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**New or otherwise interesting lichens. IX. Four new species in the family Graphidaceae, one new combination, new records and remarks**

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**Abstract**

Ten species of the lichen family Graphidaceae are treated in the ninth contribution to this series. Four species are new to science: *Allographa cameroonensis* Kalb & Schumm from Cameroon differs from *A. grandis* in having larger ascospores and in the lack of secondary lichen products. *Allographa kuetchangiana* Kalb & Schumm from Thailand differs from *A. mexicana* in having a permanent thalline cover of the ascomata and in having a whitish pruina on their top. *Cruentotrema siamense* Lücking & Kalb from Thailand differs from *C. amazonum* in having smaller ascomata and smaller ascospores. *Ocellularia striata* Kalb & Schumm from Thailand differs from *O. jutaratae* in having smaller ascospores and in lacking the purplish, K<sup>+</sup> greenish pigment which covers the remnants of the split proper exciple.

*Rhabdodiscus exutus* (Hale) Kalb & Schumm is a new combination (Bas.: *Ocellularia exuta* Hale).

Photographs of *Allographa mexicana* (Hale) Lücking & Kalb (including an isotype) show the variation of the ascomata and the differences to *A. kuetchangiana*. *Allographa isidiata* (Hale) Lücking & Kalb is reported from Ecuador, which is a new addition to the lichenobiota of this country and the second finding of this species after its description. *Allographa plagiocarpa* (Fée) Lücking & Kalb, before misidentified as *A. mexicana*, from Cartago Province is the second report of this species from Costa Rica. The chemistry of *Ocellularia kohphanganensis* Papong, Mangold & Lücking and the exact spelling of the specific epithet are corrected. *Ocellularia macrocrocea* Kalb is a new addition to the lichenobiota of Thailand where it is sometimes growing together with *O. striata*. The intraspecific variation of *Ocellularia thelotremoides* (Leight.) Hale is discussed and the name is put on the correct place of the amended key to Thai *Ocellularia* species.

Cochromatography of some *Ocellularia* species with a deep orange-yellow pigment together with a pure sample of skyrin in solvents A, B' and C showed identical R<sub>F</sub>-values in all three solvent systems.

## Introduction

Graphidaceae is the second largest family of lichenized Ascomycota (Lücking *et al.* 2017) with ca. 2200 species described. By far most of them are restricted to (sub-) tropical regions. Therefore, collecting material remains challenging for several reasons and identification often turns out even more difficult, due to the lack of modern systematic treatments and identification keys. This situation changed with the pivotal papers of Staiger (2002) and Frisch *et al.* (2006). Shortly after, Lücking, Lumbsch and collaborators started to investigate this family based on extensive field work in many countries and modern molecular methods. This led to a new systematics with ca. 80 genera in the family, the description of hundreds of new species, and many influential papers, e. g. Archer 2007, 2009, Cáceres *et al.* 2014, Kalb *et al.* 2004, Kraichak *et al.* 2014, Lücking *et al.* 2009, Lücking 2014, Lücking 2015, Lücking *et al.* 2011, Lücking *et al.* 2016b, Mangold *et al.* 2009, Medeiros *et al.* 2017, Pamong *et al.* 2010, Parmen *et al.* 2012, Rivas Plata *et al.* 2010a, b, 2012a, b, 2013), Sipman *et al.* 2012. These publications, some of them containing world-keys to genera of Graphidaceae, inspired even more papers with the descriptions of new findings or new species (e. g. Aptroot 2016, Borgato & Ertz 2018, Cáceres *et al.* 2020, Kalb *et al.* 2017, Kalb 2020a, 2020b, Lima *et al.* 2019, Lücking & Kalb 2018, Medeiros 2018, Seavey *et al.* 2017). Despite of all these efforts, there is still no light at the end of the tunnel, and the present paper represents another drop in the bucket.

## The species

*Allographa cameroonensis* Kalb & Schumm, *sp. nov.*

Fig. 1

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Similar to *Allographa grandis* Kalb, but differs in having larger ascospores (110–175 × 25–48 µm in *A. grandis*) and in lacking lichen products (norstictic acid aggr. in *A. grandis*).

Type: REPUBLIC OF CAMEROON. **South Province:** Campo Forest Reserve, 02°17'45" N, 10°14'10" E, 350 m, corticolous on trunk and branches of dead trees lying at the roadside, 01 March 1999, leg. A. Frisch & T. Idi s.n. (B, holotype).

