







## Standard Paper

# Three new species of thelotremoid lichens (lichenized *Ascomycota*: *Ostropales*) with 15 new records of lichenized fungi from Thailand and a worldwide key to species of the genus *Ampliotrema*

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## Abstract

Three new species of thelotremoid lichens, *Ampliotrema subglobosum* Poengs. & Lumbsch, *Ocellularia lichexanthonica* Poengs. & Lumbsch and *O. saxiprotocetrarica* Poengs. & Lumbsch, are described and illustrated based on specimens from southern Thailand. *Ampliotrema subglobosum* is similar to *A. globosum* but differs by having larger ascospores with more septa. *Ocellularia lichexanthonica* differs from *O. subdolichotata* in ascomata diameter and by containing lichexanthone. *Ocellularia saxiprotocetrarica* is similar to *O. gentingensis* in ascospore length and the number of ascospore septa but has narrower ascospores and contains protocetraric acid. Fifteen species are reported for the first time for Thailand: *Austrotrema bicinctulum* (Nyl.) I. Medeiros *et al.*, *Baeomyces heteromorphus* Nyl. ex C. Bab. & Mitt., *Chapsa niveocarpa* Mangold, *Chiodecton sphaerale* Ach., *Erythrodictyon malacum* (Kremp.) G. Thor, *Lecanora subjaponica* L. Lü & H. Y. Wang, *Leucodecton subcompunctum* (Nyl.) Frisch, *Myriotrema concretum* (Fée) Hale, *M. neoterebrans* Frisch, *Ocellularia khasiana* (Patw. & Nagarkar) Kraichak *et al.*, *O. upretii* S. Joshi *et al.*, *Pseudotopeliopsis scabiomarginata* (Hale) Parmen *et al.*, *Sulzbacheromyces sinensis* (R. H. Petersen & M. Zang) Dong Liu & Li S. Wang, *Thelotrema diplotrema* Nyl., and *T. isidiophorum* (Kremp.) Zahlbr. *Ampliotrema globosum* (Hale) Poengs. & Lumbsch is proposed as a new combination. The genus *Erythrodictyon* G. Thor is a new genus for the lichen flora of Thailand.

**Keywords:** biodiversity; South-East Asia; taxonomy; tropical rainforest

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## Introduction

For over a century, numerous scientific expeditions have been conducted to explore the diversity of lichens throughout Thailand, with the first publication in 1909 by Vainio documenting 95 species (Vainio 1909). Since then, both international and Thai lichenologists have made significant contributions (Paulson 1930; Homchantara & Coppins 2002; Wolseley *et al.* 2002; Aptroot *et al.* 2007; Papong & Lumbsch 2011; Sutjaritturakan *et al.* 2014; Mongkolsuk *et al.* 2015). The information gathered from these studies was compiled into a checklist by Buaruang *et al.* (2017) with 1297 species. Although this number appears substantial compared to other South-East Asian countries (Aptroot & Sparrius 2006; Sipman 2010; Nguyen *et al.* 2011; Joshi *et al.* 2013, 2014, 2015, 2019; Weerakoon *et al.* 2015; Paguirigan 2020), there have been subsequent reports of new records and new species, leading to the 1410 species in 257 genera of

lichenized fungi currently found in Thailand (Kalb *et al.* 2018; Naksuwankul & Lücking 2019; Poengsungnoen *et al.* 2021, 2022). Here we focus primarily on thelotremoid lichens, which include a number of genera classified in *Graphidaceae* or *Thelotremataceae* (Rivas Plata *et al.* 2010, 2012; Kraichak *et al.* 2018), which are very diverse in tropical habitats. We add three new species to science and 15 new records for the country, further contributing to our long-term project of understanding the species diversity of lichenized fungi in Thailand. Descriptions, notes and illustrations of the new species are provided.

## Materials and Methods

The majority of samples used in studies were collected in April 2008 from Tarutao National Park, situated in Satun Province on the west coast of the Thai peninsula in the Andaman Sea, between 6°30'–6°44'N and 99°44'–99°9'E. Examination of the external morphology of thalli and ascomata was conducted using a dissecting microscope (Olympus SZ30). Thin cross-sections were prepared by hand from ascomata and observed in material mounted in tap water under a light microscope (Olympus CH). Macroscopic photographs of the specimens were taken using an Olympus Tough TG-6 camera, while microscopic images were captured using an Olympus BX51 microscope mounted with a

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Canon EOS 800D camera. To determine the amyloid reaction of hymenium and ascospores, Lugol's iodine solution was employed. Spot tests were carried out using a 10% aqueous solution of potassium hydroxide (K), for norstictic and stictic acids. Fluorescent substances were examined under long-wavelength UV light (366 nm). Identification of secondary metabolites was performed by thin-layer chromatography (TLC), following standard methods described in Elix (2014). The material studied is deposited in the herbarium of Ramkhamhaeng University (RAMK).

## The Species

### *Ampliotrema subglobosum* Poengs. & Lumbsch *sp. nov.*

Mycobank No.: MB 849885

Similar to *Ampliotrema globosum* but differs in having larger and more septate ascospores.

Type: Thailand, Satun, La-ngu District, Tarutao National Park, tropical rainforest, 06°36'41"N, 99°39'29"E, c. 600 m elev., on bark, 6 April 2008, *W. Polyiam* & *S. Meesim* WP-TT-077 (RAMK40295—holotype).

