The Lichenologist **44**(1): 91–99 (2012)
doi:10.1017/S0024282911000569

Cameronia (lichenized Ascomycetes), a remarkable new alpine genus from Tasmania

Gintaras KANTVILAS

Abstract: The new genus, *Cameronia* Kantvilas, is described and illustrated. It is characterized by a crustose thallus, a chlorococcalean photobiont, deeply immersed perithecioid ascomata, four-spored asci with an intensely hemiamyloid outer wall and non-amyloid, well-developed tholus, and hyaline, muriform ascospores. The taxonomic position of the new genus is uncertain although a relationship with the *Ostropomycetidae* is likely. Two species, both endemic to the highlands of Tasmania, are described: *C. pertusarioides* Kantvilas, which is one of the most common lichens on dolerite in alpine Tasmania, and *C. tecta* Kantvilas, which is confined to metamorphosed sediments.

Keywords: *Arthoniales*, asci, dolerite, flora of Australia, lichens, *Ostromycetidae*

Introduction

The island of Tasmania, located at 42°S in the Southern Ocean, south of the Australian continent, has a remarkable lichen biota that has gradually been collected, documented and described, especially over the last three decades. Its major biogeographic affinities are, not surprisingly, with nearby landmasses (Galloway 1991; Kantvilas 1996*a*). Thus many species are shared with or related to those of other austral cool temperate regions with which Tasmania was conjoined in geological history, *viz*. New Zealand and southern South America, or with Australia, with which it has been connected during the Pleistocene by a landbridge across the Bass Strait. The Tasmanian lichen biota also displays significant cosmopolitan and pantemperate elements, as well as being the southernmost outpost of some essentially tropical species that extend from equatorial regions down the eastern Australian coast. Studying lichens in Tasmania inevitably brings many remarkable discoveries, as evidenced by the large number of new genera, new species and regional new records that have been found there [for example, see Henssen & Kantvilas (1985), Henssen *et al*. (1992), Kantvilas (1996*b*), Kantvilas *et al*. (1992, 1999), Kantvilas & Vězda (2000), Kantvilas & Lumbsch (2009) as well as various additional papers by these and other authors].

The island's alpine regions in particular have long been a source of interesting discoveries, especially the remote, rugged, south-west region composed mainly of Precambrian, highly siliceous rocks such as quartzites and where rainfall may exceed 3000 mm per year (Kantvilas 1995). The central and eastern mountains, where Jurassic dolerite prevails, also support a diverse lichen biota. Here one of the most common and attractive species is a thick, pale lemon-yellow crust that forms extensive patches on rock outcrops and boulders. This species, which often comprises the attractive foreground in the alpine wilderness photographs for which Tasmania is well-known, has long been a mystery to the author who has observed it very frequently, although collected it only occasionally, because of its predilection for the largest, hardest rock surfaces, in areas where carrying the necessary heavy rock-splitting equipment is injudicious or impossible. The few collections made have

G. Kantvilas: Tasmanian Herbarium, Private Bag 4, Hobart, Tasmania 7001, Australia. Email: gkantvilas@tmag.tas.gov.au

invariably seemed sterile, and no lichenologist who has been offered a specimen for study in the past has ever been prepared to accept it in their specialist group.

Although superficially resembling a species of *Pertusaria* or *Lecanora*, it has been deemed not to belong to these or to any other obvious choice of genera.

Recently, the author made a more determined attempt to elucidate the relationships of this lichen. Persistent anatomical study located asci and spores, but these characters were equivocal, and efforts to accommodate the taxon in any known lichen genus proved fruitless. The discovery of a second, clearly related species from similar habitats on Precambrian metamorphosed rocks led to the decision to erect a new lichen genus for these species. These new taxa are described here.

Material and Methods

The study is based on herbarium collections housed in the Tasmanian Herbarium (HO) and on the field observations made by the author. Anatomical studies were based on thin, hand-cut sections of the thallus, mounted in water, 10% KOH, ammoniacal erythrosin, Trypan Blue in lactophenol, ammoniacal Congo Red and Lugol's iodine. Reactions in Lugol's are given in the text as I or K/I, the latter referring to pre-treatment with dilute KOH; terminology follows Baral (2009). Dimensions of ascospores are given in the format: lowest value–*mean*–highest value and are based on 30 observations each. The presence of calcium oxalate was investigated using 25% sulphuric acid following the method of Thor (1997).

Routine chemical analyses using thin-layer chromatography followed standard methods (Culberson 1972; Elix & Ernst-Russell 1993). The determination of critical compounds was undertaken by Professor J. A. Elix using high-performance liquid chromatography (Elix *et al.* 2003).

The Species

Cameronia Kantvilas gen. nov.

