



## The lichen genus *Enterographa* Fée (Roccellaceae) in Tasmania

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### Introduction

This paper continues the author's studies of the lichen family Roccellaceae in the broad sense, which hitherto have dealt with new taxa and revisions of *Angiactis* Aptroot & Sparrius (Kantvilas *et al.* 2020a), *Bactrospora* A.Massal. (Kantvilas 2004), *Cresponea* Egea & Torrente (Kantvilas 2020a), *Lecanactis* Körb. (Kantvilas 2021), *Lecanographa* Egea & Torrente (Kantvilas 2004), *Mazosia* A.Massal. (Kantvilas 2020b) and *Ocellomma* Ertz & Tehler (Kantvilas *et al.* 2020b). Here the focus is *Enterographa* Fée, a genus of about 35 species, rich in highly localised taxa found chiefly in tropical and oceanic areas. These occur on bark, rocks or living leaves, or are lichenicolous on foliicolous lichens.

A world revision of the genus was published by Sparrius (2004), who dealt with nine taxa present in Australia. Additional species were added by McCarthy & Elix (2002, 2016, 2018), bringing the total number from Australia and its offshore islands to 12, of which only one, *E. bella* R.Sant., is listed for Tasmania (McCarthy 2020). Five species are known from New Zealand, of which two are shared with Australia (Galloway 2007). In this paper, five species are recorded for Tasmania of which four are shared with other areas of Australasia. Three represent new records for the island, and a further species is described as new to science. All are relatively uncommon and, like most species of the Roccellaceae, are usually found in relatively sheltered, stable microhabitats, often in climax and/or relict vegetation communities.

### Abstract

Five species of *Enterographa* Fée from Tasmania are treated: the foliicolous *E. bella* R.Sant., the corticolous *E. divergens* (Müll.Arg.) Redinger, and three saxicolous species, *E. cretacea* P.M.McCarthy & Elix, *E. subgelatinosa* (Stirt.) Redinger, and *E. ophiolithica* Kantvilas, the last being new to science. The new species is known only from Tasmania and is characterised by a whitish thallus that lacks lichen substances, black apothecia, 0.15–0.4 mm long, and by the (3–)5–7(–8)-septate ascospores, 20–30 x 4–6 µm.

**Keywords:** lichenised Ascomycetes, new species, new records, taxonomy

## Material and methods

The study is based mainly on specimens housed in the Tasmanian Herbarium (HO) and field observations by the author. Morphological and anatomical investigations were undertaken on hand-cut sections of the thallus and apothecia, using standard methods, reagents and stains: water, 10% KOH (K), Lactophenol Cotton Blue, ammoniacal erythrosin and Lugol's Iodine (I). Amyloid reactions where sections were pre-treated in K, rinsed in water and then mounted in I are described in the text as KI. Calcium oxalate was detected by eluting thin sections with 20% H<sub>2</sub>SO<sub>4</sub>. Measurements of ascospores are based on at least 50 observations per taxon and are presented in the format 5<sup>th</sup> percentile–average–95<sup>th</sup> percentile, with outlying values in brackets. Routine chemical analysis was undertaken using standard methods (Orange *et al.* 2010).

## Taxonomy

### Generic characters

*Enterographa* is characterised by a crustose, ecorticate thallus containing calcium oxalate in the medulla. The photobiont is either trentepohlioid, with roundish or ellipsoid cells in clusters or short chains, or *Phycopeltis* where the cells are ±oblong, and form radiating plates. The apothecia are lirelliform, with or without a thalline margin, or punctiform and grouped in pseudostromata, with a brown to black, usually slit-like and enclosed disc. The proper exciple is cupulate in section, very highly reduced, composed of loosely interwoven hyphae interspersed with crystals, and is poorly differentiated from adjacent tissues. The hypothecium is hyaline to pale yellowish brown. The 8-spored asci approximate the