(Fig. 1A–C)

*Thallus* corticolous, partly endoperidermal, up to c. 5 cm diam., up to 70 µm thick, continuous; surface smooth to slightly uneven, whitish grey, dull; *prothallus* absent. *Cortex* ecorticate or weakly corticate, irregular, partially endoperidermal, prosoplectenchymatous, 10–20 µm thick. *Algal layer* containing a trentepohlioid photobiont, indistinctly separated from medulla, 15–25 µm thick. *Medulla* with very few calcium oxalate crystals, 30–50 µm thick. *Isidia* and *soredia* absent.

*Ascomata* rounded, solitary, prominent, with nearly complete thal-line margin, 1.0–1.5 mm diam.; pore 0.2–0.3 mm wide; *disc* slightly open, covered by whitish grey pruina; proper margin indistinct; thal-line margin smooth, concolorous with thallus, sometimes yellowish circle around the pore. *Excipulum* entire, apically carbonized, up to 120 µm wide; lateral paraphyses absent. *Columella* absent. *Hymenium* inspersed, 120–150 µm high, hyaline, non-amyloid. *Paraphyses* unbranched, with slightly thickened tips. *Epihymenium* greyish granulose, 10–25 µm high. *Asci* clavate, 80–110 × 25–35 µm.

## Worldwide key to species *Ampliotrema*

- |      |   |                                      |
|------|---|--------------------------------------|
| 1    | Isidia or soredia present; apothecial disc yellow-orange pruinose; transversely septate ascospores, 50–90 µm long | 2                                    |
|      | Isidia or soredia absent; apothecial disc variable; ascospore variable  | 3                                    |
| 2(1) | Isidia present; ascospores 4 per ascus; apothecial disc with 0.2–0.5 mm wide pore                                 | <b><i>Ampliotrema dactylizum</i></b> |
|      | Soredia present; ascospores 4–8 per ascus; apothecial disc with 0.2–0.3 mm wide pore                              | <b><i>Ampliotrema sorediatum</i></b> |
| 3(1) | Ascospores (sub)muriform; apothecial disc yellow-orange pruinose  | 4                                    |
|      | Ascospores transversely septate; apothecial disc variable   | 7                                    |
| 4(3) | Ascospores muriform, 80–100 × 17–22 µm  | <b><i>Ampliotrema cocosense</i></b>  |
|      | Ascospores submuriform, 15–30 × 8–12 µm   | 5                                    |
| 5(4) | Ascospores hyaline  | <b><i>Ampliotrema auratum</i></b>    |
|      | Ascospores brown  | 6                                    |
| 6(5) | Ascospores 15–20 µm long; laterally carbonized exciple  | <b><i>Ampliotrema sanguineum</i></b> |
|      | Ascospores 24–28 µm long; apically carbonized exciple   | <b><i>Ampliotrema panamense</i></b>  |

*Ascospores* 4–8 per ascus, hyaline, ellipsoid, 15–19-septate, 55–80 × 11–13 µm, distoseptate with lens-shaped lumina, I+ violet-blue.

*Pycnidia* not observed.

*Chemistry.* Thallus UV–, K+ pale brown, P+ red. TLC: protocetraric acid.

*Etymology.* The specific epithet refers to the similarity with *Ampliotrema globosum*.

*Distribution and ecology.* This species occurred on bark in a tropical rainforest at 600 m elev. It is so far known only from the type locality.

*Notes.* At first glance, the external morphology of the new taxon resembles species in the genus *Ocellularia* G. Mey. However, the carbonized exciple, eolumellate, inspersed hymenium, and the presence of protocetraric acid as a major substance suggest a placement in the genus *Ampliotrema* Kalb ex Kalb (Frisch *et al.* 2006). The closest similar species is *Ampliotrema globosum* (Hale) Poengs. & Lumbsch comb. nov. (Mycobank No.: MB 849889. Basionym: *Ocellularia globosa* Hale, *Phytologia* 27, 492 (1974)). However, the latter taxon differs by its smaller ascospores (40–50 × 8–10 µm) with fewer septa (8–10-septate) (Hale 1974b). According to Mangold (A. Mangold, unpublished data), the material cited by Hale (1974b) under *O. globosa* is not conspecific. The additional material cited (Hale 30773) studied by Mangold has larger ascospores with more septa, similar to *A. subglobosum*, and hence might belong to the new species described here.

Additionally, two other species, *A. amplius* (Nyl.) Kalb and *A. palaeoamplius* (Aptroot & Sipman) Kalb, are similar to the new taxon in having a grey-pruinose disc and transversely septate ascospores, but the former species has smaller ascospores (15–25 × 8–10 µm), and the latter has an uneven-verrucose thallus with a dense cortex (Aptroot & Sipman 2001; Sipman *et al.* 2012). For easier comparison of the new species with previously described one, we provide below a worldwide key for the identification of *Ampliotrema* species.

*Additional specimen examined. Thailand:* Satun: La-ngu District, Tarutao National Park, tropical rainforest, 06°37'12"N, 99°38'40"E, c. 500 m elev., on bark, 2008, *W. Polyiam* & *S. Meesim* WP-TT-153 (RAMK40296).

