range of orcinol depsides and depsidones as chemical constituents, sessile apothecia, and 1–3-septate yellow-brown to brown ascospores. However, several yellow-medulla species having sessile apothecia, colourless septate ascospores, and a chemical signature of pulvinic acid, pulvinic dilactone, calycin and stictane triterpenoids form a distinctive assemblage within *Pseudocyphellaria* and need further study to ascertain their correct generic status.

Accordingly, as part of reassigning species of yellow-medulla species of *Pseudocyphellaria sens. lat.* to other genera, we here propose reinstatement of Link's genus *Crocodia* (with *Sticta aurata* as generitype) to accommodate five related taxa having a yellow medulla, yellow pseudocyphellae on the lower surface, distinctively pedicellate apothecia with a green photobiont in the thalline margin tissues, a colourless hymenium, ellipsoidal red-brown 3-septate ascospores, colourless bacilliform conidia, and fernene or lupane triterpenoids as characteristic chemical signatures (Corbett *et al.* 1985, 1987; Wilkins & Elix 1990; Galloway 1991). This conclusion is supported by molecular data, at least for *P. aurata, P. clathrata* and *P. poculifera* (e.g. Thomas *et al.* 2002; Högnabba *et al.* 2009; Magain *et al.* 2012).

Crocodia Link, *Handbuch* **3**, 177 (1883)
Typus: *C. aurata* (Ach.) Link
= *Parmosticta* Nyl., *Flora* **58**: 303 (1875) *nom. superfl.* Typus: *P. aurata* (Ach.) Nyl.

Thallus foliose in neat rosettes to irregularly spreading, with or without surface tomentum, soralia or isidia. *Photobiont* green, ?*Dictyochloropsis*. *Medulla* yellow. *Lower surface* yellow to dark brown, tomentose, with scattered, prominent yellow pseudocyphellae. *Ascomata* apothecia, submarginal to laminal, distinctly pedicellate**;** thalline exciple always containing photobiont cells, concolorous with thallus, with or without soredia, isidia or phyllidia. *Disc* plane to concave, matt, red-brown to dark brown, epruinose. *Epithecium* red-brown, minutely granular. *Hymenium* colourless to pale straw-yellow, (45–)50–75(–90) µm tall [100–135 µm tall in *C. rubella*]. *Hypothecium* opaque, pale yellow-brown to red-brown, unchanged in K. *Asci* broadly clavate, 8-spored. *Ascospores* ellipsoidal with pointed apices, 3-septate, pale to dark red-brown to brown. *Conidiomata* pycnidia scattered, occasional, minute, punctiform to ±raised-papillate, to 0.1 mm diam., red-brown when moist, black when dry. *Conidia* colourless, straight, bacilliform, 3–5 × 1–1.5 µm.
Chemistry: pulvinic acid, pulvinic dilactone, calycin, lupeol acetate, 3β-acetoxyfern-9(11)-en-12-one, 3β–acetoxyfern-9(11)-en-12β-ol, fern-9(11)-ene-3β,12β-diol and 3β-acetoxyfern-9(11)-en-19β-ol (Wilkins & Elix 1990; Galloway 1991) and unidentified compounds in four species (*C. aurata, C. arvidsonii, C. clathrata* and *C. poculifera*); *C. rubella* has 20 lupane terpenoids rather than fernene triterpenoids (Corbett *et al.* 1985, 1987). Pending molecular studies, it is here included in *Crocodia*.

Lichenicolous fungi: Several lichenicolous fungi are associated with species of *Crocodia*, especially *C. aurata,* of which two taxa, *Sticta aurata* b. *abortiva* Schaer. (Schaerer 1850) and *Celidium pelveti* Hepp (Hepp 1857), were the first to be described. Other taxa associated with the genus include *Abrothallus parmeliarum*, *Arthonia epiphyscia*, *A. fusco-*

rubella, *A. pelveti*, *A. stictaria*, *Lichenoconium plectocarpoides*, *Nectria heterospora* and *Scutula epiblastemica* (Hawksworth & Booth 1976; Kondratyuk & Galloway 1995; Wedin & Hafellner 1998; Lawrey & Diederich 2011).