Description: Thallus corticolous, beige to light olive, smooth, corticate, dull to slightly shiny. Lirellae erumpent to prominent, with a complete thalline margin of same colour as the thallus, elongate, straight, curved or sinuose, unbranched or irregularly branched, up to 25 mm long and 0.6 mm wide, labia divergent, entire (*illinata*-morph), disc widely open, light chocolate brown with a whitish pruina. Exciple honey-brown, mostly apically (partly also laterally) carbonized; hymenium interspersed (type B); ascospores 1/ascus, hyaline, becoming slightly brownish with age, richly muriform, 40–50 × 10–15-septate, 110–260 × 35–50 µm, I+ blue.

Chemistry: no lichen substances detected by TLC.

Etymology: The specific epithet refers to the country where the lichen was collected.



**Fig. 1:** *Allographa cameroonensis* (holotype); thallus with ascomata, bar 1 mm.

Remarks: Using the world key to *Graphis* s. lat. (Lücking *et al.* 2009) the new species would key out as *Graphis pertriosa* (Kremp.) A. W. Archer, but this species has much smaller ascospores ( $25\text{--}40 \times 8\text{--}14 \mu\text{m}$ ), *negrosina*-morph ascomata, a norstictic acid aggr. chemistry and a type A inspersion of the hymenium. Using the key to African species of *Graphis* s. lat. (Joshi *et al.* 2016), the new species would key out as *Graphis subvelata* Stirt. However, this species differs in having *lineola*- or *deserpens*-morph ascomata, much smaller ascospores ( $35\text{--}50 \times 8\text{--}15 \mu\text{m}$ ) and also a type A inspersion of the hymenium. Most similar is the recently described *Allographis grandis* Kalb, also collected in Cameroon, but this species differs in having smaller ascospores ( $110\text{--}175 \times 25\text{--}48 \mu\text{m}$ ) and the norstictic acid aggr. as secondary metabolites.

Additional specimen examined: REPUBLIC OF CAMEROON. **South Province:** Campo Forest Reserve, Oveng village,  $02^{\circ}24'35''$  N,  $10^{\circ}21'50''$  E, 350 m, corticolous on trunk and branches of felled trees lying in a small logging area, 02 March 1999, leg. A. Frisch 99/Ka3095 & T. Idi (herb. A. Frisch).

***Allographa isidiata* (Hale) Lücking & Kalb**

Fig. 2

Remarks: Hale (1975) described this lichen from Venezuela as *Thelotrema isidiatum*. Later, Lücking *et al.* 2009, published the combination *Graphis isidiata* (Hale) Lücking. Finally the species ended up in the genus *Allographa* (Lücking & Kalb 2018). We found no mention of this species in the literature except the original description. In the herbarium of the second author, among unidentified material, we discovered another

specimen of this species, collected in Ecuador, which is a new addition to the lichenobiota of that country.

ECUADOR. **Province Napo:** Near Sarayacu, ca. 30 km SSE of Baeza, 0°38'27" N, 77°48'32" E, growing over mosses on a humid batter along the road E20/E45, 2000 m, 10 September 1987, leg. K. & A. Kalb 17038.