*vulgata*-type (Torrente & Egea 1989) and have a non-amyloid wall and tholus except for a highly reduced amyloid ring that becomes compressed into a thin sheet in older asci (Figure 1). The paraphysoids are richly branched and anastomosing and lack swollen apices. Ascospores are transversely multi-septate, hyaline, narrowly ellipsoid to fusiform, with a gelatinous halo at least when young, and with cylindrical locules. The immersed pycnidia produce bacilliform to filiform, curved or straight conidia. The non-carbonised exciple distinguishes *Enterographa* from *Dirina* Fr., *Sclerophyton* Eschw. and *Opegrapha* Ach. The most closely related genus is probably *Mazosia* (Ertz *et al.* 2015, Sparrius 2004), which has generally roundish apothecia with a distinctly layered proper exciple, and, in the Tasmanian species, 3-septate ascospores with an enlarged uppermost median cell (Kantvilas 2020b). Also similar is *Austrographa* Sparrius, which differs chiefly by having a carbonised hypothecium (Sparrius *et al.* 2010).

### *Enterographa bella* R.Sant.

*Symb. Bot. Ups.* 12(1): 106 (1952).

*Thallus* pale greyish to ± translucent, very thin, mostly in small circular spots 0.4–1 mm wide that merge into colonies to 10 mm wide when well-developed; *medulla* KI–, interspersed with minute crystals; *prothallus* absent. *Photobiont* *Phycopeltis*. *Apothecia* lirelliform, to 0.5–1 mm long, straight, curved or serpentine, occasionally branched, mostly one per small thallus, surrounded by a pale orange-pink thalline margin; *disc* slit-like; exciple orange-brown, obscuring the disc. *Hypothecium* hyaline, 10–15 µm thick. *Hymenium* 55–70 µm thick, diffusely pale brown in the upper part; *asci* ± ellipsoid, 43–52 x 17–25 µm. *Ascospores* transversely 7-septate,

### Key to the species

- 1 Thallus foliicolous; photobiont *Phycopeltis*..... ***E. bella***
- 1: Thallus corticolous or saxicolous; photobiont trentepohlioid .....2
- 2 Thallus corticolous ..... ***E. divergens***
- 2: Thallus saxicolous ..... 3
- 3 Thallus greenish grey, C+ red and/or P+ yellow (gyrophoric and psoromic acids); apothecia red-brown ..... ***E. subgelatinosa***
- 3: Thallus white, with all spots tests negative; apothecia blackish ..... 4
- 4 Thallus thick, with a pruina of calcium oxalate, containing dehydroconstipatic acid; apothecia occurring in stellate clusters, to 2 mm long ..... ***E. cretacea***
- 4: Thallus thin, epuriose, lacking lichen substances; apothecia scattered, often punctiform or if elongate then <0.4 mm long ..... ***E. ophiolithica***

20–25.1–29.5(–31) × (3.5–)4–4.6–5(–5.5)  $\mu\text{m}$ . *Conidia* not seen in Tasmanian specimens, reported as bacilliform, 4–6 × 1.5–2  $\mu\text{m}$ . Chemical composition: psoromic acid, typically in trace amounts due to the thinness of the thallus and therefore not detectable by spot tests. Figure 2A.