MycoBank No.: MB 561950

Genus fungorum lichenisatorum, thallo crustaceo, algas chlorococcaleas continenti. Ascomata perithecioidea, in thallo profunde immersa, excipulo debiliter effecto inclusa, paraphysoidibus abundis, guttis olei et cellulis algarum inspersis. Asci tetraspori, late obovati, pariete exteriore intense hemiamyloideo, tholo bene evoluto, non-amyloideo. Ascosporae hyalinae, non-halonatae, muriformes. Pycnidia immersa, conidiis bacilliformibus vel ossiformibus.

Typus: *Cameronia pertusarioides* Kantvilas.

Thallus crustose, ecorticate; photobiont an unidentified green alga with irregularly roundish cells, 3–6 μm wide.

Ascomata perithecioid, deeply embedded in the thallus, enclosed by a rudimentary, poorly differentiated excipulum and densely packed with branched and anastomosing paraphysoids inspersed with oil droplets and scattered photobiont cells; periphyses absent. *Asci* 4-spored, broadly obovate, with outer coat hemiamyloid (I+ reddish, K/I+ intensely blue), and tholus well-developed, I−, K/I− or very weakly pale blue; ocular chamber lacking. *Ascospores* hyaline, non-halonate, highly muriform with irregularly rhomboid cells.

Pycnidia immersed in the thallus; *conidia* bacilliform to bone-shaped.

Etymology. The genus is named in honour of Jan Cameron in appreciation of her contribution to nature conservation in Tasmania.

The genus contains two species, *C. pertusarioides* and *C. tecta*, both described for the first time below. Salient features of the two taxa are given in Table 1.

Cameronia pertusarioides Kantvilas sp. nov.

MycoBank No.: MB 561951

Species insignis, saxicola, thallo 0·7–1 mm crasso, pallide citrino, acidum 9-*O*-methylpannaricum continenti, ascosporis late ellipsoideis, muriformibus, 48–72 μm longis, 24–40 μm latis, et conidiis bacilliformibus vel ossiformibus, 5–9 μm longis, 1–1·3 μm latis.

Typus: Australia, Tasmania, Hartz Mountains Plateau near Lake Osborne, 43°13′S 146°46′E, on dolerite roche moutonnée in alpine heathland, 890 m altitude, 30 January 2007, *G. Kantvilas* 2/07 *& J. Jarman* (HO—holotypus; BM—isotypus).

(Figs 1A & B, 2A–E, 3)

Thallus pale lemon-yellow, forming extensive, irregular thalli to 50 cm or more wide, mostly smooth, a little glossy, usually deeply cracked, 0·7–1 mm thick, sometimes delimited by a blackish prothallus but more commonly not delimited and with actively growing margins usually a little thickened, plicate-placodioid and at times somewhat blackened or greyish; *epinecral layer* hyaline,

TABLE 1. *Salient features of the species of* Cameronia

		Cameronia pertusarioides	*Cameronia tecta*
Thallus	colour	pale lemon yellow, UV+ bright yellow	pale brown, greyish or yellowish brown, UV−
	chemistry	9-*O*-methylpannaric acid	unknown triphenyl
	thickness	0·7–1·0 mm	0·2–0·5 mm
Ascomata		immersed perithecia	immersed perithecia
Hymenium		inspersed with oil droplets and algal cells	inspersed with oil droplets and algal cells
Ascospores		muriform, 48–72 × 24–40 µm	muriform, 34–78 × 22–36 µm
Conidia		bacilliform to bone-shaped, 5–9 × 1·0–1·3 µm	bacilliform, 6–8 × 1 µm
Ecology		alpine, on Jurassic dolerite	alpine, on Precambrian quartzites and metapmorphosed sediments

