



Two additions to the lichen genus *Coenogonium* in Tasmania, with a revised key

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Abstract

Two species of the lichen genus *Coenogonium* are added to the Tasmanian census: *C. dilucidum* (Kremp.) Kalb & Lücking, a widespread, pantropical, foliicolous species; and *C. flavoinpersum* Kantvilas *sp. nov.*, characterised by apothecia 0.5–1.2 mm wide, a subhymenium and hypothecium densely interspersed with yellow oil droplets, and narrowly ellipsoid ascospores, 8.5–12 × 2.5–4 µm. The placement of the new species in *Coenogonium* is discussed. A key to the nine species of the genus recorded for Tasmania is presented.

Keywords: Australia, Coenogoniaceae, exciple, *Gyalecta*, lichenised fungi, *Melaleuca* woodland, new species, taxonomy

Introduction

Coenogonium is a large genus of about 90 species, represented in most regions of the world but most speciose by far in the tropics (Rivas Plata *et al.* 2006; Kalb *et al.* 2016; Lücking *et al.* 2017; Lima *et al.* 2023). As currently circumscribed, it includes both filamentous species and crustose species that were traditionally placed in the genus *Dimerella* (Lücking & Kalb 2000). Species of *Coenogonium* occur on a wide range of substrata, including bark, wood, bryophytes and rocks; a significant number, particularly in tropical latitudes, is exclusively foliicolous. In general, the orange to yellowish, biatorine apothecia with a persistent margin, in combination with the *Gyalecta*-type asci and *Trentepohlia* photobiont, make *Coenogonium* easily recognisable at genus rank. However, the identification and delimitation of species can be challenging and is based on often-subtle differences in apothecial size and colour, hymenium height, ascospore size and arrangement within the ascus, and conidial size and morphology.

McCarthy (2023) lists 34 species for Australia, with the greatest diversity occurring in Queensland. In Tasmania, the genus was revised by Kantvilas *et al.* (2018) who recognised seven species. These included two that are endemic to the island (*C. atherospermatis* Kantvilas *et al.* and *C. urceolatum* Kantvilas *et al.*), the Australasian species *C. australiense* Kantvilas & Lücking, *C. implexum* Nyl. and *C. lutescens* (Vězda & Malcom) Malcolm, and two cosmopolitan/pan-temperate species (*C. luteum* (Dicks.) Kalb & Lücking and *C. pineti* (Schrad. ex Ach.) Lücking & Lumbsch). In that work, it was acknowledged that further taxonomic questions remained to be addressed and that it was likely that additional species may well be present. Further studies of then-unresolved herbarium collections, and additional field work, especially in some previously poorly-studied, coastal swampy woodlands in Tasmania's north, have led to the recognition of two further taxa. These are described and discussed here.

Material and Methods

The study is based mainly on the collections of the first author held in the Tasmanian Herbarium (HO) and comparison with selected reference exsiccatae from other herbaria as cited in text. Observations and measurements are based on hand-cut sections of the thallus and apothecia mounted in water and Lugol's iodine after pretreatment with 10% KOH (indicated as KI in the text). Exciple structure was studied by staining apothecial sections in lactophenol cotton blue, lactophenol trypan blue and vinegar-ink (Powell 2018), all without pretreatment in 10% KOH. Measurements of asci, ascospores and conidia are based exclusively on sections mounted in water. Ascospore measurements are presented in the format: smallest measurement–mean–largest measurement, with *n* signifying the number of observations and outlying values given in parentheses.

Taxonomy

Coenogonium flavoinspersum Kantvilas *sp. nov.*

Mycobank no. MB 854418

Similar to *Coenogonium luteum* (Dicks.) Kalb & Lücking, with apothecia 0.5–1.2 mm wide and narrowly ellipsoid ascospores, 8.5–12 x 2.5–4 µm, but differing by having the subhymenium and hypothecium densely inspersed with yellow oil droplets.

Type: Australia: Tasmania, Stony Head Training Area, Quarry Road, c. 830 m E of Airfield Quarry, 41°02'26"S 146°59'40"E, 50 m, on *Melaleuca ericifolia* in a small, degraded patch of swamp, 19 March 2021, G. Kantvilas 95/21 (holo - HO; iso - B).