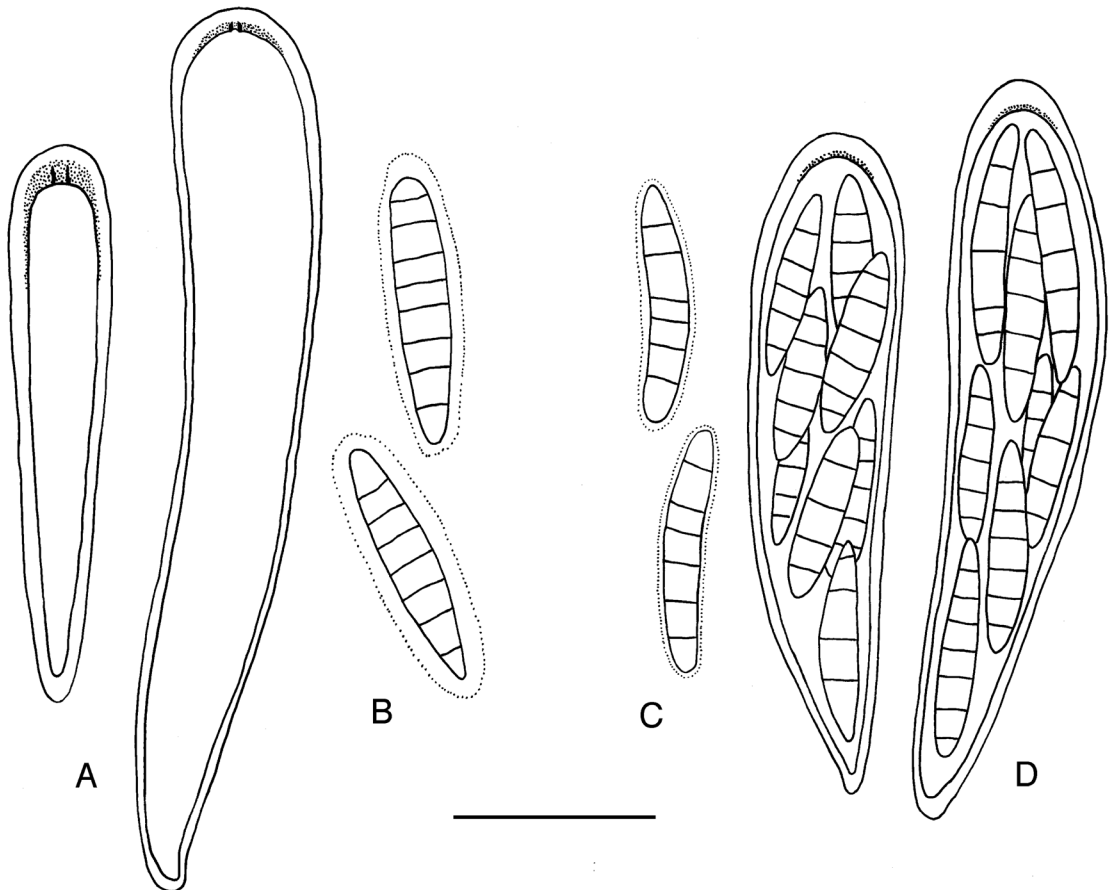
**Remarks:** This is the only foliicolous member of the genus in Tasmania, first recorded by McCarthy *et al.* (2001). It is restricted to a single locality: a narrow, relict corridor of *Atherosperma*-dominated rainforest in a landscape dominated by dry sclerophyll forest. Here it is relatively abundant on the leaves of *A. moschatum* and *Parsonsia straminea*. The orange-brown, often serpentine lirellae make this species very attractive and eye-catching. This species is also known from Victoria and New Zealand (Sparris 2004).

**Specimens examined: TASMANIA:** Track to Cape Surville, 42°57'S 147°59'E, 110 m, 2000, G. Kantvilas 404/00 (HO); *ibid.*, 2014, G. Kantvilas 471/14 (HO).

***Enterographa cretacea* P.M. McCarthy & Elix**

*Telopea* 19: 138 (2016). Type: Australia, New South Wales: 5 km N of Bermagui, Camel Rock, 36°22'41"S 150°04'37"E, alt. c. 3 m, on sheltered quartzitic sandstone on the seashore, above the splash zone, 10 February 2016, P.M. McCarthy 4475 (holotype – CANB!).