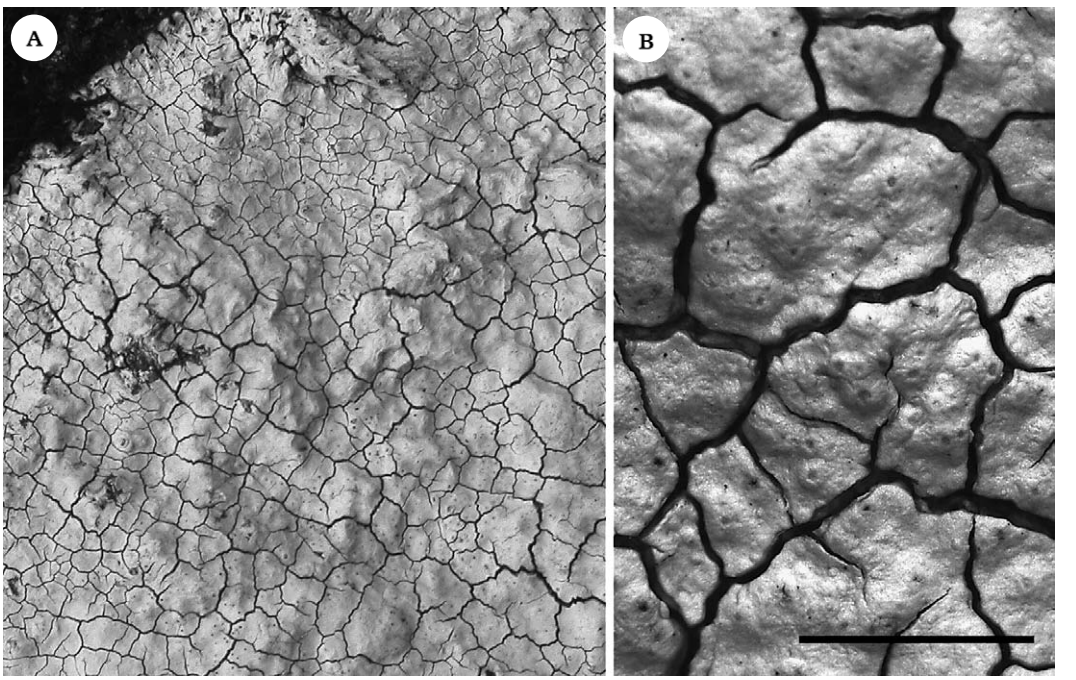

FIG. 1. *Cameronia pertusarioides*, morphology (holotype). A, deeply cracked, actively advancing thallus; B, thallus detail; the minute, crater-like pits mark the location of the asci within the medulla. Scale = 2 mm.

5–20 µm thick; *medulla* white, rather cretaceous, densely inspersed with minute crystals that fluoresce in polarized light and dissolve slowly in KOH, composed of compact, indistinct hyphae, patchily I+ violet, K/I+ violet.

Perithecia ± subglobose, *c.* 200–300 µm wide, usually detected by minute, 0·05–0·08 mm wide, greyish to flesh-coloured depressions or perforations in the thallus surface; *excipulum* hyaline to pale brownish, 10–20 µm thick; surrounding medullary tissue I+ blue, K/I+ blue; involucrellum absent. *Paraphysoids* 1–1·5 µm thick; oil droplets scattered, to 10 µm diam.; hymenial photobiont cells globose to ellipsoid, 4–9 × 4–7 µm. *Asci* in clusters of 3–7 or more, 110–170 × 50–80 µm. *Ascospores* broadly ellipsoid to ovate, 48–*57·8*–72 × 24–*30·7*–40 µm.

Pycnidia scattered, immersed in the thallus within scattered swellings or roundish

https://doi.org/10.1017/S0024282911000569 Published online by Cambridge University Press