Thallus crustose, corticolous, dull pale grey-green to dingy green, usually smooth and effuse, forming irregular, diffuse, often rather discontinuous patches 30–100(–160) mm thick amongst other lichens; photobiont cells subglobose to ellipsoid, 8–20 x 7–10 µm, usually forming short chains. *Apothecia* sessile, 0.5–1.2 mm wide, scattered; disc dull orange-pink to pale orange, sometimes wholly or partially discoloured dark brown, persistently plane; proper exciple persistent, pale cream (paler than the disc), sometimes with a faint orange-pink tinge, smooth and entire, in section annular, hyaline, 70–110 µm thick at the sides, 70–130 µm thick at the base, composed of branched and anastomosed hyphae with narrow

lumina that expand and become parenchymatous towards the outermost edge. *Hypothecium* 50–120 µm thick, hyaline, inspersed in the upper part with yellow oil droplets 2–6 µm wide, the colour fading with herbarium storage. *Hymenium* 50–80 µm thick, hyaline in the upper part, yellow below due to inspersation with yellow oil droplets as in the hypothecium, I+ fleeting greenish blue, soon yellow-brown, KI+ pale blue; paraphyses straight, simple, 1–1.5 µm thick, with the apices swollen, sometimes moniliform, 2.5–3.5 µm thick; asci 40–55 x 5–8 µm. *Ascospores* mostly irregularly biserial in the ascus, occasionally uniserial and obliquely arranged, narrowly ellipsoid, (8.5–)9–10.4–12 x 2.5–3.0–4 µm; length to breadth ratio 2.8–3.5–4.2 (*n* = 80). *Pycnidia* very rare, wartlike, 0.1–0.2 mm wide; conidia ellipsoid, simple, 3.5–5 x 1.5–2 µm. Figs 1–2, 3C.

Etymology: The specific epithet *flavoinspersum* refers to the inspersation of subhymenial tissues with large, yellow oil droplets.

Remarks: With its relatively narrow, small ascospores, the new species is most similar to the widespread *C. luteum*. It differs starkly by having a subhymenium and hypothecium densely inspersed with large, yellow oil droplets which convey a strong yellowish colour to these tissues when viewed in thin cross-section at high-power magnification (Fig. 2). A difficulty arises, however, in that the yellow colour fades in herbarium storage (usually after c. 3 years), even as the droplets themselves remain. Thus, the identification of older herbarium specimens requires considerable care, and most such collections of the new species were initially subsumed



Figure 1. *Coenogonium flavoinspersum* habit (type collection). Scale = 2 mm. Photo: J. Jarman.

within the broad variation of *C. luteum* or, in one case, *C. australiense*. Similar instances where taxonomically significant oil bodies can only be observed in fresh collections occur in some liverwort groups (Stewart 1978). Oil droplets are seen in some specimens of *C. luteum*, but these are smaller ($<3\ \mu\text{m}$ wide), fewer and hyaline from the outset. A further anatomical difference displayed by the new species lies in the paraphyses, which have barely capitate apices, whereas these are usually markedly capitate in other species of *Coenogonium*.