*Thallus* chalky white, minutely scabrid and pruinose due to an overlying layer of calcium oxalate crystals, lumpy and uneven, to 1.5 mm thick, sometimes  $\pm$  lobate at the margins, forming irregularly roundish, undelimited patches to 20 mm wide; *medulla* densely interspersed with angular crystals to 15  $\mu\text{m}$  wide, patchily

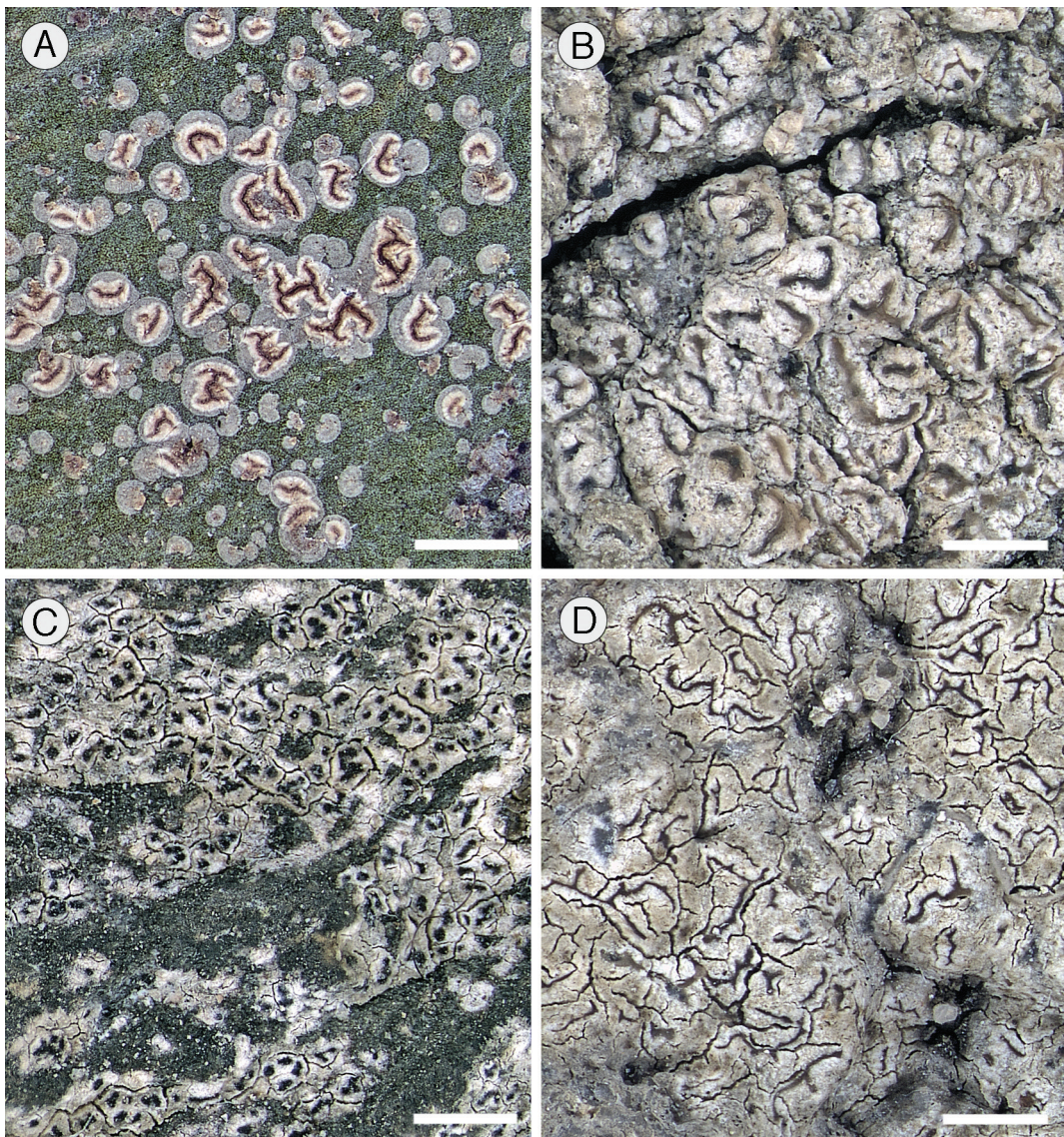


**Figure 1.** Asci and ascospores of *Enterographa* (with amyloid parts after pretreatment in K stippled). **A.** *E. divergens*, with immature ascus (left) and sub-mature ascus (right); note the reduction of the amyloid area and the darker-staining ring. **B.** *E. divergens* ascospores in K, with a highly swollen gelatinous halo. **C.** *E. ophiolithica* ascospores in K, with a thin halo. **D.** *E. ophiolithica* mature asci, with the amyloid area compressed into a thin sheath. Scale = 20  $\mu\text{m}$ .