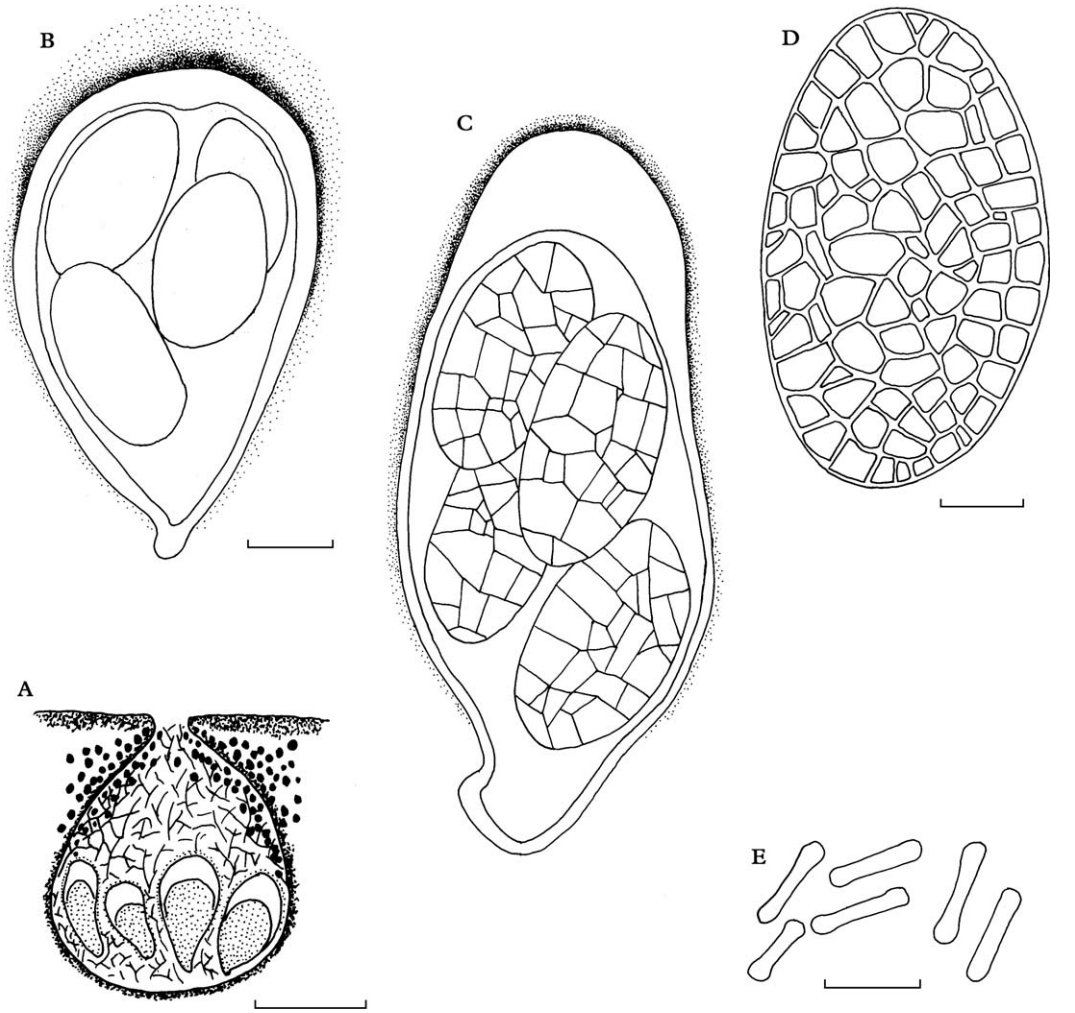

FIG. 2. *Cameronia pertusarioides*, anatomy. A, schematic view of section through thallus and ascus-bearing chamber, showing four asci, encased in anastomosing paraphysoids (holotype); B & C, asci with K/I+ blue tissues stippled, mature ascus on right (*Kantvilas* 73/05), young ascus on left (holotype); D, mature ascospore (*Bratt* 71/827); E, conidia (*Kantvilas* 73/05). Scales: A = 100 μm; B & C = 20 μm; D = 10 μm; E = 6 μm.

verrucae, mostly 0·5–0·8 mm wide, with age becoming more prominent and to 1·5–2 mm wide, initially pierced apically by 1–4 minute, black ostioles, at length becoming apically cracked, in part somewhat blackened and abraded; individual chambers 200–250 μm wide. *Conidia* bacilliform to ± 'bone-shaped', 5–9 × 1–1·3 μm.

Chemistry. Containing 9-*O*-methyl pannaric acid (major), pannaric acid (minor), porphyrilic acid (trace), pannaric acid 2-methyl ester (trace) and methyl porphyrilate (trace); thallus K+ yellow, C+ pale yellowish, KC+ pale yellowish, P−, UV+ bright lemon-yellow. The major compound appears as a pale grey spot on developed TLC plates.

Etymology. The epithet '*pertusarioides*' refers to the startling morphological similarity of the new taxon (with its thick, yellowish thallus and often very prominent verrucae

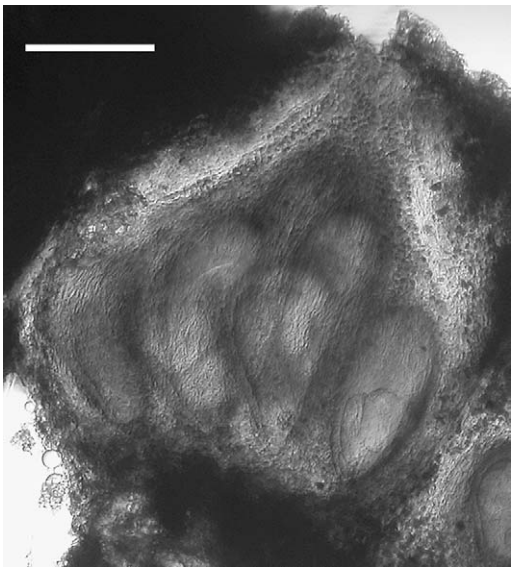

FIG. 3. *Cameronia pertusarioides*, section through an ascus-containing chamber(holotype). Scale = 100 µm.

pierced by a central ostiole-like hole) to verruciform species of the genus *Pertusaria*.

Remarks. Cameronia pertusarioides is known only from Tasmania, where it occurs exclusively on Jurassic dolerite at alpine altitudes. It is one of the most conspicuous and common lichens in such areas, forming extensive, roundish or irregular colonies up to 50 cm wide on the exposed tops of boulders and rock plates, a very harsh habitat exposed to abrasive winds, driving rain, snow and ice as well as to direct, baking sun, especially in the summer months. It may also occur on sheltered vertical rock faces. The combination of habitat and morphology means that this species has no confusing taxa in the Tasmanian biota. Its bright yellow colour produces an attractive mosaic with several other large, attractively coloured crustose species, including *Trapelia lilacea* Kantvilas & Elix (± pale violet), *Lecanora farinacea* Fée and *L.* cf. *demersa* (Kremp.) Hertel & Rambold (white), and an unidentified, bright orange species (belonging to the *Hymeneliaceae*; G. Kantvilas, unpublished data). Other associated lichens include *Hypogymnia lugubris* (Pers.) Krog, *Poeltiaria coromandelica* (Zahlbr.) Rambold & Hertel, *Ramboldia petraeoides* (Nyl. ex C. Bab. & Mitt.) Kantvilas & Elix, *Rhizocarpon geographicum* (L.) DC., *Stereocaulon caespitosum* Redinger, *Umbilicaria umbilicarioides* (B. Stein) Krog & Swinsc. and species of *Paraporpidia* and *Placopsis*; the moss genus *Andreaea* is also prominent.