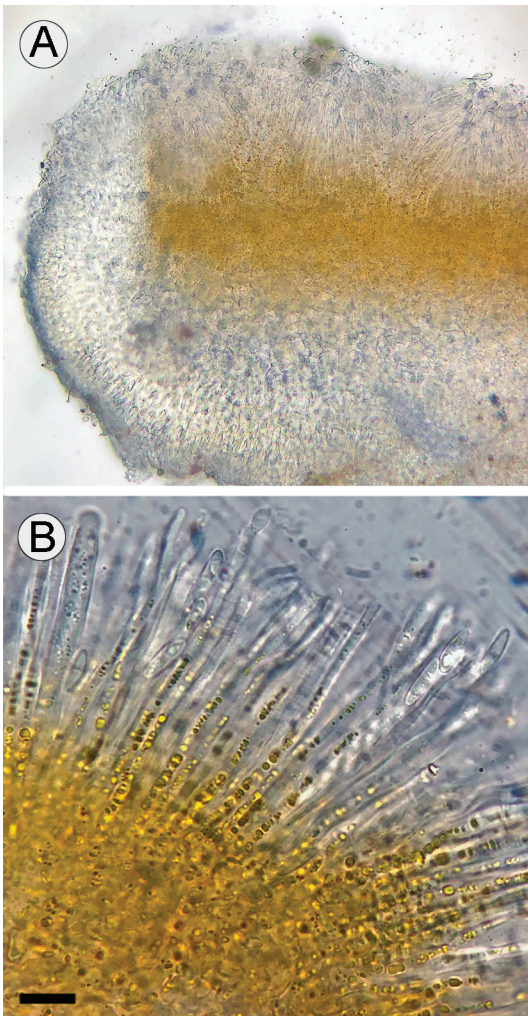


Figure 2. Anatomy of the apothecia of *Coenogonium flavoinspersum*. **A:** transverse section (in lactophenol cotton blue); note the yellow subhymenial tissues. **B:** detail of the hymenium, showing large, yellow oil droplets in the hypothecium and the lower part of the hymenium. Scale = $10\ \mu\text{m}$. Photo: M. Baker.

The distinctiveness of the new species only came to be appreciated as a result of several field excursions to typical *C. flavoinspersum* habitat, where microscope examination of fresh collections immediately drew attention to the significance of the yellow oil droplets. Other differences between *C. flavoinspersum* and *C. luteum* are that the apothecia of the former are at the smaller end of the range displayed by *C. luteum* and do not exceed 1.2 mm diameter, whereas those of *C. luteum* are frequently as wide as 2.5 mm. In addition, the apothecial margin of *C. flavoinspersum* is consistently markedly paler than the disc, whereas in *C. luteum*, the margin is often \pm concolorous with the disc or only a little paler. Furthermore, *C. luteum* occurs on a relatively wide range of substrata, including moist or dry bark, wood, rotting plant material, fibrous fern trunks and even, rarely, rocks; it also overgrows epiphytic bryophytes. Its thallus ranges from smooth to verruculose and typically reflects the texture of the substratum. In contrast, *C. flavoinspersum* has only been recorded growing directly on bark, and only with an effuse, film-like thallus. Separation of *C. flavoinspersum* from *C. australiense* is more straightforward, with the latter having longer and wider ascospores: $10\text{--}14\ \times\ 3\text{--}4\text{--}(4.5)\ \mu\text{m}$ (Kantvilas *et al.* 2018).

It is the habitat ecology of the two species that is completely different. *Coenogonium luteum* is mostly a species of rainforest and wet eucalypt forest where it forms extensive thalli on moist, often mossy tree trunks and especially on the fibrous trunks of tree ferns (*Dicksonia antarctica*). In Australasia, it is known from Tasmania, Victoria, New South Wales, Queensland (McCarthy 2023) and New Zealand (Galloway 2007). It is essentially a cosmopolitan species found in wet forest habitats (Cannon *et al.* 2021; McCune 2017). In contrast, *C. flavoinspersum* is almost exclusively found in lowland, coastal vegetation. Its Tasmanian stronghold is in *Melaleuca ericifolia*-dominated swamps where it occurs on the papery bark of *Melaleuca* itself, or on subdominant trees in these swamps, such as *Bursaria spinosa* and *Acacia melanoxylon*. In this woodland type, it is associated with a small number of other lichens with a similarly distinct habitat ecology, including *Arthonia nigrorufa* Müll.Arg., *Bacidia septosior* (Nyl.) Zahlbr., *Bactrospora metabola* (Nyl.) Egea & Torrente, *B. paludicola* Kantvilas, *Caloplaca pulcherrima* (Müll.Arg.) S.Y.Kondr.

& Kärnefelt, *Enterographa micrographa* (Nyl.) Redinger, *Haematomma sorediatum* R.W.Rogers, *Leptogium coralloideum* (Meyen & Flot.) Vain., *Pseudocyphellaria aurata* (Ach.) Vain. and two, as yet undescribed taxa of *Arthothelium* and *Enterographa* respectively, as well as with the ecologically more widespread species, *Arthothelium ampliatus* (C.Knight & Mitt.) Müll.Arg., *Cliostomum griffithi* (Sm.) Coppins, *Ochrolechia africana* Vain. and *Pannaria elixii* P.M.Jørg. & D.J.Galloway. Two specimens from locally wet scrub communities at higher elevations in the drier hinterland of Tasmania's east coast were also identified as *C. flavoinspersum* on the basis of the presence of dense, large oil droplets in the subhymenium, although their habitat and localities are rather distant from core *C. flavoinspersum* habitat. A specimen from Kangaroo Island, South Australia, remains enigmatic. Collected from relict, coastal, *Callitris*-dominated woodland, it was initially ascribed to *C. australiense* by Kantvilas (2019). However, the small ascospores, 10–13 x 2.5–3 µm, and moderately inspersed hypothecium and subhymenium suggest it is better accommodated, albeit with some reservation, under *C. flavoinspersum*.