KI+ blue; *prothallus* absent. *Photobiont* trentepohlioid. *Apothecia* initially  $\pm$  ellipsoid, soon lirelliform, 0.2–2 mm long, simple or branched, curved or straight, at maturity aggregated in stellate clusters and typically radiating from a central point within roundish, convex, stroma-like thalline lumps to 5 mm wide; *disc* brown-black, slit-like or open and greyish pruinose; *exciple* blackish and usually grey pruinose, mostly obscuring the disc, sometimes gaping, in section c. 10  $\mu$ m thick and red-brown in the uppermost part. *Hypothecium* 25–40  $\mu$ m thick, pale brown. *Hymenium* 70–90  $\mu$ m

thick, mostly hyaline, red-brown and intensifying in K in the uppermost c. 10–15  $\mu$ m, sometimes overlain by a crystalline pruina; *asci* narrowly clavate, 60–80  $\times$  12–18  $\mu$ m. *Ascospores* transversely 7(–8)-septate, (18–)20–24.3–28.5(–30)  $\times$  4–4.6–5  $\mu$ m. *Conidia* filiform, curved, 10–20  $\times$  0.5  $\mu$ m. Chemical composition: dehydroconstipatic acid; thallus K–, KC–, C–, P–, UV–. Figure 3.

**Remarks:** This species is here recorded for Tasmania for the first time, based on a single, large collection from a sheltered overhang on a large outcrop of calcarenite along the sea-shore on Flinders Island. There



**Figure 2.** Habit of Tasmanian *Enterographa* species. **A.** *E. bella*. **B.** *E. divergens*. **C.** *E. ophiolithica*. **D.** *E. subgelatinosa*. Scale = 1 mm.

it was closely associated with *Angiactis banksiae* (Müll. Arg.) Kantvilas & Stajsic, a similarly uncommon, highly restricted species of the Roccellaceae. The thick, white, chalky thallus, marked with the black clusters of linear lirellae make *E. cretacea* very distinctive, and it has no known confusing species. Several species of *Opegrapha* occur in similar habitats but these tend to have a thin, crustose or evanescent thallus and lirellae with a heavily carbonised exciple. The original description of this species (from a specimen from NSW) (McCarthy & Elix 2016) appears to be based on a poorly developed, possibly immature thallus.