Fertile material of *C. pertusarioides* is very uncommon. For example, of the approximately 25 specimens available for study, only five yielded fertile asci, which were found in only very occasional thallus sections. The locations of the asci are typically marked by shallow, crater-like, greyish depressions or by minute swellings with a tiny perforation (Fig. 1), but the latter structures may also mark the location of pycnidia, which in general are far more common. Although some thalli or sections of thalli may be covered with large, *Pertusaria*-like verrucae, typically with prominent black 'ostioles', such verrucae are inevitably sterile and densely packed with hyphae and crystals. At length these verrucae become abraded and ultimately excavate. Mature asci are particularly uncommon and rather fragile. The measurements given in the description above may well be biased towards younger, developing asci. With pre-treatment in KOH, staining and placing under a cover slip, mature asci tend to burst and the intensely amyloid outer jacket ruptures and tears away.

The thallus is very thick, tightly adnate to the substratum and distinctly hydrophobic. In nature, water 'beads' on the thallus surface, and during anatomical study it was very difficult to moisten thin sections of the thallus, pycnidia or perithecia. These all tend to be rather densely inspersed with crystals that require clearing (typically with dilute KOH or ammoniacal erythrosin) before observation. These crystals probably contribute to the lichen's hydrophobic nature. In 25% H_2SO_4 (Thor 1997), there is minimal formation of needle-like crystals, suggesting the crystals are not calcium oxalate; their identity is unknown.

Selected specimens examined. **Australia:** *Tasmania*: summit area of Mt Cuvier, 42°02′S 146°02′E, 1350 m alt., 2005, *G. Kantvilas* 73/05 (HO); summit of Mt Lot, 42°57′S 146°27′E, 1260 m alt., 2000, *G. Kantvilas* 473/00 (HO); Mt Wellington plateau, 42°54′S,

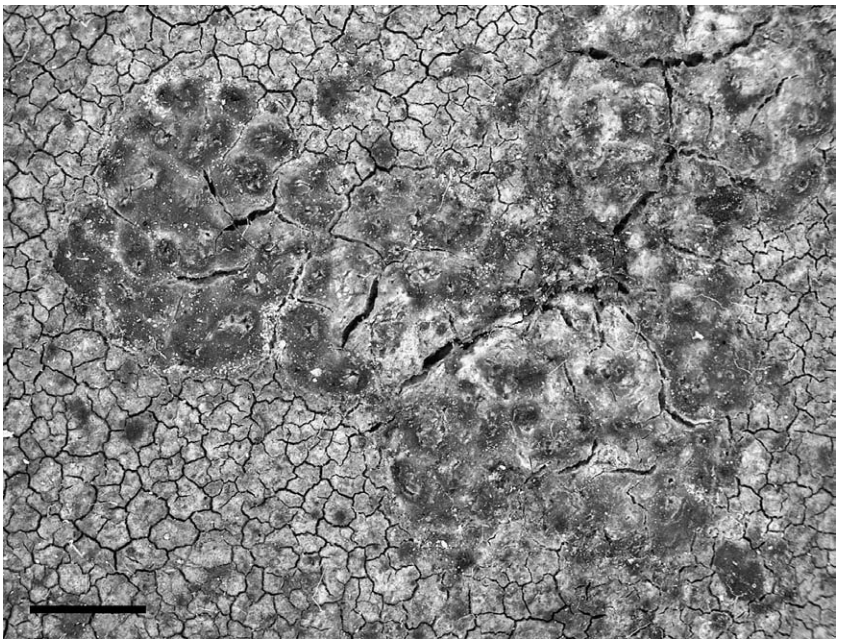

FIG. 4. *Cameronia tecta*, morphology (*Kantvilas* 498/06). Scale = 2 mm.