Key to species

1 With soredia, isidia or phyllidia 2
1: Without soredia, isidia or phyllidia ..... **C. clathrata**

2 With phyllidia or granular-erose isidia 3
2: With soredia 4

3 With phyllidia ..... **C. arvidssonii**
3: With granular-erose isidia ..... **C. poculifera**

4 Soralia marginal; upper surface mainly glabrous ..... **C. aurata**
4: Soralia laminal; upper surface tomentose ..... **C. rubella**

The species

Crocodia arvidssonii (D.J.Galloway) D.J.Galloway & Elix, comb. nov.
Basionym: *Pseudocyphellaria arvidssonii* D.J.Galloway, *Lichenologist* **22**, 109 (1989).

Remarks: Crocodia arvidssonii is characterized by broadly rounded to irregularly laciniate lobes, a yellow medulla, prominent marginal (occasionally also laminal), palmate, coralloid phyllidia that are delicately white-pubescent at the margins and often also eroded-yellow on the ventral surface, pedicellate apothecia with ragged, densely phyllidiate margins, a thecium 55–90 µm tall, and brown, fusiform-ellipsoidal ascospores (20–)23–27(–30) × 7–9 µm.

Ecology and distribution: *Crocodia arvidssonii* is a corticolous lichen mainly occurring in montane (1500–2850 m) rainforest habitats on the northern Andes in Colombia, Ecuador, Peru and Bolivia (Galloway 1989; Galloway & Arvidsson 1990; Sipman 2002; Moncada & Forero 2006; Flakus *et al.* 2012). It is also disjunct on Tenerife in the Canary Islands, where it grows in evergreen laurel forest at 600 m (Tønsberg 1999).

Crocodia aurata (Ach.) Link, *Handbuch* **3**, 177 (1833)
Basionym: *Sticta aurata* Ach., *Methodus*: 277 (1803).
= *Pseudocyphellaria aurata* (Ach.) Vain., *Acta Soc. Fauna Fl. Fenn.* **7**, 183 (1890).
For typification and additional synonymy, see Galloway (1988, 1992) and Galloway & James (1986).

Remarks: *Crocodia aurata* is characterized by irregularly laciniate lobes, a yellow medulla, prominent marginal, labriform, ±linear, yellow soralia eroding back the lower surface and containing coarse, granular soredia, a thecium 55–75 µm tall, and brown ascospores (25–)30–32 × 6–7 µm.

Ecology and distribution: *Crocodia aurata* is a strongly oceanic species widespread in the tropics and in temperate areas of the Southern Hemisphere. Once extremely common and luxuriant in coastal forest in Brittany (there are very large and ample specimens from the now destroyed Forêt de Briquebec preserved in PC-LENORMAND), it is now rare or absent from many sites where it once occurred in Western Europe. It is also apparently now extinct in mainland Britain and more restricted in range than formerly (James & Purvis 2009). It is known by the trivial names "gilt-edged lichen" in the United Kingdom [J.E. Smith's name for it was "golden-edged lichen" (Smith & Sowerby 1811: 2359)], and "green specklebelly" in North America. *Crocodia aurata* has been recorded from the British Isles (now only on the Channel Islands, the Isles of Scilly and SW Ireland), oceanic parts of Western Europe (France, Portugal and Spain), the Azores, Madeira, St Helena, Tristan da Cunha, Canary Islands, East Africa, Réunion, Madagascar, India, Sri Lanka, Japan, North America, Mexico, Costa Rica, Jamaica, Dominica, Panama, Colombia, Guyana, Ecuador, Bolivia, Chile, Brazil, Argentina, Islas Galápagos, Islas Juan Fernández, Hawai'i, Malaysia, Indonesia, Java, Papua New Guinea, Lord Howe Island, New Caledonia, Norfolk Island, Samoa, Fiji, Tahiti, Australia and New Zealand (including the Kermadec Islands) (Acharius 1803; Smith & Sowerby 1811; Delise 1825; Montagne & van den Bosch 1857; Nylander 1868; Leighton 1869; Zahlbruckner 1925 [for details of earlier publications]; Degelius 1935 [including map of European distribution, fig. 43, p. 194]; Jovet 1941; Magnusson 1955; Imshaug 1957; Follmann 1963, 1968; Follmann & Redón 1972; Redón 1973, 1976; Poelt 1974; Redón *et al.* 1975; Jørgensen 1977; Redón & Lange 1983; Galloway 1985, 1988, 1992, 2007; Galloway & James 1986; Swinscow & Krog 1988; Galloway & Arvidsson 1990; Arvidsson 1991; Lambley 1991; Marcelli 1991; Sipman 1991; Wolseley 1991; Burgaz *et al.* 1994; Osorio & Flieg 1994; Hafellner 1995; Osorio 1997; Sipman & Wolf 1998; Elix & McCarthy 1998; Galloway & Quilhot 1999; Sales & Hedge 2000; Krog 2000; Llimona & Hladun 2001; Brodo *et al.* 2001; Galloway *et al.* 2001; Calvelo & Liberatore 2002; Kurokawa 2003; Breuss 2004; Lange *et al.* 2004; Killmann & Fischer 2005; Moncada & Forero 2006; Spielmann 2006; Bock *et al.* 2007; Scholz 2007; Käffer *et al.* 2007, 2010; Aptroot 2008, Pišút 2009; James & Purvis 2009; Martins *et al.* 2011; Esslinger 2011; van den Boom *et al.* 2011; Flakus *et al.* 2012; McCarthy 2013; de Lange & Galloway 2013).