**Specimen examined:** TASMANIA: Flinders Island, Cave Beach, 41°01'S 147°53'E, 5 m, 2006, G. Kantvilas 82/06 (HO).

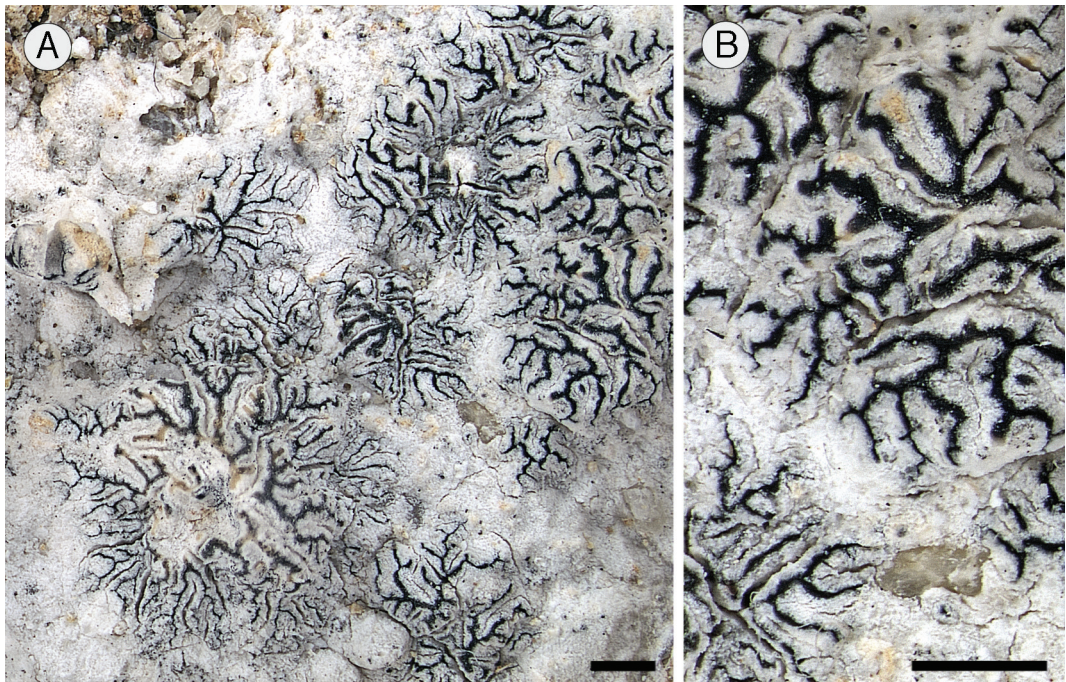
### *Enterographa divergens* (Müll.Arg.) Redinger

*Reprum* Nov. Spec. Regni Veg. 43: 62 (1938); – *Chiodecton divergens* Müll.Arg., Bull. Herb. Boissier 1: 62 (1893). Type: Australia, Victoria: Cheltenham, on *Banksia serrata*, 1890, F.R.M. Wilson 870 (holotype – G, isotype – MEL 0026211A!).

*Thallus* pale cream to pale pinkish beige-grey, rather scurfy, verruculose and often as much as 0.7 mm thick, forming extensive, undelimited patches; *medulla*

interspersed with angular crystals c. 12–25 µm wide, KI+ violet-blue. *Photobiont* trentepohlioid. *Apothecia* lirelliform, 0.2–1 mm long, simple, branched or stellate, curved or straight, immersed in verrucae c. 1–1.5 mm wide that dominate the thallus; *disc* brown, slit-like or, rarely, ellipsoid; *exciple* pale to dark red-brown, mostly obscuring the disc. *Hypothecium* 25–70 µm thick, hyaline. *Hymenium* 80–110 µm thick, diffusely pale brown in the upper part; *asci* narrowly clavate, 70–95 × 14–17 µm. *Ascospores* transversely 7–8(–9)-septate, (22–)23–28.0–33(–35) × (3.5–)4–4.7–5.5 µm. *Conidia* filiform, curved, 10–20 × 0.8–1 µm. Chemical composition: nil. Figures 1A–B, 2B.

**Remarks:** Previously unrecorded for Tasmania, this species is widely distributed but highly localised around the Tasmanian coast. It occurs on the twigs and small branches of shrubs and small trees, sometimes covering these entirely to give them a lumpy appearance. It is sometimes associated with another member of the Roccellaceae, *Schismatomma occultum* (C.Knight & Mitten) Zahlbr., which has a thallus of a similar pinkish hue, elongate apothecial discs that are sometimes elongate and lirelliform, but differs, *inter alia*, in having a thalline apothecial margin and 3-septate ascospores.



**Figure 3.** *Enterographa cretacea*. Scale = 1 mm.

*Enterographa divergens* is known from mainland Australia, especially the coasts of Victoria and South Australia (Kantvilas 2019) as well as from South-East Asia and East Africa (Sparrius 2004).

Sparrius (2004) incorrectly cited a specimen in BM as the holotype, but although this specimen was collected from the same substratum and locality as the type, it cannot be regarded as type material as it was collected in 1893, three years after original publication. On the other hand, a specimen in MEL (26211), dated 'April 1890' is still likely to be correctly cited as an isotype, especially as there are numerous such examples of duplicates in MEL of specimens that Wilson sent to Jean Müller in Geneva.