- 7(3) Apothecial disc grey-pruinose . . . . . 8  
 Apothecial disc yellow-red pruinose . . . . . 11
- 8(7) Ascospores 15–25 µm long, 5–9-septate . . . . . **Ampliotrema amplius**  
 Ascospores 40–80 µm long, 8–21-septate . . . . . 9
- 9(8) Ascospores 40–50 µm long, 8–10-septate . . . . . **Ampliotrema globosum**  
 Ascospores 55–80 µm long, 13–21-septate . . . . . 10
- 10(9) Thallus ecorticate or weakly corticate, smooth to slightly uneven, whitish grey . . . . . **Ampliotrema subglobosum**  
 Thallus corticate, rugulose to finely warted, grey-olive . . . . . **Ampliotrema palaeoamplius**
- 11(7) Ascospores 40–150 µm long; protocetraric acid present . . . . . 12  
 Ascospores 20–35 µm long; secondary metabolites variable . . . . . 13
- 12(11) Ascospores 40–80 × 9–15 µm long, 11–17-septate . . . . . **Ampliotrema megalostoma**  
 Ascospores 60–150 × 10–12 µm long, 15–35-septate . . . . . **Ampliotrema lepadinoides**
- 13(11) Apothecial disc yellow-pruinose, 0.3–0.5 mm wide pore; protocetraric acid present . . . . . **Ampliotrema discolor**  
 Apothecial disc red-pruinose, 0.1–0.2 mm wide pore; lichen substances absent . . . . . **Ampliotrema rimosum**

***Ocellularia lichexanthonica* Poengs. & Lumbsch sp. nov.**

Mycobank No.: MB 849887

Similar to *Ocellularia subdolichotata* but with larger ascomata, a deeply cracked thallus and containing lichexanthone.

Type: Thailand, Satun, La-ngu District, Tarutao National Park, tropical rainforest, 06°36'41"N, 99°39'29"E, c. 600 m elev., on bark, 6 April 2008, *W. Polyiam* & *S. Meesim* WP-TT-240 (RAMK40298—holotype).

(Fig. 1D–F)

*Thallus* corticolous, partly endoperidermal, up to c. 10 cm diam., up to 150 µm thick, deeply cracked; surface smooth to uneven, yellowish green, dull; *prothallus* absent. *Cortex* ecorticate or weakly corticate, prosoplectenchymatous, sometimes difficult to separate from the algal layer, 10–20 µm thick. *Algal layer* containing a trentepohlioid photobiont, indistinctly separated from medulla, 15–30 µm thick. *Medulla* with very few calcium oxalate crystals, 60–100 µm thick, irregularly immersed in the periderm. *Isidia* and *soredia* absent.

*Ascomata* rounded, mostly solitary, erumpent to prominent, with nearly complete thalline margin, 1.5–2.5 mm diam.; pore 0.5–1.0 mm wide; *disc* invisible, hidden by a black columella covered by a white pruina; proper margin indistinct; thalline margin smooth, concolorous with thallus. *Excipulum* entire, lateral carbonized, up to 150 µm wide; lateral paraphyses absent. *Columella* present, completely carbonized, conical, up to 500 µm high, 350 µm wide. *Hymenium* clear, 250–300 µm high, hyaline, amyloid. *Paraphyses* unbranched, apically smooth. *Epihymenium* indistinct, 5–10 µm high. *Asci* cylindrical, 200–250 × 25–30 µm. *Ascospores* 2–4 per ascus, hyaline, fusiform, 17–25-septate, 150–200 × 15–20 µm, distoseptate with lens-shaped lumina, I+ violet-blue.

*Pycnidia* not observed.

**Chemistry.** Thallus UV+ yellow, K–, P–. TLC: lichexanthone.

**Etymology.** The specific epithet refers to the occurrence of lichexanthone in the species.

**Distribution and ecology.** This species occurred on bark in a tropical rainforest at c. 600 m elev. It is so far known only from the type locality.

**Notes.** *Ocellularia subdolichotata* Papong *et al.* is similar to the new species, which shares the columellate ascomata, clear hymenium and large, transversely septate ascospores, 2–4 per ascus, but differs in the smooth thallus, smaller ascomata diameter and lack of secondary metabolites (Papong *et al.* 2014b). The species is also similar to *O. fecunda* (Vain.) Hale in general ascoma anatomy and ascospore size (Hale 1974a), but can be distinguished by the presence of lichexanthone. Another similar species is *O. lichexanthocavata* Aptroot, which has similar, transversely septate ascospores and also contains lichexanthone. However, it differs in having smaller ascospores (18–21 × 5.5–6.5 µm) (Aptroot 2023).

***Ocellularia saxiprotocetrarica* Poengs. & Lumbsch sp. nov.**

Mycobank No.: MB 849888

Similar to *Ocellularia gentingensis* but differing in having narrower ascospores, more ascospores per ascus and containing protocetraric acid.