147°14′E, 1180 m alt., 1980, *G. Kantvilas* 400/80 (BM, HO); Wylds Craig summit, 42°28′S 146°23′E, 1330 m alt., 1998, *G. Kantvilas* 274/98 (HO); Blue Peaks, northern summit, 41°43′S 146°22′E, 1350 m alt., 2006, *G. Kantvilas* 528/06A (HO); Mt Eliza summit, 42°58′S 146°24′E, 1290 m alt., 1971, *G. C. Bratt & M. A. Cutliffe* 71/827 (HO); *c.* 1 km N of Lake Ironstone, 41°42′S 146°28′E, 1190 m alt., 2005, *G. Kantvilas* 338/05 (HO); Mt Mueller, western peak, 42°46′S 146°28′E, 1240 m alt., 1998, *G. Kantvilas* 258/98 (HO); un-named lake 1 km S of Pindars Peak, 43°31′S 146°41′E, 920 m alt., 1990, *G. Kantvilas* 99/90 (HO); Sandbanks Tier, 41°51′S 146°52′E, 1969, *G. C. Bratt* 69/198 (HO); Mt Thetis, 41°52′S 146°00′E, 1380 m alt., 1992, *G. Kantvilas* 289/92 (HO); Hartz Mountains summit area, 43°15′S 146°46′E, 1255 m alt., 1963, *G. C. Bratt* 706 (HO).

Cameronia tecta Kantvilas sp. nov.

MycoBank No.: MB 561952

Species inconspicua, saxicola, thallo 0·2–0·5 mm crasso, pallide brunneo, plerumque paulum substantiae ignotae continenti, ascosporis late ellipsoideis, muriformibus, 34–78 µm longis, 22–36 µm latis, et conidiis bacilliformibus, 6–8 µm longis, 1 µm latis.

Typus: Australia, Tasmania, Sentinel Range summit, 42°52′S 146°15′E, in sheltered crevices and overhangs on alpine quartzite boulders, 880 m altitude, 3 November 2007, *G. Kantvilas* 346/07 (HO—holotypus).

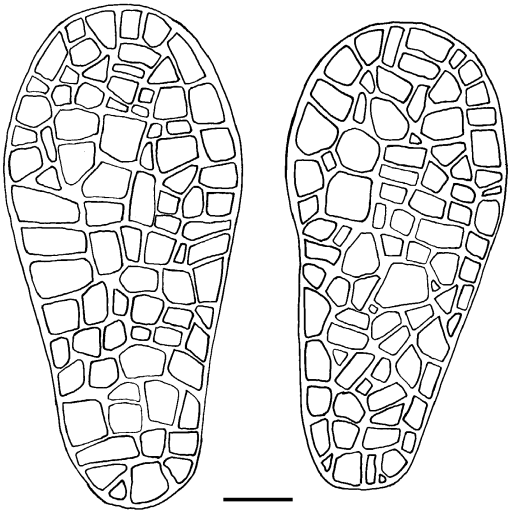

FIG. 5. *Cameronia tecta*, ascospores (*Kantvilas* 498/06). Scale = 10 µm.

(Figs 4 & 5)

Thallus pale beige-brown to mottled greyish or yellowish brown, forming irregular thalli up to 10 cm wide, mostly smooth,

https://doi.org/10.1017/S0024282911000569 Published online by Cambridge University Press

usually deeply cracked, 0·2–0·5 mm thick, typically not delimited or at most with a blackish, prothallus-like leading edge; *epinecral layer* discontinuous, 5–20 µm thick; *medulla* white or discoloured orange-brown, cretaceous, inspersed with minute crystals that fluoresce in polarized light but do not dissolve completely in KOH, composed of compact, indistinct hyphae, patchily I+ violet, K/I+ violet.

Perithecia located in the thickest parts of the thallus, frequently clustered together, ± globose, (120–)160–280 µm wide, detected by minute, 0·05–0·1 mm wide, greyish black depressions or ostiole-like perforations with a rather ragged, elevated rim; *excipulum* brownish, 10–20 µm thick; surrounding medullary tissue I+ blue, K/I+ blue; involucrellum absent. *Paraphysoids* 1–2 µm thick; oil droplets scattered, to 16 µm diam.; hymenial photobiont cells globose to ellipsoid, 5–8 × 3–5 µm. *Asci* in clusters of 4–7, 90–140 × 35–60 µm. *Ascospores* broadly ellipsoid to ovate, often a little tapered at one end, 34–*59·9*–72(–78) × (22–)24–*30·9*–36 µm.

Pycnidia scattered, *c*. 200–250 µm wide, immersed in the thallus and sometimes forming irregular swellings or roundish verrucae, typically detected by their minute, black or brownish, speck-like ostioles. *Conidia* mostly bacilliform, 6–8 × 1 µm.

Chemistry. Unknown substance, appearing as a slow-moving, colourless spot on developed TLC plates. Professor J. A. Elix (*in litt*.) observes that "its UV spectrum and chromatographic behaviour closely resembles that of deacetylbutlerin A".

Etymology. The specific epithet means 'concealed' and refers to the habitat of this lichen in clefts and underhangs.

Remarks. *Cameronia tecta* is an uncommon (or overlooked) species restricted to the south-west of Tasmania where it occurs on highly siliceous, very hard Precambrian quartzite. It typically grows in deeply shaded, sheltered, moist underhangs in alpine heathland, a habitat with few specialist lichens, although a notable exception is *Rimularia umbricola* Kantvilas & Coppins. One unusual collection was from shaded, seasonally inundated rocks from the edge of an alpine lake.