**Fig. 2:** *Allographa isidiata*, thallus and ascomata, bar 0.5 mm.

*Allographa kuetchangiana* Kalb & Schumm, *sp. nov.*

Figs. 3, 4

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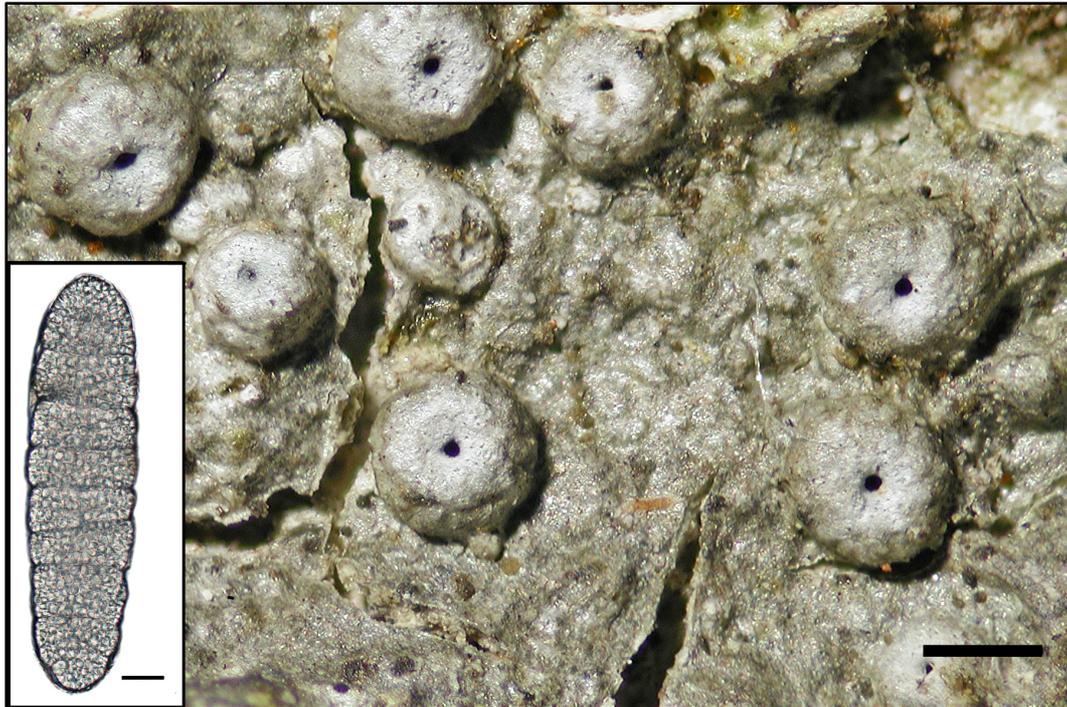
Differing from *Allographa mexicana* (Hale) Lücking & Kalb in having a remaining complete thalline cover of the ascomata (flaking off with age in *A. mexicana*; compare Figs. 5 and 7) with a whitish pruina on their top (not pruinose in *A. mexicana*; compare Figs. 3 and 5).

Type: THAILAND. **Mae Hong Son Province:** Pai District; Tambon Kuet Chang, just in front of the entry to Huai Nam Dang National Park, at the campsite area, 19°17' N, 98°36' E, 1450 m, on bark of a ± freestanding *Pinus* sp., 30 November 2016, leg. J. & K. Kalb 41856 (RAMK, holotype).

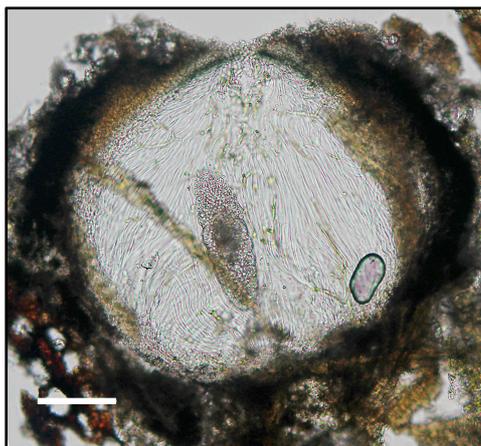
Description: Thallus corticolous, smooth to uneven, silvery-gray, brilliant with a dense prosoplectenchymatic cortex, up to 25  $\mu$  thick, large clumps of crystals between cortex and photobiont layer, the latter up to 75  $\mu$ m thick, medulla whitish, up to 75  $\mu$ m thick, also with clusters of crystals. Lirellae sessile, round, with complete thalline cover, 0.5–0.9

mm diam.; labia entire. Proper ecipeculum completely carbonized, ca. 75  $\mu\text{m}$  thick. Hymenium ca. 250  $\mu\text{m}$  high, clear. Ascospores single, densely muriform, 145–200  $\times$  35–55  $\mu\text{m}$ , hyaline, I+ blue.

Chemistry: no lichen substances detected by TLC.