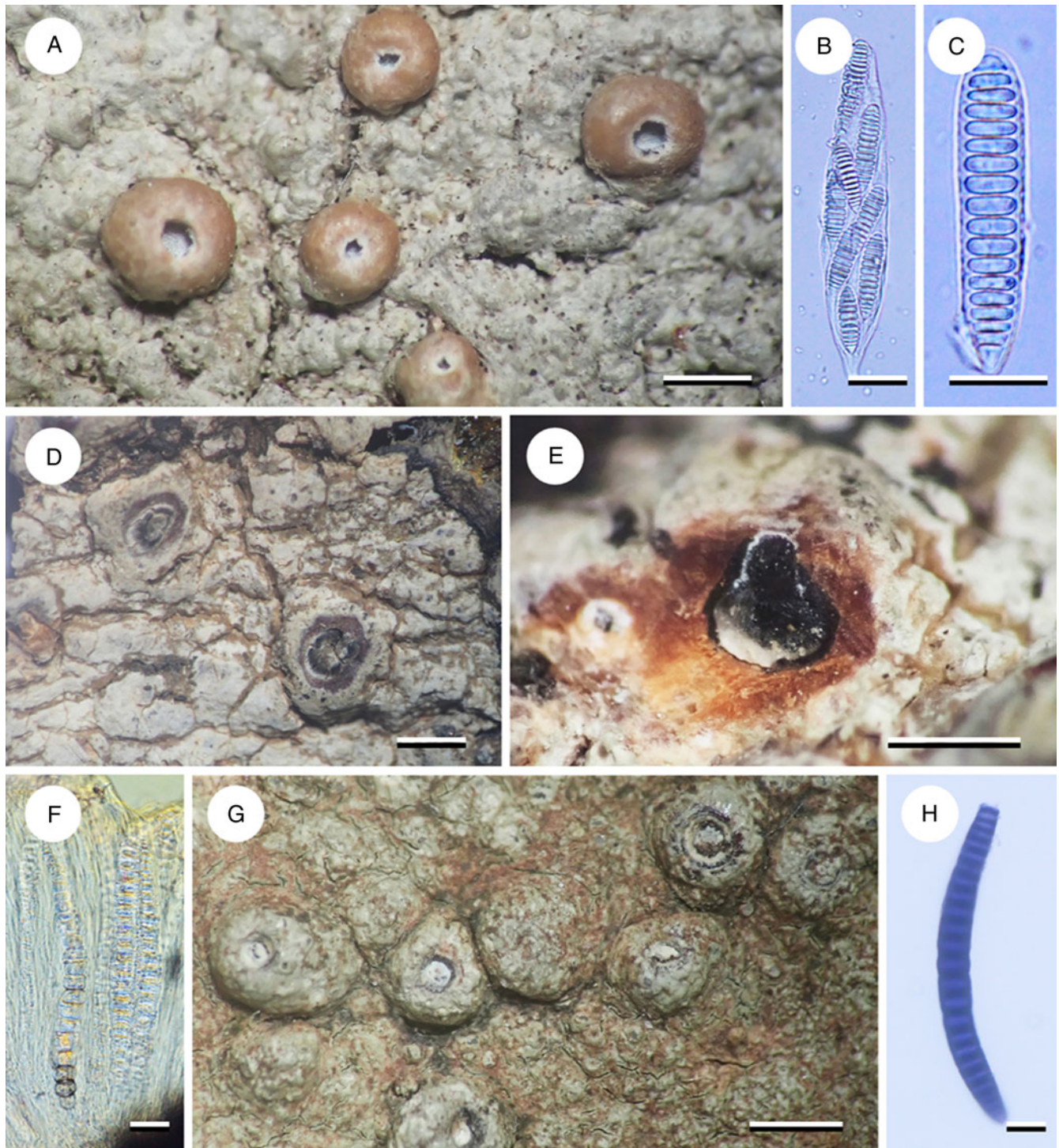
Type: Thailand, Satun, La-ngu District, Tarutao National Park, tropical rainforest, 06°37'18"N, 99°38'13"E, c. 200 m elev., on rock, Lo Poh waterfall, 7 April 2008, *W. Polyiam* & *S. Meesim* WP-TT-268 (RAMK40299—holotype).

(Fig. 1G & H)

*Thallus* saxicolous, up to c. 10 cm diam., up to 150 µm thick, continuous to finely cracked; surface smooth to uneven, yellowish brown, dull; *prothallus* absent. *Cortex* ecorticate or weakly corticate, prosoplectenchymatous, 10–20 µm thick. *Algal layer* containing a trentepohlioid photobiont, indistinctly separated from medulla, 20–30 µm thick. *Medulla* with very few calcium oxalate crystals, 40–60 µm thick, up to 120 µm thick. *Isidia* and *soredia* absent.

*Ascomata* rounded, mostly solitary, prominent, with complete thalline margin, 1.0–2.0 mm diam.; pore 0.3–0.5 mm wide; *disc*





**Figure 1.** The new species. A–C, *Ampliotrema subglobosum* (holotype). A, thallus with ascomata. B, ascus with young ascospores. C, mature ascospore. D–F, *Ocellularia lichexanthonica* (holotype). D, thallus with ascomata. E, section through ascoma. F, asci with ascospores. G & H, *Ocellularia saxiprotocetrarica* (holotype). G, thallus with ascomata. H, ascospore in iodine. Scales: A, D, E & G = 1 mm; B, C, F & H = 20  $\mu$ m. In colour online.

invisible, hidden by a black columella covered by white pruina; proper margin indistinct; thalline margin smooth, concolorous with thallus, sometimes yellowish circle around the pore. *Excipulum* entire, apically to laterally carbonized, up to 250  $\mu$ m wide; lateral paraphyses absent. *Columella* present, completely carbonized, conical, up to 500  $\mu$ m high, up to 400  $\mu$ m wide. *Hymenium* clear, 350–500  $\mu$ m high, hyaline. *Paraphyses* unbranched, apically smooth. *Epihymenium* indistinct, 5–10  $\mu$ m

high. *Asci* cylindrical to clavate, 280–350  $\times$  35–50  $\mu$ m. *Ascospores* 4–8 per ascus, hyaline, fusiform, 25–35-septate, 175–225  $\times$  15–20  $\mu$ m, distoseptate with lens-shaped lumina, I+ violet-blue.

*Pycnidia* not observed.

**Chemistry.** Thallus UV–, K+ pale brown, P+ red. TLC: protocetraric acid.

**Etymology.** The specific epithet refers to the habitat and the occurrence of protocetraric acid in the species.

**Distribution and ecology.** This species occurred on rock in a tropical rainforest at an altitude of *c.* 200 m elev. It is so far known only from the type locality.

