Trapelia concentrica (lichenized Ascomycota, Trapeliaceae), a new species from south-eastern Australia, with a key to the genus in Australia

John A. Elix
Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Patrick M. McCarthy
64 Broadsmith St, Scullin, A.C.T. 2614, Australia
e-mail: pmcc2614@hotmail.com

Abstract
Trapelia concentrica Elix & P.M.McCarthy (Trapeliaceae) is described as new from siliceous rocks and soil in south-eastern Australia. It is characterized by the inconspicuous, greyish white to dark grey, areolate thallus containing gyrophoric acid and calcium oxalate, and small, immersed to adnate, pseudolecanorine apothecia with white-pruinose discs often surrounded by a series of more-or-less concentric, circular fissures with a white-pruinose upper surface such that the apothecium can appear almost gyrose. A preliminary key to *Trapelia* in Australia is provided.

Introduction
The genus *Trapelia* M.Choisy (1929), based on *Lecidea coarctata* Sm., includes lichens with a *Chlorella*-type photobiont, hemiangiocarpic apothecia that burst through the upper surface of the thallus, a reduced, cupulate excipulum composed of prosoplectenchymatous hyphae, eight-spored, hemiamyloid asci (Baral 1987) in which the tholus typically lacks internal amyloid structures, simple ascospores, richly branched paraphyses and bacilliform to filiform conidia (Lumbsch & Kainz 2004; Kantvilas & Elix 2007; Purvis *et al*. 2009; Kantvilas *et al.* 2015; Orange 2018). All species contain gyrophoric acid or related substances.

Seven species of *Trapelia* have been reported from Australia (McCarthy 2018), including the widespread and probably cosmopolitan *T. coarctata* (Sm.) M.Choisy and *T. involuta* (Taylor) Hertel, the latter listed incorrectly by McCarthy (2018) as a synonym of the non-Australian *T. glebulosa* (Sm.) J.R.Laundon, as well as the Australasian *T. macrospora* Fryday, and four Australian endemics, *T. calvariana* Kantvilas & Lumbsch, *T. crystallifera* Kantvilas & Elix, *T. lilacea* Kantvilas & Elix and *T. thieleana* Kantvilas, Lumbsch & Elix. In this paper, a new species, *T. concentrica*, is described and illustrated from siliceous rocks and clay soil in the Australian Capital Territory and southern New South Wales. A preliminary key to the Australian species of *Trapelia* is also provided.

Trapelia concentrica Elix & P.M.McCarthy, sp. nov. Figs 1, 2
MycoBank No.: **MB 830251**
Similar to *Trapelia crystallifera*, but differs in having an areolate rather than a squamulose thallus, markedly pruinose discs, apothecia commonly surrounded by concentric fissures and thus appearing gyrose, and somewhat larger ascospores, 11–17 × 6–10 µm.

Type: Australia, Australian Capital Territory, Mount Majura Nature Reserve, Mawson Trail to Mt Majura, 35°13'34"S, 149°10'48"E, 720 m alt., on volcanic rocks in dry *Eucalyptus* woodland, *J.A. Elix 46713*, 13.ii.2019 (CANB – holotype).

Thallus whitish grey to glaucous grey or dark grey, sometimes with a pale fawn tinge, smooth at first, soon becoming rather scabrid, at length irregularly cracked, mealy and coarsely crystalline, not sorediate, areolate; areoles dispersed or contiguous, 0.15–0.3 mm wide, roundish then irregularly crenulate, plane to convex; medulla white, containing calcium oxalate (H_2SO_4+), I–. *Photobiont* green, of the *Chlorella*-type, with individual cells irregularly roundish or rhomboid, 6–9 × 5–8 µm, solitary or in pairs, triads or tetrads. *Apothecia* scattered, 0.1–0.7 mm wide, irregularly roundish, at first appearing as a pale pruinose disc, then often splitting at the apex, soon becoming superficial and often with white, slightly roughened or pruinose margins; proper margin very thin, brownish, usually with a well-developed, rather ragged, white thalline rim; apothecia occasionally surrounded by 1–3 more-or-less concentric fissures with a white-pruinose surface so that the apothecium appears almost gyrose; disc concave or plane to rather convex, brown, often densely white-pruinose. *Excipulum* in section cupular, brown at the sides, pale brown to colourless within, unchanged in K, 25–30 µm thick at the sides, 8–10 µm thick at the base. *Hypothecium* 40–60 µm thick, colourless to very pale brown, poorly differentiated from the hymenium. *Hymenium* 75–90 µm thick, colourless, I+ blue, not inspersed with granules or oil droplets. *Paraphyses* richly branched, particularly at the base and near the apices, slender, 1–2.5(–3) µm thick, flexuose, tangled, separating readily in K; apices not markedly expanded. *Asci* 8-spored, of the *Trapelia*-type, with an amyloid wall and a prominent, non-amyloid tholus, elongate-clavate, often with a long tapering stalk, 50–80 × 10–18 µm. *Ascospores* simple, non-halonate, thin-walled, often vacuolate, ovate to subglobose, 11–[*13.3*]–17 × 6–[*7.7*]–10 µm. *Pycnidia* punctiform, brown-black, immersed in areoles; conidia filiform, straight or weakly curved, 11–17 × 0.7 µm.
Chemistry: Thallus K–, C+ red, KC+ red, P–, UV–; containing gyrophoric acid (major), 5-*O*-methylhiascic acid (trace or absent).