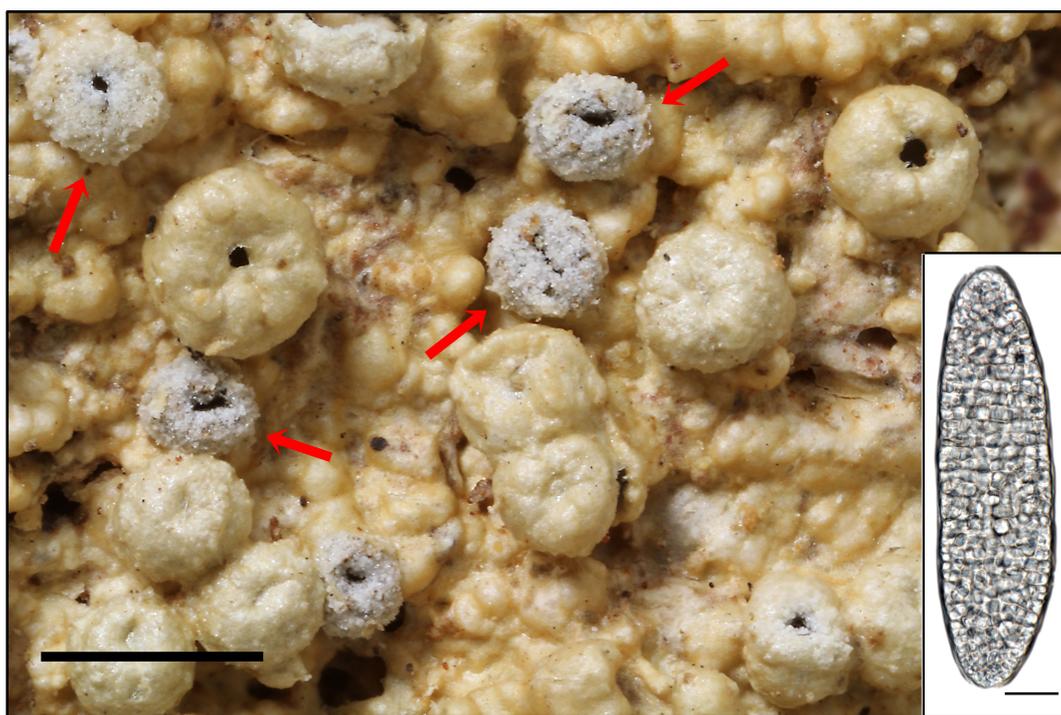
**Fig. 3:** *Allographa kuetchangiana* (Holotype, KK 41856); thallus with ascomata having a whitish pruina at the top, note that the thalline exciple does not flake off as in *Allographa mexicana* (see below), bar 0.5 mm; inlay: ascospore, bar 20  $\mu\text{m}$ .



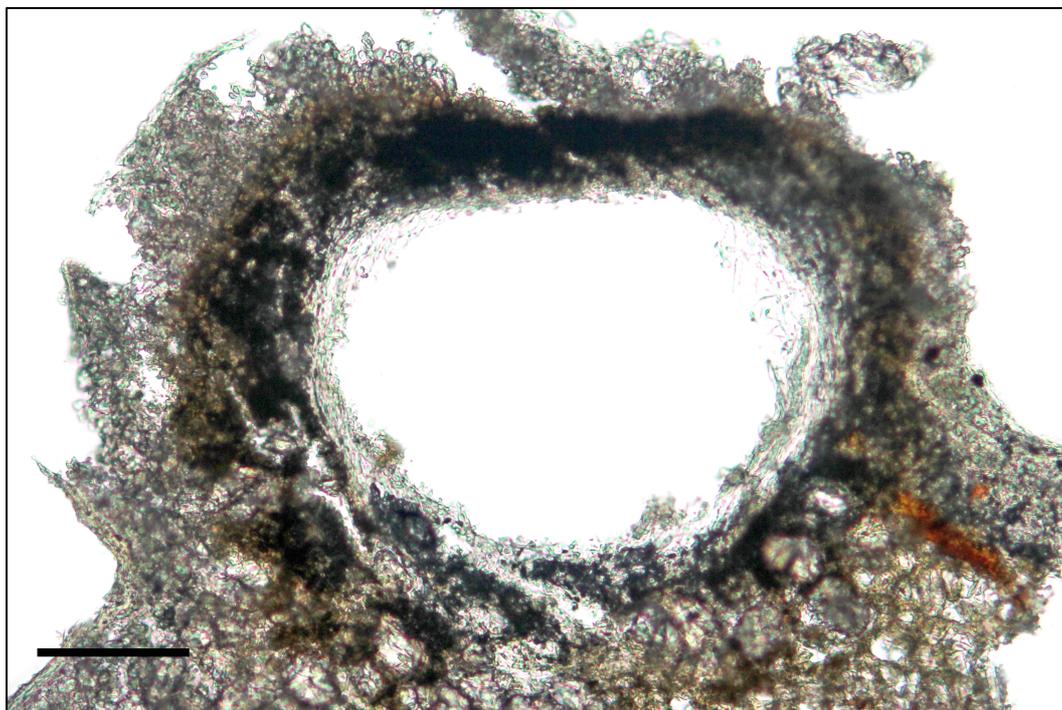
**Fig. 4:** *Allographa kuetchangiana*; section through ascoma, bar 100  $\mu\text{m}$ .