Generic considerations

The inspersation of subhymenial tissues with yellow oil droplets in the new species is so unusual for *Coenogonium* that an alternative classification in *Gyalecta* was considered (at the suggestion of an anonymous referee). After traditionally having been included in the same family (Gyalectaceae), *Coenogonium* was removed to its own family, Coenogoniaceae, on the basis of DNA sequence data (Kauff & Lutzoni 2002; Lücking *et al.* 2019) and anatomical and ontogenetic observations (Kauff & Büdel 2005). *Gyalecta* itself has also been subject to taxonomic reappraisal that has seen it subsume *Belonia* and *Pachyphiale* (Baloch *et al.* 2013) and *Cryptolechia* (Lücking *et al.* 2019).

Anatomical differences in the apothecia of *Coenogonium* and *Gyalecta* are discussed by Kauff & Büdel (2005). Following detailed examination of apothecial structure in the present study, the most critical of these is the cupulate exciple composed of branched and anastomosed hyphae with relatively thin lumina in *Gyalecta*, versus an annular exciple composed of hyphae with relatively wide lumina that

become parenchymatous in *Coenogonium*. The annular structure is easily missed in broadly flattened apothecia and requires sectioning through the apothecium centre, but a good transverse section demonstrates that it is the subhymenial tissues that connect the apothecium to the substratum and thallus, and not the exciple. This feature is evident in the new species described here and supports its inclusion in *Coenogonium*. The form of excipular hyphae in *Coenogonium* is more variable (Fig. 3). In all species examined, these are branched and radiate towards the outer edge where the lumen broadens to form a parenchyma. However, the hyphae within the exciple vary, and whereas in some species (or specimens) studied, the lumen is relatively wide throughout, in *C. flavoinspersum* it is very narrow and widens to a parenchyma only at the very outer edge. To what extent this is an artefact of apothecium age, and not species-specific could not be established. However, the anatomy of *C. flavoinspersum* is also strongly supportive of its inclusion in *Coenogonium* rather than *Gyalecta* (see Fig. 3).

Further supporting the inclusion of this taxon in *Coenogonium* is the morphology of the ascospores. These are identical to those of other species of the genus: narrowly ellipsoid and 1-septate, whereas in *Gyalecta*, the ascospores are highly variable and can be multiseptate or muriform.

Kauff & Büdel (2005) also observed that the hymenial gel in *Gyalecta* is KI-, whereas that of *Coenogonium* is KI+ pale blue. This was not confirmed in the present study, where a KI+ pale blue hymenial reaction was observed in *Gyalecta sens. str.* [as exemplified by the type, *G. geoica* (Wahlbg.) Ach.] and species of *Gyalecta* that had previously been included in *Belonia*. In all *Coenogonium* species studied, the hymenium is KI+ pale blue.

Specimens examined: TASMANIA: Meadstone Falls, 41°45'S 148°05'E, 420 m, 1.viii.1999, *G. Kantvilas* 334/99 (HO); M-Road, c. 1 km N of Breasted Sugarloaf, 42°11'42"S 147°53'12"E, 630 m, 26.vi.2018, *G. Kantvilas* 87/18 (HO); end of Bolduans Road, 40°47'S 145°02'E, 1 m, 30.xi.2011, *G. Kantvilas* 475/11 (HO); Stony Point, 40°45'S 144°59'E, 2 m, 25.x.2016, *G. Kantvilas* 272/16 (HO); Cape Portland, Musselroe Wind Farm, northern end of Musselroe Bay, 40°48'36"S 148°06'44"E, 11.ix.2019, *G. Kantvilas* 240/19 (HO); Stony Head Training Area, Ryans Hill, SE of summit, 41°01'05"S 147°01'43"E, 210 m, 4.xi.2020, *G. Kantvilas* 195/20 (HO); Stony Head Training Area, Ryans Hill, 41°01'S 147°02'E, 50 m, 16.iii.2021, *G. Kantvilas* 301/21 (HO); Umtali, behind