Etymology: The specific epithet refers to the apothecia that are commonly surrounded by concentric fissures.

Remarks
The new species is characterized by small but conspicuous, pseudogyrose apothecia with pruinose discs, the nondescript, areolate thallus with a cracked, mealy surface, the simple, ovate to subglobose ascospores and the presence of gyrophoric acid. *Trapelia concentrica* appears to be most closely related to the widespread Australian endemic *T. crystallifera*, with both species having a crystalline, cracked, mealy surface and an esorediate, areolate to squamulose thallus that contains gyrophoric acid. There are, however, clear and consistent differences between the two taxa. In *T. crystallifera*, the squamules are very well-developed, generally separate and relatively large and crenulate-lobate throughout. By contrast, *T. concentrica* is areolate, with the areoles rounded, often dispersed and only rarely becoming crowded, overlapping, convex and bullate. In addition, *T. crystallifera* has epruinose discs, somewhat smaller spores, 9–[*12.3*]–15 × 4–[*6.4*]–8 µm, often pointed at one end, and a hymenium that is orange-brown in the upper part (intensifying orange in K) and colourless below.

At present, this species is known from siliceous rocks and clay soil in dry *Eucalyptus* woodland in the Australian Capital Territory and southern New South Wales. Commonly associated lichens on rock include various *Caloplaca* and *Xanthoparmelia* species, *Acarospora citrina* (Taylor) Zahlbr. ex Rech., *Buellia amandineiformis* Elix & Kantvilas, *B. suttonensis* Elix & A.Knight, *Candelariella vitellina* (Hoffm.) Müll.Arg., *Diploschistes eugeneus* (A.Massal.) J.Steiner, *D. sticticus* (Körb.) Müll.Arg., *Lecanora pseudistera* Nyl., *Lecidea terrena* Nyl., *Lepra erubescens* (Hook.f. & Taylor) A.W.Archer & Elix, *Pertusaria lophocarpa* Körb., *Rhizocarpon geographicum* (L.) DC. and *R. reductum* Th.Fr.

ADDITIONAL SPECIMENS EXAMINED
New South Wales: ● South Western Plains, 15 km SE of Berrigan, on "Brynton" farm, 35°47'23"S, 145°51'15"E, on consolidated clay soil in open *Eucalyptus* woodland, *D.J. Eldridge SAND 91 & D. Freudenberger*, 4.x.2000 (CANB); ● Coornartha Nature Reserve, Numeralla road, 15 km E of Cooma, 36°11'12"S, 149°16'50"E, 950 m alt., on sandstone in pasture, *P.M. McCarthy 4693*, 3.xi.2017 (CANB).
Australian Capital Territory: ● Woodstock Nature Reserve, Shepherds Lookout Walk, 20 km WNW of Canberra, 35°14'34"S, 148°58'38"E, 555 m alt., on porphyry rocks in open *Eucalyptus-Callitris* woodland, *J.A. Elix 46640*, 5.xii.2018 (CANB); ● Mugga Mugga Nature Reserve, W face of Mt Mugga Mugga, 8 km S of Canberra, 35°20'48"S, 149°07'09"E, 700 m

alt., on porphyry rocks in open *Eucalyptus-Allocasuarina* woodland, *J.A. Elix 46702*, 27.xii. 2018 (CANB); ● along the Molonglo River, 0.5 km W of Coppins Crossing, 8.5 km W of Canberra, 35°17'17"S, 149°01'58"E, 530 m alt., on porphyry rock outcrops in pasture, *J.A. Elix 46710*, 30.i.2019 (CANB); *P.M. McCarthy 4844*, *4849*, 30.i.2019 (CANB).

Preliminary Key to *Trapelia* in Australia

1 Thallus squamulose or subsquamulose 2
1: Thallus crustose; surface continuous, rimose or areolate 3

2 Thallus squamulose; upper surface scabrid, mealy, coasely crystalline; ascospores 9–16 × 4–8 µm ..... **T. crystallifera**
2: Thallus subsquamulose; upper surface smooth or minutely rugose; ascospores 15–25 × 7–13 µm ..... **T. involuta**

3 Ascospores 25–30 × 12–20 µm; apothecia immersed ..... **T. macrospora**
3: Ascospores 9–25 × 4–13 µm; apothecia immersed at first, then adnate to sessile 4

4 Thallus surface scabrid, mealy, coarsely crystalline; apothecia becoming pseudogyrose; disc pruinose at least in part ..... **T. concentrica**
4: Thallus surface smooth to rugulose, not crystalline; apothecia not pseudogyrose; disc epruinose 5