Etymology: The specific epithet refers to the name of the subdistrict (tambon) where the lichen was collected.

Remarks: *Allographa kuetchangiana* is obviously a rare species, because despite of an extensive sampling of members of Graphidaceae in Thailand, this was the only specimen representing this taxon. It was growing over mosses on bark or directly on bark in a montane region of northern Thailand. At first glance, its round apothecia resemble those of *Allographa mexicana*, and only a detailed look reveal some slight differences which are mentioned in the diagnosis. In Mangold *et al.* (2008), *Graphina muscicola* Kalb was treated as a synonym of *Thelotrema mexicanum* Hale ( $\equiv$  *Allographa mexicana*). During the preparation of this paper, we reinvestigated an isotype of the latter and the holotype of *Graphina muscicola* and found different spore dimensions [95–163 (142.7)  $\times$  20–40 (30.7)  $\mu\text{m}$  in *Thelotrema mexicanum*; 13 spores measured from five ascomata, 175–260 (210,9)  $\times$  35–73 (44.8) in *Graphina muscicola*; 10 spores measured from four ascomata]. In *Allographa kuetchangiana*, we found 145–200 (168)  $\times$  35–55 (48,6)  $\mu\text{m}$ ; 10 spores measured from 4 four ascomata. Despite these differences, we think that spore dimensions in Graphidaceae with extremely large ascospores can vary considerably and do not allow to separate taxa on this character alone. Also the shape of the ascomata in *A. mexicana* is very variable. We have seen very few lirellae which are elongate and even branched on the same thallus with *globosa*-morph lirellae.



**Fig. 5:** *Allographa mexicana* (Isotype); thallus with ascomata, note the exfoliating thalline exciple (red arrows) and the round openings; bar 1 mm; inset: ascospore, bar 20  $\mu\text{m}$ .



**Fig. 6:** *Allographa mexicana* (Isotype); section through ascoma, note the thalline exciple flaking off, bar 100  $\mu$ m.



**Fig. 7:** *Allographa mexicana*; thallus with ascomata, bar 0.5 mm; note the oblong ascomata with slit-shaped opening. From almost all ascomata, the thalline exciple is split off .

*Allographa plagiocarpa* (Fée) Lücking & Kalb

Fig. 8

Remarks: Staiger (2002) identified one collection (Kalb & Plöbst 28386) from Costa Rica as *Allographa mexicana* (Staiger 2002: 244, originally as *Graphis muscicola*). Reinvestigation of this material revealed that it represents another species, *A. plagiocarpa*. The two species can be separated by their different lirellae morphs, i.e. *globosa*-morph in *A. mexicana*, with mostly rounded ascomata and complete thalline margin, and *dussii*-morph in *A. plagiocarpa*, with shortly elongated ascomata and lateral thalline margin leaving the upper part of the black labia permanently exposed (Lücking *et al.* 2009).

COSTA RICA. **Cartago Province:** Cordillera de Talamanca; Interamerican Highway, ca. 3.5 km S of El Empalme, 09°43' N, 83°57' W, muscicolous in a mountain cloud forest, 2500 m, 28 December 1978, leg. K. Kalb 28386 & G. Plöbst.

Lücking *et al.* (2008) reported *Allographa plagiocarpa* from Alajuela Province. The above mentioned collection from Cartago Province is the second finding from Costa Rica.

Due to a lapsus in Lücking *et al.* (2008) the ascospores of *Allographa plagiocarpa* (as *Graphis p.*) were described as terminally muriform (loc. cit.: 31) and 4–8/ascus (loc. cit.: 99). They were correctly described as regularly muriform in the world key by Lücking *et al.* (2009), corresponding to the sheet of the type specimen in G with a drawing showing densely muriform ascospores. In our material, the ascospores are 1/ascus, 105–175 × 23–35 µm, becoming brownish with age (Fig. 8, inlay).



**Fig. 8:** *Allographa plagiocarpa*, thallus and ascomata, bar 0.5 mm; inlay: ascospore, bar 20 µm.

*Cruentotrema siamense* Lücking & Kalb *sp. nov.*

Fig. 9

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Differing from *Cruentotrema amazonum* M. Cáceres, Aptroot & Lücking in having smaller ascomata and smaller ascospores.

Type: THAILAND. **Trang Province:** Yantakhao District; Tambon Thung Khai, edge of Peninsular Botanic Garden Thung Khai, 7°28' N, 99°38' E, on bark of an unidentified deciduous tree, in a tropical rainforest, 25 m; 17 December 2016, leg. J. & K. Kalb 41966 (RAMK, holotype; B, isotype).