**Specimens examined:** TASMANIA: Bruny Island, The Neck, 43°16'S 147°21'E, 30 m, 2005, *G. Kantvilas* 152/05 (HO); Flinders Island, Wybalena, 40°01'S 147°53'E, 10 m, 2006, *G. Kantvilas* 75/06 (HO); Slaves Bay, 40°55'S 144°39'E, 15 m, 2003, *G. Kantvilas* 543/03 (HO); *ibid.*, 10 m, 2014, *G. Kantvilas* 407/14 (HO); Spring Bay Mill, Lispers Corner, 42°32'S 147°56'E, 10 m, 2021, *G. Kantvilas* 15/21 (HO).

### *Enterographa ophiolithica* Kantvilas, sp. nov.

Mycobank No.: MB841137

Recognised by the whitish thallus lacking lichen compounds, the short, often punctate, black apothecia, 0.15–0.4 mm long, and the (3–)5–7(–8)-septate ascospores, 20–30 µm long and 4–6 µm wide.

Type: Tasmania: Trial Harbour, 41°56'S 145°10'E, on coastal serpentinite boulders and outcrops, 2 m elevation, 10 September 2014, *G. Kantvilas* 420/14 (holo – HO).

*Thallus* whitish, ± smooth, rimose, to c. 200 µm thick, forming irregular, undelimited, discontinuous patches closely following the cracks and contours of the substratum; *medulla* densely interspersed with angular crystals to 30(–100) µm wide, patchily KI+ blue. *Photobiont* trentepohlioid. *Apothecia* scattered, at first punctiform and 0.08–0.12 mm wide, becoming elongate-lirelliform and 0.15–0.4 mm long, abundant, immersed in the thallus; *disc* dark brown to black, rather fleck-like; *exciple* concolorous with and mostly ± obscuring the disc, in section red-brown and 10–50 µm thick in the uppermost part. *Hypothecium* 30–50 µm thick, hyaline. *Hymenium* 80–110 µm thick, diffusely pale brown in the upper part; *asci* narrowly clavate, 65–90 x 12–16 µm. *Ascospores* transversely (3–)5–7(–8)-septate,

(20–)22–25.6–30 x 4–4.6–5(–6) µm. *Pycnidia* black, very abundant, resembling incipient apothecia; *wall* red-brown in the upper part; *conidia* filiform, curved, 10–25 x 0.5 µm. Chemistry: nil; all spot tests negative. Figures 1C–D, 2C.

**Etymology:** The specific epithet refers to the substratum of the new species (Latin for “growing on serpentine rock”).

**Remarks:** Saxicolous species of *Enterographa* are relatively few and, in that respect, *E. ophiolithica* is more easily distinguished by a dearth of particular features rather than by any single unusual one. In the Australian flora, there are only two saxicolous taxa, both differing from the new species by their thallus morphology and chemistry: *E. cretacea* has a chalky white thallus containing dehydroconstipatic acid; *E. subgelatinosa* has a greenish grey thallus containing gyrophoric and psoromic acids. Both of these species also tend to occur in sheltered underhangs, whereas *E. ophiolithica* occurs on the upper, exposed surface of rocks. Further afield, other saxicolous species of the genus can be similarly distinguished. The pan-tropical *E. leucolyta* (Nyl.) Redinger has a thick, verruculose green-grey thallus containing gyrophoric acid, whereas the temperate Northern Hemisphere taxa, *E. hutchinsiae* (Leight.) A.Massal., *E. crassa* (DC.) Fée and *E. pitardii* (B. de Lesd.) Redinger, all contain confluent acid.