5 Thallus thicker at margins; containing 5-*O*-methylhiascic acid (major) 6
5: Thallus thinner at margins; containing gyrophoric acid (major) 7

6 Ascospores 16–23 × 9–15 µm; conidia 10–17 µm long; containing additional 5-methoxylecanoric acid ..... **T. lilacea**
6: Ascospores 11–18 × 5–10 µm; conidia 16–30 µm long; lacking 5-methoxylecanoric acid ..... **T. calvariana**

7 Upper surface often yellow-pigmented; containing gyrophoric acid (major) and 5-*O*-acetylhiascic acid (minor) ..... **T. thieleana**
7: Upper surface greenish grey; containing gyrophoric acid (major); 5-*O*-acetylhiascic acid absent ..... **T. coarctata**

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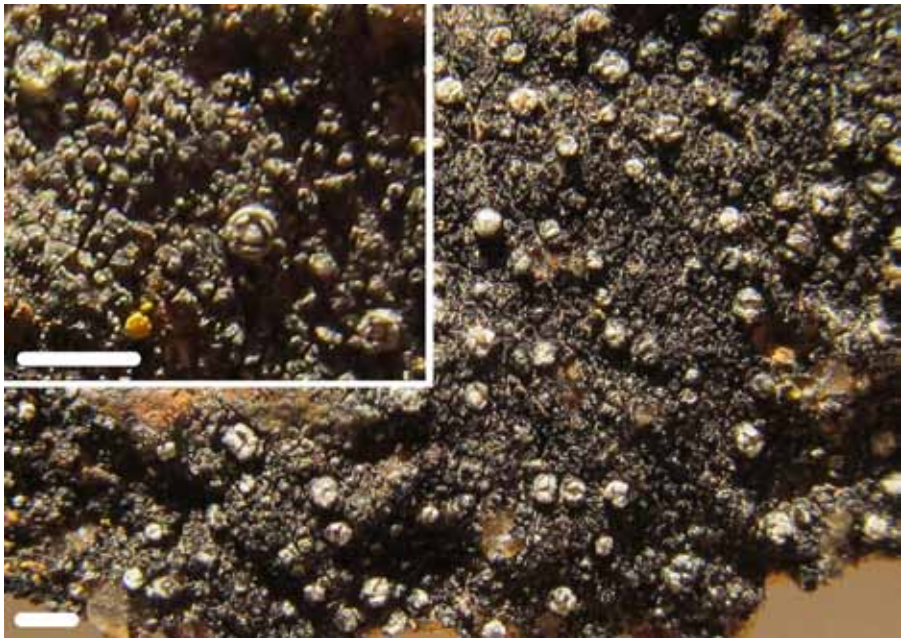

Figure 1. *Trapelia concentrica* (holotype in CANB), Scale = 1 mm.

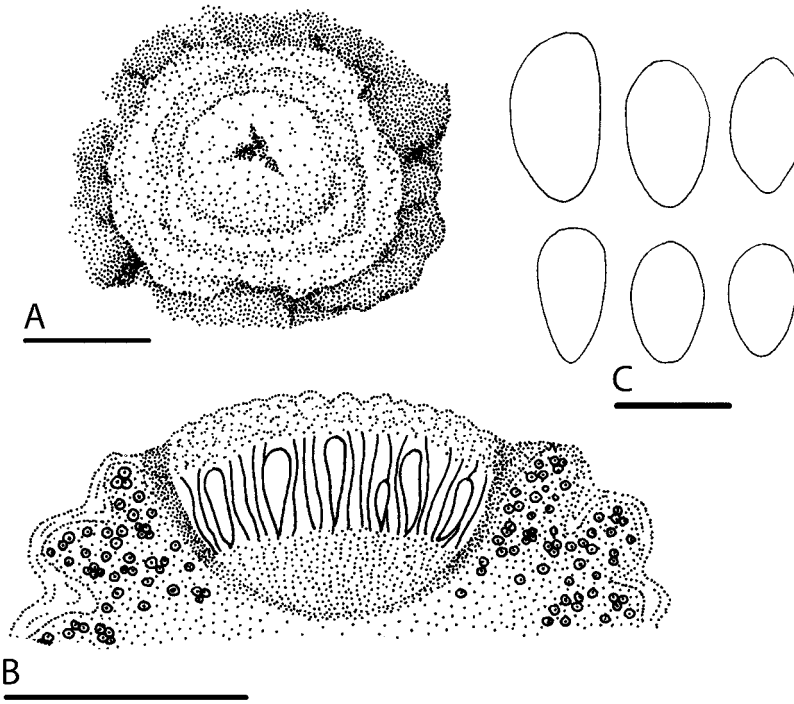

Figure 2. *Trapelia concentrica* (holotype in CANB), Scales A, B = 0.2 mm; C = 10 µm.