This is a most enigmatic lichen, and one that proved technically challenging to examine and describe. The thallus is extremely brittle and filled with crystals of an unknown identity, but which do not dissolve in either KOH or H_2SO_4. Fertile material is extremely rare, as are pycnidia, and although several specimens are abundantly sprinkled with ostiole-like holes, sectioning revealed only an incipient 'chamber', presumably an incipient ascoma or pycnidium; the fact that the tissue is typically non-amyloid suggests the latter. The single specimen from inundated rocks displayed abundant, semi-emergent, brown 'perithecia' but these contained no fertile tissues at all. Fertile asci were located by sectioning thicker parts of the thallus that were ± 'lifting' from the substratum and had scattered, rather ragged, ostiole-like perforations (Fig. 4).

The chemical composition of the species was also very difficult to ascertain. The thallus is thin and difficult to remove from its substratum, and the concentration of the unknown compound is low; hence most TLC analyses revealed no substances, at least initially. Lobaric acid was detected occasionally, but this is attributed to the thallus of *Rimularia umbricola* with which the new species is often closely associated.

Specimens examined. **Australia:** *Tasmania*: Crater Peak, 41°39′S 145°56′E, 1200 m alt., 1984, *G. Kantvilas* 408/84 *& P. James* (BM, HO); Mt Sprent, 42°48′S 145°58′E, 1000 m alt., 1987, *G. Kantvilas* s.n. (HO); Lake Cygnus, 43°08′S 146°14′E, 880 m alt., 2006, *G. Kantvilas* 498/06 (HO); Schnells Ridge, 43°01′S 146°25′E, 1070 m alt., 2007, *G. Kantvilas* 316/07 (HO); same locality, 1050 m alt., 2009, *G. Kantvilas* 432/09 (HO).

Systematic position

The systematic position of *Cameronia* is uncertain and there is no doubt that in time it will prove to be a fascinating subject for a molecular study. For now, its classification was explored by comparison of its salient features (such as thallus morphology, anatomy and chemistry, ascomatal anatomy,

ascus and ascospore structure) with those of other known lichens. This work was complicated by technical difficulties posed by the new taxon: well-developed fertile material is very uncommon, and all structures are very cretaceous and brittle. Literally hundreds of sections were required simply to compile the data necessary for a formal description and consequently not every aspect of the species (e.g. ascus dehiscence) could be examined in detail. The chemistry of the new genus is unusual but offers few clues. In *C. pertusarioides*, it consists of dibenzofuranes, and similar substances have been recorded in *Lepraria* (in species previously referred to *Leproloma*) (*Stereocaulaceae*, *Lecanorales*) and in *Roccella capensis* Follman (*Arthoniales*) (Elix *et al.* 1992). In *C. tecta*, the unknown substance is a triphenyl; this group of substances occurs sporadically in non-lichenized and lichenized fungi, including the *Parmeliaceae* (J. A. Elix, pers. comm.).

Initially a placement in the *Arthoniales* was considered. Characters that seemed to support such a classification were the crustose thallus with a patchily I+ blue or violet medulla, the ascus type, in particular the well-developed, non-amyloid tholus and the hemiamyloid wall, together with the anastomosing periphysoids and muriform ascospores (Grube 1998). However, the asci of *Cameronia* lack the well defined 'foot' and ocular chamber that is common in many *Arthoniales* asci, and the photobiont, whilst unidentified, is certainly not *Trentepohlia*. In the *Arthoniales*, all groups have *Trentepohlia* except for the *Chrysotrichaceae* (Ertz & Tehler 2010) to which *Cameronia* is certainly unrelated. In addition, no member of the *Arthoniales* is known to produce perithecia, although some genera, such as *Chiodecton* and its allies, produce perithecioid ascomata aggregated in stroma-like structures (Thor 1990).

Amongst perithecioid lichens, the inclusion of photobiont cells in the hymenium is reminiscent of *Staurothele* (*Verrucariaceae*, *Chaetothyriomycetidae*), a genus which shares several other characteristics with *Cameronia*, including the overall morphology of the thallus, a hemiamyloid hymenial gel and muriform ascospores. However, the ascomata of *Staurothele* and other *Verrucariales* lack interascal filaments and the asci are of the *Verrucaria*-type, with a pronounced ocular chamber. Another perithecioid genus that was considered (at the suggestion of an anonymous referee of an earlier version of this paper) was *Thelenella* (*Ostropomycetidae*). However, despite many similarities, this genus is clearly unrelated as well: its asci are cylindrical and display no amyloid reactions (Mayrhofer 1987).