Adams Beach, 40°59'S 147°22'E, 2 m, 10.ix.2021, *G. Kantvilas* 380/21 (HO); beyond end of Bolduans Road, 40°47'S 145°02'E, 1 m, 22.x.2021, *G. Kantvilas* 431/21 (HO); Woolnorth, "Paperbark Corner", 40°44'S 144°43'E, 15 m, 6.ii.2023, *G. Kantvilas* 69/23

(HO); King Island, Pennys Lagoon, 39°39'28"S 144°04'16"E, 14 m, 24.x.2023, *G. Kantvilas* 358/23 (HO); King Island, Collier Swamp Conservation Area, 40°05'47"S 143°58'41"E, 25 m, 26.x.2023, *G. Kantvilas* 413/23 (HO). **SOUTH AUSTRALIA:** Kangaroo Island,

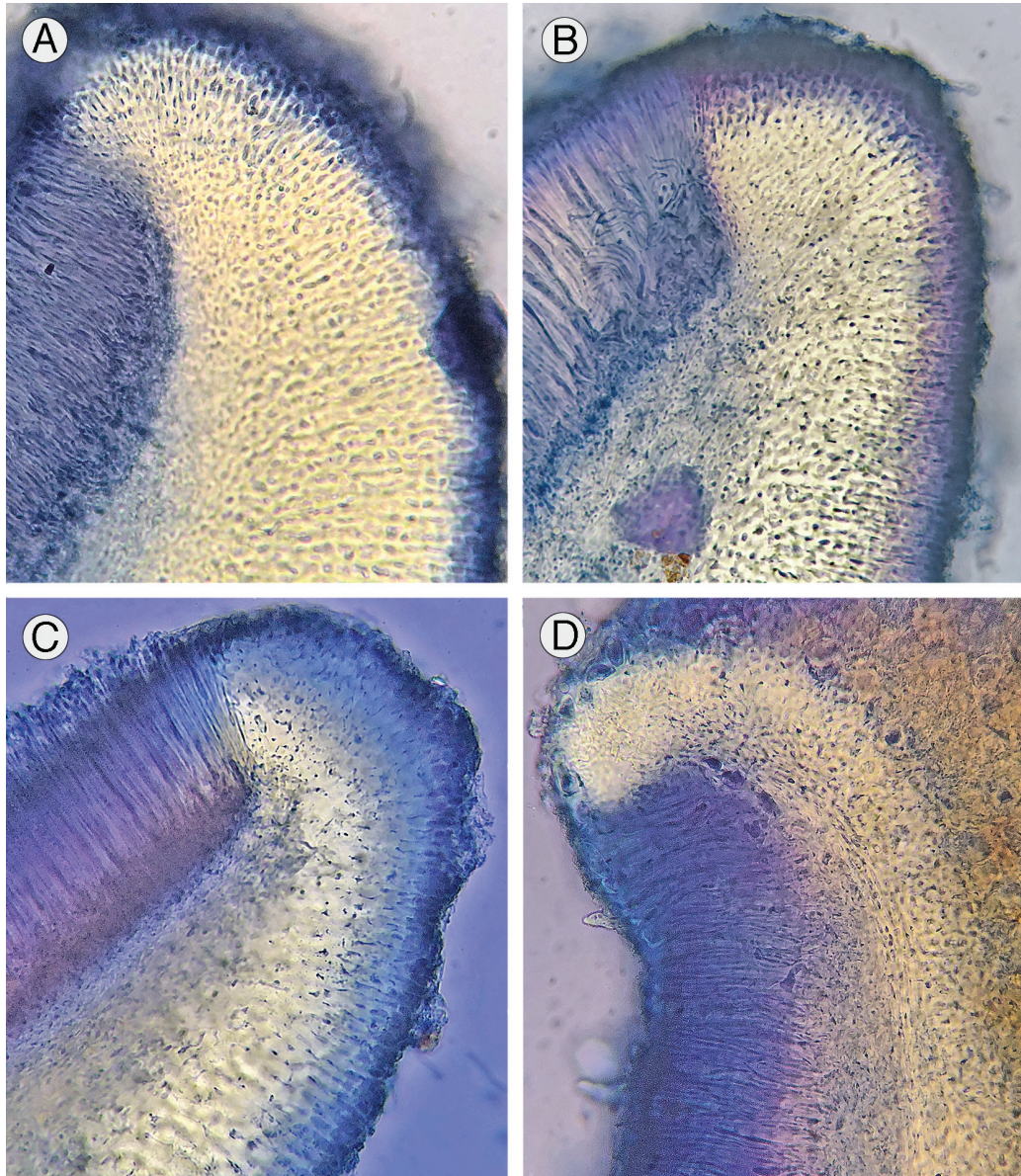


Figure 3. Transverse sections of apothecia, comparing excipular anatomy of *Coenogonium* (A-C) and *Gyalecta* (D), stained in Lactophenol Trypan Blue. **A:** *Coenogonium luteum* [Italy, *D. Puntillo* s.n. (*A. Vězda: Lich. Sel. Exsicc.* 24060 (HO))]: radiating hyphae with wide lumina, becoming parenchymatous towards the outer edge. **B:** *C. australiense* [Tasmania, *Kantvilas* 691/84 (holotype) (HO)]: similar anatomy to *C. luteum*, with hyphae with narrow lumina internally, radiating and becoming parenchymatous at the outer edge. **C:** *C. flavoispersum* [Tasmania, *Kantvilas* 301/21 (holotype) (HO)], with internal hyphae with very narrow lumina, nevertheless radiating and becoming parenchymatous at the outer edge. **D:** *Gyalecta geoica* (type species of the genus) [Czech Republic, *B. Bruna & A. Vězda* s.n. (*A. Vězda: Lich. Rar. Exsicc.* 321) (HO)]: all hyphae with narrow lumina, tangentially arranged adjacent to the hypothecium and irregularly arranged elsewhere; the large cells at the outer edge belong to the photobiont.

(Photos: M. Baker)

Pelican Lagoon Conservation Park, 35°48'S 137°48'E, 10 m, 7.x. 2015, G. Kantvilas 316/15 & B. de Villiers (AD, HO).

***Coenogonium dilucidum* (Kremp.) Kalb & Lücking**

In R. Lücking & K. Kalb, *Bot. Jahrb. Syst.* 122, 32 (2000); —*Lecidea diluta* Kremp., *J. Mus. Godeffroy* 1, 103 (1873); *Dimerella dilucidum* (Kremp.) R.Sant., *Symb. Bot. Upsal.* 12(1), 394 (1952).