**Notes.** The new saxicolous species exhibits similarities, in terms of length and the number of septations of the ascospores, with *O. domingensis* (Fée ex Nyl.) Müll. Arg. However, the latter species differs in having wider ascospores (120–220 × 20–40 µm) with 1–2 ascospores per ascus, and by containing hypoprotocetraric acid (Mangold *et al.* 2009). *Ocellularia cocosensis* Lücking and *O. neopertusariiformis* Hale both share similarities in ascospore size but can be distinguished by their cinnabar-red medulla and ecolmellate ascomata, respectively (Hale 1981; Sipman *et al.* 2012). The combination of large, transversely septate ascospores and the presence of protocetraric acid in the new species makes it almost unique in the genus *Ocellularia*. Another similar species is *O. gentingensis* Nagarkar & Hale, but that species differs in having smaller ascospores (54–69 × 9–12 µm) and ecolmellate ascomata (Nagarkar & Hale 1989).

### The New Records

#### *Austrotrema bicinctulum* (Nyl.) I. Medeiros, Lücking & Lumbsch

*Fieldiana, Life and Earth Sciences* 9, 15 (2017).

Illustration in Medeiros *et al.* (2017).

**Distribution and ecology.** This taxon has been found mainly in the Australasian region (Mangold *et al.* 2009). It is a corticolous species that is typically found in relatively exposed environments such as mangroves, seashores and lowland rainforests (Medeiros *et al.* 2017). In Thailand, it occurred on bark in mangrove forest at an altitude of *c.* 5 m elev.

**Notes.** Three species of the lichen genus *Austrotrema* I. Medeiros *et al.* have been reported so far (Medeiros *et al.* 2017). *Austrotrema terebrans* (Nyl.) I. Medeiros *et al.* and *A. bicinctulum* are similar species in having transversely septate ascospores, but the former has an uneven to verrucose thallus surface, more distinct periphysoids, and persistently weakly amyloid ascospores. The other species, *A. myriocarpum* (Fée) I. Medeiros *et al.*, can be distinguished by muriform ascospores (Medeiros *et al.* 2017).

**Specimen examined. Thailand:** Satun: La-ngu District, Tarutao National Park, mangrove forest, *c.* 5 m elev., on bark, 06° 42'14"N, 99°38'56"E, 5 m elev., 2008, S. Santanoo & W. Polyiam TAL-TT-194 (RAMK40301).

#### *Baeomyces heteromorphus* Nyl. ex C. Bab. & Mitt.

*Bot. Antarct. Voy., III, Fl. Tasman.* 2, 351 (1859) [1860].

Illustration in Galloway (1980).

**Distribution and ecology.** *Baeomyces heteromorphus* is a widely distributed terricolous species in Australia, New Zealand, Fiji and Tasmania (Galloway 1980, 2007; Johnston 2001; Lumbsch *et al.* 2011). It has also been recorded from New Guinea and

the Philippines (Streimann 1986; Paguirigan 2020). In Thailand, it occurred on soil and rock in lower montane rainforest at *c.* 1000–2500 m elev.

**Notes.** This species is characterized by a green corticate thallus, pale pink to brown apothecia, hyaline, simple ascospores, 8–13 × 3–5 µm in size, and by containing the norstictic acid chemosyndrome (Galloway 1980; Johnston 2001).

**Specimens examined. Thailand:** Chiang Mai: Chom Thong District, Doi Inthanon National Park, lower montane rainforest, 18°35'22"N, 98°29'15"E, 2400–2500 m elev., on soil, 2005, J. Phra-phuchamnong CP2224 (RAMK35442), CP2228 (RAMK35444). Nakhon Ratchasima: Pak Chong District, Khao Yai National Park, lower montane rainforest, 14°21'39"N, 101°23'35"E, 1000–1200 m elev., on rock, 2005, P. Nirongbut RU-PN22615 (RAMK08413).

#### *Chapsa niveocarpa* Mangold

*Flora of Australia* 57, 654 (2009).

Illustration in Mangold *et al.* (2009).

**Distribution and ecology.** The taxon was originally described from tropical rainforests in Australia and was recently documented in China (Dou *et al.* 2021). In Thailand, it occurred on bark in a tropical rainforest at an altitude of *c.* 700 m elev.

**Notes.** The new record and *C. meridensis* (Kalb & Frisch) Lücking *et al.* can be distinguished from other similar species in the genus by their inspersed hymenium and muriform ascospores. However, *C. niveocarpa* occurs on bark and has an ecorticate thallus, whereas *C. meridensis* is commonly found on moss and has a corticate thallus (Rivas Plata *et al.* 2010).

**Specimens examined. Thailand:** Satun: La-ngu District, Tarutao National Park, tropical rainforest, 06°37'11"N, 99°38'54"E, *c.* 700 m elev., on bark, 2008, W. Polyiam & S. Meesim TAL-TT-128 (RAMK40300).

#### *Chiodecton sphaerale* Ach.

*Syn. Meth. Lich.* (Lund), 108 (1814).