Nevertheless, the *Ostropomycetidae* appears to offer a reasonable, tentative systematic position for the new genus. In this class, there are genera with a range of ascomatal forms, including perithecia. Asci are variable, but cases of large-spored taxa with asci with a well-developed non-amyloid tholus are not uncommon (e.g. *Megaspora*, *Aspicilia*, many taxa of the *Gomphillaceae*), nor are examples of asci with a hemiamyloid wall (e.g. *Trapelia*). Futhermore, the *Ostropomycetidae* display a range of photobiont types that include small-celled coccoid species (e.g. in the *Gomphillaceae*). The ecology of many taxa of the *Ostropomycetidae* is also not inconsistent with that of *Cameronia*.

It could be argued that, given the incomplete information on the taxonomy of *Cameronia*, its description should have been delayed pending more extensive investigations, including molecular studies. However, given how dominant and conspicuous this lichen is in the Tasmanian landscape and, in particular, the degree to which it characterizes the wild places for which the island is famed, it is my opinion that it requires a valid name, even if its systematic position is yet to be resolved.

I thank Professor Jack Elix for determining the chemistry of the new species and Dr Jean Jarman for the photographs and for preparing the line drawings for publication. I am particularly indebted to Drs Göran Thor and Robert Lücking, and to several anonymous referees, for many very helpful comments and suggestions on earlier versions of this paper.

References

Baral, H.O. (2009) Iodine reaction in Ascomycetes: why is Lugol's solution superior to Melzer's reagent?

http://www.gbif-mycology.de/HostedSites/Baral/IodineReaction.htm

Culberson, C. F. (1972) Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *Journal of Chromatography* **72:** 113–125.

Elix, J. A. & Ernst-Russell, K. D. (1993) *A Catalogue of Standardized Thin Layer Chromatographic Data and Biosynthetic Relationships for Lichen Substances*. 2nd Edn. Canberra: Australian National University.

Elix, J. A., Naidu, R. & Laundon, J. R. (1992) A synthesis of the lichen dibenzofuran pannaric acid 2-methyl ester and its isomer 3-*O*-methylpannaric acid. *Australian Journal of Chemistry* **45:** 785–791.

Elix, J. A., Giralt, M. & Wardlaw, J. H. (2003) New chloro-depsides from the lichen *Dimelaena radiata*. *Bibliotheca Lichenologica* **86:** 1–7.

Ertz, D. & Tehler, A. (2010) The phylogeny of *Arthoniales* (Pezizomycotina) inferred from nuucLSU and RPB2 sequences. *Fungal Diversity* DOI: 10.1007/s13225-010-0080-y.

Galloway, D. J. (1991) Phytogeography of Southern Hemisphere lichens. In *Quantitative Approaches to Phytogeography* (P. L. Nimis & T. J. Crovello, eds): 233–262. Dordecht: Kluwer Academic Publishers.

Grube, M. (1998) Classification and phylogeny in the *Arthoniales* (lichenized Ascomycetes). *Bryologist* **101:** 377–391.

Henssen, A. & Kantvilas, G. (1985) *Wawea fruticulosa*, a new genus and species from the Southern Hemisphere. *Lichenologist* **17:** 85–97.

Henssen, A., Döring, H. & Kantvilas, G. (1992) *Austropeltum glareosum* gen. et sp. nov., a new lichen from mountain plateaux in Tasmania and New Zealand. *Botanica Acta* **105:** 457–467.

Kantvilas, G. (1995) Alpine lichens of Tasmania's south-west wilderness. *Lichenologist* **27:** 433–449.

Kantvilas, G. (1996*a*) Tasmania: its vegetation and lichens. *British Lichen Society Bulletin* **78:** 1–10.

Kantvilas, G. (1996*b*) A new byssoid lichen genus from Tasmania. *Lichenologist* **28:** 229–237.

Kantvilas, G. & Lumbsch, H. T. (2009) *Meridianelia*, a new genus in the *Elixiaceae* (Ascomycota) from Tasmania. *Lichenologist* **41:** 261–270.

Kantvilas, G. & Vězda, A. (2000) Studies on the lichen family *Thelotremataceae* in Tasmania. The genus *Chroodiscus* and its allies. *Lichenologist* **32:** 325–357.

Kantvilas, G., Elix, J. A. & James, P. W. (1992) *Siphulella*, a new lichen genus from Southwest Tasmania. *Bryologist* **95:** 186–191.

Kantvilas, G., Hafellner, J. & Elix, J. A. (1999) *Tasmidella*, a new lichen genus from Tasmania, with a revised circumscription of the family *Megalariaceae*. *Lichenologist* **31:** 213–225.

Mayrhofer, H. (1987) Monographie der Flechtengattung *Thelenella*. *Bibliotheca Lichenologica* **26:** 1–106.

Thor, G. (1990) The lichen genus *Chiodecton* and five allied genera. *Opera Botanica* **103:** 1–92.

Thor, G. (1997) The genus *Cryptothecia* in Australia and New Zealand and the circumscription of the genus. *Symbolae Botanicae Upsaliensis* **32**(1): 267–289.

Accepted for publication 07 *July* 2011