Thallus crustose, epiphyllous, pale greenish grey, smooth, forming diffuse, rather discontinuous, very thin, irregular patches 1–2 mm wide; photobiont in ± dispersed chains of rectangular cells 8–15 x 5–7 µm. *Apothecia* sessile, 0.12–0.26 mm wide; disc pale orange-pink, waxy and ± translucent, persistently plane; proper exciple persistent, a little paler than the disc, smooth and entire, in section 50–90 µm thick, hyaline. *Hypothecium* to 20 µm thick, hyaline. *Hymenium* 60–80 µm thick, hyaline, + fleeting blue, soon yellow-brown, KI+ pale blue; paraphyses straight, simple, 1–1.5 µm thick, with the apices swollen to 3–4 µm and sometimes moniliform; asci 40–55 x 6–9 µm. *Ascospores* oblique and uniseriate in the ascus, ellipsoid, 8–9.0–10 x 3–3.8–4.5 µm; length to breadth ratio 2–2.4–2.9 (*n* = 50). *Pycnidia* not seen.

Remarks: The above description is based exclusively on the single Tasmanian specimen. Further descriptive data based on Neotropical material are provided by

Santesson (1952) and Lücking (2008). In the absence of pycnidia and their characteristic 1-septate, 14–18 x 2–2.5 µm conidia (Lücking 2008), the identification of the single Tasmanian specimen is tentative. Nevertheless, with its tiny apothecia and relatively broad, short, ellipsoid ascospores, it matches herbarium material (determined and distributed by the respected specialist of foliicolous lichens, the late Antonin Vězda) of *C. dilucidum* perfectly. Both of the authors referred to above cite somewhat smaller ascospores (6–10 x 2.5–3 µm in the case of Lücking (2008)) but the somewhat wider ascospores of the Tasmanian specimen are also seen in Vězda's exsiccatae.

This is a pantropical foliicolous species, similar to the equally widespread *C. subluteum* (Rehm) Kalb & Lücking which differs chiefly by having larger, darker orange apothecia (Lücking 2008). However, study of Vězda's exsiccatae suggests that this species also has somewhat longer ascospores, 11–13 x 4–4.5 µm.