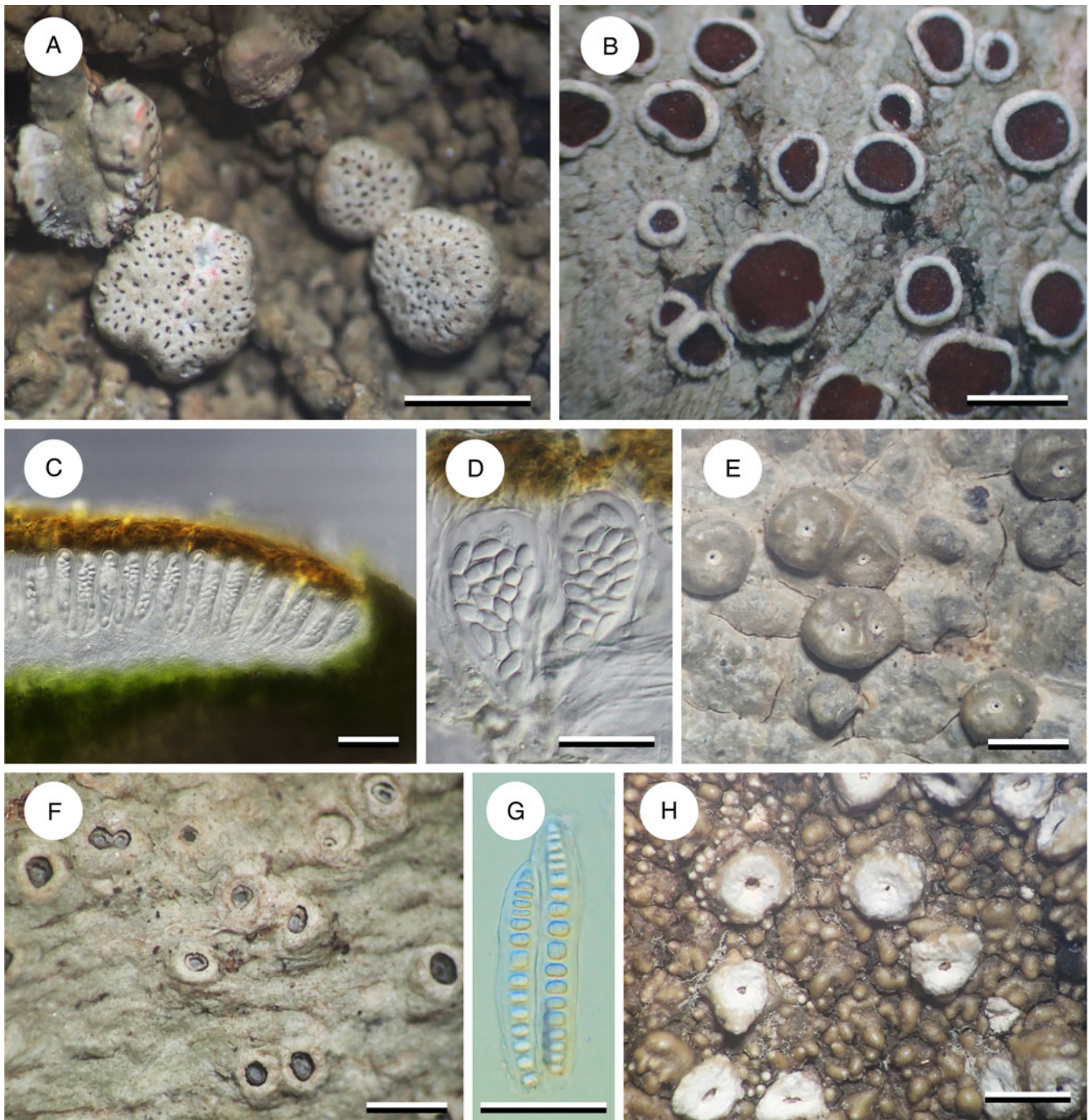
Illustration in Thor (1990).

**Distribution and ecology.** The taxon was found in various locations within the neotropical region (e.g. Vainio 1890; Thor 1990; Ertz *et al.* 2015) and was also recorded from Australia (McCarthy 2023). In Thailand, it occurred on bark in a tropical rainforest at an altitude of *c.* 600 m elev.

**Notes.** *Chiodecton sphaerale* differs from its morphologically most similar species, *C. malmei* G. Thor, by having larger ascospores (26–41 µm vs 20–30 µm long) and conidia (8–14 µm vs 5–7 µm long) (Thor 1990).

**Specimen examined. Thailand:** Satun: La-ngu District, Tarutao National Park, tropical rainforest, 06°36'41"N, 99°39'29"E, *c.* 600 m elev., on bark, 2008, W. Polyiam & S. Meesim WP-TT-324 (RAMK40302).





**Figure 2.** New records. A, *Erythrodecton malacum* (W. Polyiam & S. Meesim WP-TT-111), thallus with ascomata. B–D, *Lecanora subjaponica* (V. Poengsunnoen VP-1392). B, thallus with ascomata. C, section through ascoma. D, asci with ascospores. E, *Ocellularia khasiana* (W. Polyiam & S. Meesim WP-TT-47), thallus with ascomata. F & G, *Thelotrema diplorema*, (P. Pornprom PP-TT-132). F, thallus with ascomata. G, thick-walled ascospores. H, *Thelotrema isidiophorum* (B. Wannaluk BW-TT-152), thallus with ascomata and isidia. Scales: A, B, E, F & H = 1 mm; C, D & G = 30  $\mu$ m. In colour online.

*Erythrodecton malacum* (Kremp.) G. Thor

*Op. Bot.* **103**, 78 (1991).

(Fig. 2A)

**Distribution and ecology.** This is a widespread corticolous species in the eastern Palearctic (Thor 2007). In Thailand, it occurred on bark in a tropical rainforest at an

altitude of c. 600 m elev. This is the first record of the genus for Thailand.