Crocodia clathrata (De Not.) Trevis., *Lichenotheca Veneta* No. 75 (1869)
Basionym: *Sticta clathrata* De Not., *Memorie della Reale Accademia delle scienze di Torina*, ser. 2, 150 (1851).
= *Pseudocyphellaria clathrata* (de Not.) Malme, *Ark. Bot.* **26A** (14), 9 (1934).
For typification and additional synonymy, see Galloway & Arvidsson (1990: 119–121).

Remarks: *Crocodia clathrata* is characterized by broadly rounded to subdichotomously or irregularly branching lobes with entire margins without soredia or phyllidia, a yellow medulla, a glabrous to partly pubescent or tomentose upper surface that is ±punctate-impressed, pedicellate, marginal or submarginal apothecia with yellow pseudocyphellae along the margins, a thecium 50–58 µm tall, and red-brown, fusiform-ellipsoidal ascospores (15.5–)20–20.5(–22.5) × 3.5–4.5 µm.

Ecology and distribution: *Crocodia clathrata* is widespread in tropical regions [see maps in Galloway (1994: 123, fig. 6) and Galloway (2008: 324, fig. 16.3)], where it occurs in humid montane forest, in canopy branches and main branches of shrubs and trees, and rarely also on rock, at 400–1600 m. It has been recorded from East Africa, South Africa, Angola, Madagascar, Réunion, India, Thailand, Java, the Philippines, Papua New Guinea, New Caledonia, Norfolk Island, Mexico, Costa Rica, Colombia, Ecuador and Brazil (Martius 1828, 1833; De Notaris 1851; Osorio *et al.* 1981; Galloway & Arvidsson 1990; Marcelli 1991; Arvidsson 1991; Galloway 1993, 1994; Osorio & Flieg 1994; Singh & Sinha 1994, 2010; Osorio 1997; Sipman & Wolf 1998; Obermayer 2001; Breuss 2004; Killmann & Fischer 2005; Moncada & Forero 2006; Spielmann 2006; Scholz 2007; Aptroot *et al.* 2007; Käffer *et al.* 2007, 2010; Martins *et al.* 2011; Sinha & Jagadeesh Ram 2011; Van den Boom *et al.* 2011).

Crocodia poculifera (Müll.Arg.) D.J.Galloway & Elix, comb. nov.
Basionym: *Sticta poculifera* Müll.Arg., *Flora* **65**, 304 (1882).
= *Pseudocyphellaria poculifera* (Müll.Arg.) D.J.Galloway & P.James, *Lichenologist* **12**, 301 (1980).

Remarks: *Crocodia poculifera* is characterized by dissected-laciniate lobes, a yellow medulla, greenish yellow, mainly marginal (occasionally also laminal), densely clustered, minutely coralloid, rather delicate isidia that are ±corticate at first, but soon erode and become sorediate, marginal or submarginal, distinctly pedicellate apothecia with granular-isidiate margins, a thecium 45–60(–65) μm tall, and pale to dark red-brown, broadly fusiform-ellipsoidal ascospores, (18–)20–23(–25) × 5.5–7.5 μm.

Ecology and distribution: *Crocodia poculifera* grows on the twigs and bark of forest trees and occasionally also on rock in forest. It is a palaeotropical taxon, known from East Africa (where it is extremely rare), Peninsular Malaysia, Java, Papua New Guinea, Queensland, Lord Howe Island, Norfolk Island, New Caledonia, Fiji, and northern New Zealand (including the Three Kings Islands and the Kermadecs) (Müller Argoviensis 1882, 1897; Cheel 1911, 1913; Filson 1986; Galloway 1988, 1994 (with distribution map); Elix 1985 (as *Pseudocyphellaria aurata*), 1990; Riedl 1988 (as *Pseudocyphellaria aurata*); Elix *et al.* 1992; Elix & McCarthy 1998; Galloway *et al.* 2001; Scholz 2007; McCarthy 2012; de Lange & Galloway 2013).