Coenogonium dilucidum is seemingly rare in Tasmania and was not recorded during a survey of Tasmanian foliicolous lichens (McCarthy *et al.* 2001). It has been collected just once, growing on a frond of the fern *Blechnum wattsii* in the understorey of rainforest of the thamnitic type (Jarman *et al.* 1994), dominated by the conifer *Athrotaxis selaginoides* over an understorey of the tall heath *Archeria serpyllifolia*. Its tiny apothecia are

Key to the Tasmanian species of *Coenogonium*

- | | | |
|------|---|----------------------------------|
| 1 | Thallus filamentous; filaments very densely woven, forming pannose cushions. | <i>C. implexum</i> |
| | Thallus crustose. | 2 |
| 2(1) | Apothecia mostly <0.5 mm wide. | 3 |
| | Apothecia >0.5 mm wide and often up to 2.5 mm wide. | 6 |
| 3(2) | Occurring on living leaves. | <i>C. dilucidum</i> |
| | Occurring on bark, wood or dead plant material, but never on living leaves. | 4 |
| 4(3) | Ascospores 3–4.5 µm wide, strictly uniseriate in the ascus; apothecial disc light (yellowish) brown with a pinkish hue; margin cream. | <i>C. pineti</i> |
| | Ascospores mostly 2–3 µm wide, uniseriate or irregularly biseriate; apothecia variously coloured. | 5 |
| 5(4) | Apothecia urceolate; disc orange with a pinkish hue; margin strongly prominent, cream or tending towards the colour of the disc but lighter. | <i>C. urceolatum</i> |
| | Apothecia plane; disc light (yellowish) brown with a pinkish hue; margin barely prominent, cream. | <i>C. lutescens</i> |
| 6(2) | Apothecial disc yellowish beige; margin cream; ascospores mostly 6–8 µm long. | <i>C. atherospermatis</i> |
| | Apothecial disc orange with a pinkish hue; margin cream or tending towards the colour of the disc but lighter; ascospores mostly 8–16 µm long. | 7 |
| 7(6) | Hypothecium and subhymenium densely interspersed with oil droplets to 5 µm wide and yellow when freshly collected. | <i>C. flavoinspersum</i> |
| | Hypothecium and subhymenium not interspersed, or if interspersed then the oil droplets sparse, <3 µm wide and hyaline. | 8 |
| 8(7) | Ascospores mostly 8–11 x 2.5–3.5 µm. | <i>C. luteum</i> |
| | Ascospores mostly 10–14 x 3–4.5 µm. | <i>C. australiense</i> |

arranged mainly along the veins on the upper surface of the host. Also present are the perithecia of *Porina blechnicola* Lücking *et al.* and *P. subapplanata* Malcolm *et al.*, as well as a species of *Fellhanera*. In Australia, *Coenogonium dilucidum* is also known from New South Wales (Vězda & Kalb 1991).

Foliicolous species of *Coenogonium* are numerous and Lücking (2008) estimates that half of the known species of the genus grow on leaves. In Australia, these occur almost exclusively in Queensland (McCarthy 2023), with this report of *C. dilucidum* being the first of a foliicolous species from cool temperate latitudes.

Specimen examined: TASMANIA: Anthony Road, site W468, 41°50.5'S 145°37.5'E, 540 m, 12.xi.1992, *J. Jarman s.n.* (HO).

Comparative material examined: Coenogonium dilucidum: BRAZIL: Sao Paolo, Serra do Mar: Serra do Garraozinho, 850 m, 30.vi.1979, *K. Kalb* (HO). *Coenogonium subluteum: TANZANIA:* Morogoro Region, SE slope of Mt Kanga, 1200–1300 m, 30.iii.1998, *E. Farkas 80110* (HO). **BRAZIL:** Sao Paolo, between Osasco and Cabréuva, 750 m, 20.vii.1979, *K. Kalb 169* (HO).