**Notes.** The species is similar to *E. granulatum* (Mont.) G. Thor, differing by lacking soredia and having a black hypothecium (Thor 1990).

**Specimens examined.** **Thailand:** Satun: La-ngu District, Tarutao National Park, tropical rainforest, 06°36'41"N, 99°39'29"E, c.

600 m elev., on bark, 2008, *W. Polyiam* & *S. Meesim* WP-TT-111 (RAMK40303), WP-TT-283 (RAMK40304).

### *Lecanora subjaponica* L. Lü & H. Y. Wang

*Lichenologist* **44**, 466 (2012).

(Fig. 2B–D)

**Distribution and ecology.** This corticolous species has been described from montane habitats in China (Lü *et al.* 2012). In Thailand, it occurred on bark in a lower montane rainforest in northern Thailand at an altitude of *c.* 1640 m elev.

**Notes.** *Lecanora subjaponica* differs from its morphologically similar species, *L. japonica* Müll. Arg. and *L. pseudojaponica* Lijuan Li & Printzen, by having 16–32 ascospores per ascus (Lü *et al.* 2012; Li *et al.* 2023).

**Specimen examined. Thailand:** Chiang Mai: Chom Thong District, Inthanon Lady's Slipper Orchid Conservation Project, lower montane rainforest, 18°35'06"N, 98°30'50"E, *c.* 1640 m elev., on bark, 2021, *V. Poengsungnoen* VP-1392 (RAMK40305).

### *Leucodecton subcompunctum* (Nyl.) Frisch

*Biblioth. Lichenol.* **92**, 162 (2006).

Illustration in Hale (1974a) as *Thelotrema subcompunctum*.

**Distribution and ecology.** This taxon is a common species occurring from the coastline in mangrove forests to altitudes up to 1500 m (Mangold *et al.* 2009). It has been reported from palaeotropical regions, including Kenya, Tanzania and New Caledonia (Frisch *et al.* 2006; Mangold *et al.* 2009). In Thailand, it occurred on bark in a tropical rainforest at an altitude of *c.* 600 m elev.

**Notes.** *Leucodecton subcompunctum* is similar to *L. fissurinum* (Hale) A. Fisch. but is distinguished by its lepadinoid ascomata and conspicuously free excipulum (Rivas Plata *et al.* 2010).

**Specimen examined. Thailand:** Satun: La-ngu District, Tarutao National Park, tropical rainforest, 06°36'41"N, 99°39'29"E, *c.* 600 m elev., on bark, 2008, *W. Polyiam* & *S. Meesim* WP-TT-69 (RAMK40305).

### *Myriotrema concretum* (Fée) Hale

*Mycotaxon* **11**, 133 (1980).

Illustration in Hale (1981).

**Distribution and ecology.** *Myriotrema concretum* is a pantropical species (Lücking *et al.* 2016). In Thailand, it occurred on bark in a lower montane rainforest at an altitude of *c.* 1500 m elev.

**Notes.** This species closely resembles *M. hartii* (Müll. Arg.) Hale in terms of its prominent ascomata, fused excipulum, small muriform ascospores, and the presence of psoromic acid. However, it can be distinguished from the latter species by the absence of isidia (Lücking *et al.* 2016).

**Specimens examined. Thailand:** Chiang Mai: Mae Rim District, Doi Suthep-Pui National Park, lower montane rainforest, 18°48'56"N, 98°53'40"E, *c.* 1500 m elev., on bark, 2022, *V. Poengsungnoen* VP-1393 (RAMK40307), VP-1394 (RAMK40308).

### *Myriotrema neoterebrans* Frisch

*Biblioth. Lichenol.* **92**, 179 (2006).

Illustration in Frisch *et al.* (2006).

**Distribution and ecology.** *Myriotrema neoterebrans* has previously been recorded from tropical Africa (Frisch *et al.* 2006; Lücking *et al.* 2016). In Thailand, it occurred on bark in a beach forest at an altitude of *c.* 15 m elev.

**Notes.** This species is similar to *M. glauculum* (Nyl.) Hale and *M. neofrondosum* Sipman in terms of the presence of lichexanthone and very small, 3-septate ascospores (10–15 × 5–7 µm). *Myriotrema neoterebrans* can be differentiated from those species by having a free excipulum and containing protocetraric acid and 'neoterebrans unknown' (Frisch *et al.* 2006; Lücking *et al.* 2016).

**Specimen examined. Thailand:** Satun: La-ngu District, Tarutao National Park, beach forest, 06°37'15"N, 99°37'08"E, *c.* 15 m elev., on bark, 2008, *P. Nirongbut* PN-TT-122 (RAMK40309).

### *Ocellularia khasiana* (Patw. & Nagarkar) Kraichak, Lücking & Lumbsch

*Phytotaxa* **189**, 74 (2014).

(Fig. 2E)

**Distribution and ecology.** This species was first described from India (Patwardhan & Nagarkar 1980) and subsequently recorded from New Caledonia, Australia and the Philippines (Kraichak *et al.* 2014). In Thailand, it occurred on bark in a tropical rainforest at an altitude of *c.* 370 m elev.

**Notes.** This species can be distinguished from the similar *O. microstoma* (Müll. Arg.) Hale by producing protocetraric acid as a major substance (Kraichak *et al.* 2014).

**Specimen examined. Thailand:** Satun: La-ngu District, Tarutao National Park, tropical rainforest, 06°36'48"N, 99°39'51"E, *c.* 370 m elev., on bark, 2008, *W. Polyiam* & *S. Meesim* WP-TT-47 (RAMK40310).