Crocodia rubella (Hook.f. & Taylor) Trevis., *Lichenotheca Veneta* No. 75 (1869)
Basionym: *Sticta rubella* Hook.f. & Taylor, *London Journal of Botany* **3**, 649 (1844).
= *Pseudocyphellaria rubella* (J.D.Hook. & Taylor) D.J.Galloway & P.James, *Lichenologist* **12**, 302 (1980).
For typification and additional synonymy, see Galloway & James (1980: 302), Galloway (1988: 231) and Galloway *et al.* (2001: 71).
= *Sticta aurata* var. *pallens* Nyl., *Synopsis Methodica Lichenum* **1**(2), 361 (1860).

Type: Nova Zelandia [New Zealand], *sine loco, sine collectoribus*, "ad Myrtus", (holotype – H-NYL 33578!).

Chemistry: pulvinic acid, pulvinic dilactone, calycin and 20 lupane triterpenoids (see Corbett *et al.* 1987; Galloway 1988: 233, 1991: 336–339; Galloway *et al.* 2001: 72).

Remarks: Crocodia rubella is characterized by variable, linear-elongate to irregularly rounded lobes with rather ragged, incised or lobulate margins that are sometimes eroded-sorediate or with punctiform to linear yellow pseudocyphellae, a yellow medulla, a tomentose, yellow-sorediate upper surface, pedicellate apothecia, with a corrugate-scabrid, tomentose exciple, a thecium 100–135 μm tall, and brown ellipsoidal ascospores, 25–35(–38.5) × 9–11(–14) μm.

Ecology and distribution: *Crocodia rubella* is a photophilous species occurring in rainforest canopy branches and on the bark and twigs of trees, shrubs and scrub at or near treeline and forest margins. It is known in Australia from New South Wales, southern Victoria and Tasmania (Filson 1986; Kantvilas 1990; Kantvilas & Jarman 1999; Galloway *et al.* 2001; McCarthy 2013) and in New Zealand from lat. 35º10′S (Herekino Gorge, North Auckland) to the Auckland and Campbell Islands and the Chatham Islands (Galloway 1988, 2007; Scholz 2007; de Lange 2011).

Excluded taxa
Crocodia asticta (Nyl.) Trevis. = *Sticta asticta* Nyl. (Nylander 1868).
Crocodia aurora (De Not.) Trevis = *Pseudocyphellaria aurora* (De Not.) Vain. (Galloway 1993: 87).
Crocodia cellulifera (Hook.f. & Taylor) Trevis. = *Pseudocyphellaria faveolata* (Delise) Malme (Galloway 1988: 134–136).
Crocodia dissecta (Sw.) Trevis. = *Yoshimuriella dissecta* (Sw.) Moncada & Lücking *ined.* (Moncada *et al.* 2013, in press).
Crocodia dissimulata (Nyl.) Trevis. = *Pseudocyphellaria dissimulata* (Nyl.) Vain. (Galloway & James 1980: 301).

Crocodia fossulata (Dufour) Trevis., *nom. nud.* = *Pseudocyphellaria billardierei* (Delise) Räsänen (Galloway 1988: 75).
Crocodia guillemini (Mont.) Trevis. = *Pseudocyphellaria guillemini* (Mont.) D.J.Galloway (Galloway 1986: 127–128).
Crocodia multifida (Nyl.) Trevis. = *Pseudocyphellaria multifida* (Nyl.) D.J.Galloway & P.James (Galloway 1988: 199–200).
Crocodia obvoluta (Ach.) Trevis. = *Pseudocyphellaria obvoluta* (Ach.) Malme (Galloway 1986: 139–142).
Crocodia peltigera (Delise) Trevis. = *Yoshimuriella peltigera* (Delise) Moncada & Lücking ined. (Moncada *et al.* 2013, in press).
Crocodia richardi (Mont.) Trevis. = *Pseudocyphellaria richardi* (Mont.) Räsänen (Galloway 1992: 216–217).
Crocodia subdissecta (Nyl.) Trevis. = *Yoshimuriella subdissecta* (Nyl.) Moncada & Lücking *ined.* (Moncada *et al.* 2013, in press).

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