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References

- Baloch, E., Lumbsch, H.T., Lücking, R. & Wedin, M. (2013). New combinations and names in *Gyalecta* for former *Belonia* and *Pachyphiale* (Ascomycota: Ostropales) species. *Lichenologist* **45**, 723–727.
- Cannon, P., Malíček, J., Sanderson, N., Benfield, B., Coppins, B. & Simkin, J. (2021). Ostropales: Coenogoniaceae, including the genus *Coenogonium*. *Revisions of British and Irish Lichens* **3**, 1–4.
- Galloway, D.J. (2007). *Coenogonium* Ehrenb., 1820. In *Flora of New Zealand Lichens. Revised Second Edition*. Volume 1: 434–442. Manaaki Whenua Press, Lincoln.
- Jarman, S.J., Kantvilas, G. & Brown, M.J. (1994). Phytosociological studies in Tasmanian cool temperate rainforest. *Phytocoenologia* **22**, 355–390.
- Kalb, J., Boonpragob, K. & Kalb, K. (2016). New *Coenogonium* species (Ostropales: Coenogoniaceae) from Thailand, new reports and a revised key to the species occurring in the country. *Phytotaxa* **283**, 101–122.
- Kantvilas, G. (2019). An annotated catalogue of the lichens of Kangaroo Island, South Australia. *Swainsona* **32**, 1–97.
- Kantvilas, G., Rivas Plata, E. & Lücking, R. (2018). The lichen genus *Coenogonium* in Tasmania. *Lichenologist* **50**, 571–582.
- Kauff, F. & Büdel, B. (2005). Ascoma ontogeny and apothecial anatomy in the Gyalectaceae (Ostropales, Ascomycota) support the re-establishment of the Coenogoniaceae. *Bryologist* **108**, 272–281.
- Kauff, F. & Lutzoni, F. (2002). Phylogeny of the Gyalectales and Ostropales (Ascomycota, Fungi): among and within order relationships based on nuclear ribosomal RNA small and large subunits. *Molecular Phylogenetics and Evolution* **25**, 138–156.
- Lima, D.O., Santos, L.A., Oliveira Jr, I., Aptroot, A., Lücking, R. & Cáceres, M.E.S. (2023). New species, new records, and a checklist of *Coenogonium* (Ostropales: Coenogoniaceae) from Brazil. *Plant and Fungal Systematics* **68**, 462–474.
- Lücking, R. (2008). Foliicolous lichenized fungi. *Flora Neotropica Monograph* **103**, 1–866.
- Lücking, R. & Kalb, K. (2000). Foliikole Flechten aus Brasilien (vornehmlich Amazonien), inklusiv einer Checkliste und Bemerkungen zu *Coenogonium* und *Dimerella* (Gyalectaceae). *Botanische Jahrbücher für Systematik, Pflanzengesichte und Pflanzengeographie* **122**, 1–61.
- Lücking, R., Hodkinson, B.P. & Leavitt, S.D. (2017, 2016). The 2016 classification of lichenized fungi in the Ascomycota and Basidiomycota – Approaching one thousand genera. *Bryologist* **119**, 361–416.
- Lücking, R., Moncada, B. & Hawksworth, D.L. (2019). Gone with the wind: sequencing its type species supports inclusion of *Cryptolechia* in *Gyalecta* (Ostropales: Gyalectaceae). *Lichenologist* **51**, 287–299.
- McCarthy, P.M. (2023). *Checklist of the Lichens of Australia and its Island Territories*. Australian Biological Resources Study, Canberra. Version 7 March 2023. <http://www.anbg.gov.au/abrs/lichenlist/introduction.html>
- McCarthy, P.M., Kantvilas, G. & Vězda, A. (1991). Foliicolous lichens in Tasmania. *Australasian Lichenology* **48**, 16–26.
- McCune, B. (2017). *Microlichens of the Pacific Northwest. Volume 2. Keys to the Species*. Wild Blueberry Media: Corvallis.
- Powell, M. (2018). Spot tests and staining: some recent advances. *British Lichen Society Bulletin* **123**, 77–82.
- Rivas Plata, E., Lücking, R., Aptroot, A., Sipman, H.J.M., Chaves, J.-L., Umaña, L. & Lizano, D. (2006). A first assessment of the Ticolichen biodiversity inventory in Costa Rica: the genus *Coenogonium* (Ostropales: Coenogoniaceae), with a worldwide key and checklist and a phenotype-based cladistic analysis. *Fungal Diversity* **23**, 255–321.
- Santesson, R. (1952). Foliicolous lichens I. A revision of the taxonomy of the obligately foliicolous, lichenized fungi. *Symbolae Botanicae Upsalienses* **12**, 1–590.
- Stewart, G.H. (1978). Oil bodies of the New Zealand leafy Hepaticae (Jungermanniales). *New Zealand Journal of Botany* **16**, 185–205.
- Vězda, A. & Kalb, K. (1991). Beiträge zur Kenntnis der foliikolen Flechten australischer Regenwälder III. *Nova Hedwigia* **53**, 215–228.