The new species is known from a single collection from a seashore serpentinite boulder on Tasmania's west coast and is readily observed by its whitish thallus and the short, often punctate, black apothecia. The black pycnidia can be very similar to the apothecia and it may require thin sectioning and high-power examination to tell these structures apart. This species is part of a relatively rich saxicolous association of lichens that includes *Amandinea otagoensis* (Zahlbr.) Blaha & H.Mayrhofer, *A. variabilis* Elix *et al.*, *Bacidia littoralis* Kantvilas, *Buellia halonia* (Ach.) Tuck., *Parmotrema neopustulatum* Kurok., *Leptra erubescens* (Hook.f. & Taylor) A.W.Archer & Elix, *Monerolechia badia* (Fr.) Kalb, *Opegrapha cf. spodopolia* Nyl., *Rhizocarpon intersitum* Arnold and *Thelenella tasmanica* H.Mayrhofer & P.M.McCarthy.

Serpentinite is known the world over for supporting unusual vascular plants (van der Ent *et al.* 2015) including Tasmania (e.g. de Salas 2018), although there is far less

documented about its lichens (see Sigal 1989, Sirois *et al.* 1988). In Tasmania, many serpentinite areas have been heavily burnt, leading to a loss of much of their lichen flora and a shift towards ubiquitous taxa. Alternatively, the serpentinite is overlain by acidic peats which negate any chemical influence of the underlying rock. Kantvilas (1991) postulated that the distribution of *Cladonia praetermissa* var. *modesta* (Ahti & Krog) Kantvilas & A.W.Archer in Tasmania may be linked to serpentinite-derived soil but this ecological pattern has become less distinct as additional collections and observations have been made. In that respect, *E. ophiolithica* represents the first example of a Tasmanian lichen that is entirely linked to serpentinite.

### *Enterographa subgelatinosa* (Stirt.) Redinger

*Reprum* Nov. Spec. Regni Veg. 43: 66 (1938); – *Platygrapha subgelatinosa* Stirt., Proc. Phil. Soc. Glasgow 10: 301 (1877). Type: New Zealand: near Wellington, 1874, J. Buchanan (lectotype, *fide* Galloway 1985 – GLAM; isolectotype – BM!).

*Thallus* pale greenish grey, smooth, rimose, reflecting the contours of the substratum, to 150–250 µm thick, forming irregular, rather discontinuous patches to 120 mm wide, sometimes delimited by a thin, dark prothallus; *medulla* interspersed with angular crystals 8–30 µm wide, patchily KI+ blue. *Photobiont* trentepohlioid; *Apothecia* lirelliform, abundant, 0.1–1 mm long, simple or occasionally branched, curved or straight, immersed in the thallus; *disc* reddish brown to dark brown, slit-like or exposed; *exciple* concolorous with the disc, obscuring the disc or gaping. *Hypothecium* 20–40 µm thick, hyaline to pale yellow-brown. *Hymenium* 70–90 µm thick, diffusely pale brown in the upper part; *asci* narrowly clavate, 60–75 x 13–16 µm. *Ascospores* transversely (3–)6–7-septate, (18–)20–24.0–28(–30) x 3.5–4.4–5 µm. *Conidia* filiform, curved, 10–20 x 0.5–0.8 µm. Chemical composition: gyrophoric acid, psoromic acid (±); thallus C+ red, P+ yellow or P–; the concentration of these compounds can be very low and hence spot tests may be unreliable. Figure 2D.

**Remarks:** Previously reported from mainland Australia and New Zealand (Sparrus 2004), this species is here recorded from Tasmania for the first time. It is uncommon (or overlooked) on coastal rocks in the west and south, typically growing in sheltered underhangs

of large boulders or on the undersides of shoreline cobblestones. It is frequently associated with species of *Opegrapha*, which are distinguished readily by their black, carbonised lirellae.

**Specimens examined: TASMANIA:** Fishers Point, 43°34'S 146°55'E, sea-level, 2004, *G. Kantvilas* 75/04 (HO); Granville Harbour, 41°48'S 145°02'E, 3 m, 2013, *G. Kantvilas* 115/13 (HO); mouth of Interview River, 41°35'S 144°53'E, 3 m, 2015, *G. Kantvilas* 143/15 (HO).

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