### *Ocellularia upretii* S. Joshi *et al.*

*Lichenologist* **50**, 660 (2018).

Illustration in Joshi *et al.* (2018).

**Distribution and ecology.** *Ocellularia upretii* has so far been known only from India, where it is common across various altitudes and substrata within the evergreen forests and tropical rainforests of south India and the eastern Himalaya (Joshi *et al.* 2018). In Thailand, it occurred on bark in a tropical rainforest at an altitude of *c.* 20 m elev.



**Notes.** This species is mainly characterized by a brownish exciple, simple columella, large transversely septate ascospores (100–125 × 15–25 μm) and the absence of secondary metabolites (Joshi et al. 2018). It resembles *O. allosporoides* (Nyl.) Patw. & Kulk. in the morphology and ascospore size; however, the latter species produces norisonotatic and norsubnotatic acids.

**Specimen examined.** **Thailand:** *Satun:* La-ngu District, Tarutao National Park, tropical rainforest, 06°38'44"N, 99°37'23"E, c. 20 m elev., on bark, 2008, *N. Phenporm* & *S. Senglek* SI-TT2-10 (RAMK40311).

***Pseudotopeliopsis scabiomarginata* (Hale) Parmen, Lücking & Lumbsch**

*PLoS ONE* 7(12), e51392, 11 (2012).

Illustration in Hale (1981).

**Distribution and ecology.** The taxon was described from rainforest habitats at low to mid elevations in Sri Lanka (Hale 1981). In Thailand, it occurred on bark in a tropical rainforest at an altitude of c. 600 m elev.

**Notes.** The main distinguishing characteristics of this species are the presence of hyaline, large muriform ascospores and the absence of phenolic substances. It can be distinguished from the similar *P. laceratula* (Müll. Arg.) Parmen et al. by its amyloid ascospores and larger ascomata (Rivas Plata et al. 2010; Parmen et al. 2012).

**Specimen examined.** **Thailand:** *Satun:* La-ngu District, Tarutao National Park, tropical rainforest, 06°36'41"N, 99°39'29"E, c. 600 m elev., on bark, 2008, *W. Polyiam* & *S. Meesim* WP-TT-31 (RAMK40312).

***Sulzbacheromyces sinensis* (R. H. Petersen & M. Zang) Dong Liu & Li S. Wang**

*Mycologia* 109, 740 (2017).

Illustration in Liu et al. (2019).

**Distribution and ecology.** *Sulzbacheromyces sinensis* has been recorded from China, Japan, Korea and the Philippines (Liu et al. 2019; Suwannarach et al. 2019). In Thailand, it occurred on soil in evergreen forests between 200–800 m elev.

**Notes.** This species is characterized by a green to dark green crustose thallus, white to grey or silver prothallus, yellow to red-orange basidiomata and basidia 26–38 × 3.5–8 μm (Liu et al. 2017).

**Specimens examined.** **Thailand:** *Prachin Buri:* Mueang Prachin Buri District, Khao Yai National Park, dry evergreen forest, on soil, c. 800 m elev., 2019, *P. Fangkaew* KYPF01 (RAMK35446). *Trad:* Ko Kut District, evergreen forest, on soil, c. 200 m elev., 2019, *K. Buaruang* et al. KOB104 (RAMK36059).

***Thelotrema diplotrema* Nyl.**

*Annls Sci. Nat., Bot., sér. 4* 11, 258 (1859).

(Fig. 2F & G)

**Distribution and ecology.** This species is widely distributed in tropical and subtropical regions of Australia, Asia and Africa (Frisch et al. 2006; Mangold et al. 2009; Joshi et al. 2012). In Thailand, it occurred on bark in tropical rainforests between 15–60 m elev.

**Notes.** The species is characterized by a loosely corticate, smooth to uneven thallus, immersed to emergent ascomata, a free exciple, transversely, 10–20-septate, 45–100 × 7–12 μm, amyloid ascospores with thick outer walls, and a lack of secondary substances (Frisch et al. 2006; Mangold et al. 2009). It is similar to *T. perriei* Papong et al. but that species has smaller ascospores (50–60 × 6–8 μm) and a corticate, verrucose thallus (Papong et al. 2014a).

**Specimens examined.** **Thailand:** *Satun:* La-ngu District, Tarutao National Park, tropical rainforest, 06°37'09"N, 99°40'43"E, c. 60 m elev., on bark, 2008, *P. Pornprom* PP-TT-132 (RAMK40313), *M. Phaengphech* MP-TT-181 (RAMK40314); *ibid.*, 06°37'15"N, 99°37'08"E, c. 15 m elev., on bark, 2008, *B. Wannaluk* BW-TT-132 (RAMK40315).

***Thelotrema isidiophorum* (Kremp.) Zahlbr.**

*Cat. Lich. Univers.* 2, 619 (1923) [1924].


(Fig. 2H)

**Distribution and ecology.** This species has been described from Singapore and has also been recorded from Malaysia (Homchantara & Coppins 2002). In Thailand, it occurred on bark in a tropical rainforest at an altitude of c. 200–300 m elev.

**Notes.** This species is readily distinguished from other species in the genus *Thelotrema* by having isidia (Rivas Plata et al. 2010).

**Specimens examined.** **Thailand:** *Satun:* La-ngu District, Tarutao National Park, tropical rainforest, 06°37'18"N, 99°38'13"E, c. 200–300 m elev., on bark, 2008, *B. Wannaluk* BW-TT-150 (RAMK40316), BW-TT-152 (RAMK30317).

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