Etymology: The epithet refers to Siam, the former name for Thailand.

Description: Thallus corticolous, partially endoperidermal, continuous; surface smooth to uneven, dark olive-green to brown; prothallus absent. Thallus in section up to 100 µm thick, with epidermal, prosoplectenchymatous cortex, 10–25 µm thick, and endoperidermal photobiont layer 30–80 µm thick, lacking crystals. Photobiont *Trentepohlia*; cells rounded to irregular in outline, green, 6–10 × 5–8 µm. Ascomata rounded to angular, erumpent, chroodiscoid, with complete thalline margin, 0.2–0.5 mm diam., 0.1–0.2 mm high; disc partially exposed, light grey-brown, with a thin whitish pruina; proper margin distinct, fissured-lobulate, visible as triangular or irregular lobules initially covering the disc, grey-brown; thalline margin fissured-lobulate, greyish to light olive, formed by 4–6 triangular lobules originally covering the disc and proper margin but rupturing prior to the proper margin. Excipulum entire, brown or becoming carbonized in upper third or down to the base, 20–40 µm wide; laterally covered by, but soon splitting apart from aliferous, corticate thallus containing periderm layers; columella absent; hypothecium prosoplectenchymatous, ca. 20 µm high, hyaline; hymenium 60–80 µm high, hyaline, clear; epithecium brownish, granular, 3–10 µm high. Paraphyses unbranched, apically smooth; periphysoids absent; asci fusiform to clavate, 40–50 × 10–12 µm. Ascospores (6–) 8 per ascus, ellipsoid, 3-septate, 12–16 × 5–7 µm, hyaline, distoseptate with lens- to diamond-shaped lumina, I–.

Secondary chemistry: No substances detected by TLC; medulla P–, microscopic section K–.

Distribution and ecology: Known from tropical rainforests in three southern provinces of Thailand, Phang-gna, Trang and Songkhla.

Remarks: This new species is placed in the recently established genus *Cruentotrema* Rivas Plata, Papong, Lumbsch & Lücking in Rivas Plata *et al.* (2012: 119), due to its ascoma morphology and the non-amyloid ascospores first with ± lens-shaped lumina, becoming astrothelioid with age. It is most similar to the neotropical *C. amazonum*, which has larger ascospores (15–20 × 6–8 µm) and larger ascomata (0.4–0.7 mm). Habitually also very similar is the Australian *C. kurandense* (Mangold) Rivas Plata, Lumbsch & Lücking (2012: 119) which has submuriform ascospores. In the key to the species of *Cruentotrema*, *Dyplolabia* and *Enigmatrema* provided by Kalb *et al.* (2016), the new species would key out at couplet 7.

- 7 Ascospores 3-septate.....7a  
- Ascospores submuriform, eastern Palaeotropics (India, Thailand, Australia) .....

- ..... *Cruentotrema kurandense* (Mangold) Rivas Plata, Lumbsch & Lücking  
 7a Ascomata 0.4–0.7 mm diam., ascospores, 15–20 × 6–8 µm, Neotropics (Brazil) .....  
 ..... *Cruentotrema amazonum* M. Cáceres, Aptroot & Lücking  
 - Ascomata 0.2–0.4 mm diam., ascospores 12–16 × 5–7 µm, eastern Palaeotropics  
 (Thailand)..... *Cruentotrema siamense* Lücking & Kalb

Additional specimens examined: THAILAND. **Phang-gna Province:** Takua Pa District, Tambon Khuekkhak, Samnaksong Bandokdang, at Phetkasem Road (road Nr. 4). a few km S of Bangsak Village, 8°45' N, 98°19' E, on bark of an unidentified deciduous tree, in a secondary tropical rainforest, 25 m; 8 June 2015, leg. J. Sutjaritturakan & K. Kalb (KK 41521); **Songkhla Province:** Rataphum District, Tambon Tachamueng, Tone-Plew Waterfall, 07°00' N, 100°14' E, on bark of unidentified deciduous tree, in a tropical rainforest, 100 m; 18 December 2016, leg. J. & K. Kalb (KJK 41752).



Fig. 9: *Cruentotrema siamense* (holotype), thallus and ascomata, bar 0.5 mm

*Ocellularia striata* Kalb & Schumm, *sp. nov.*

Figs. 10, 11, 12

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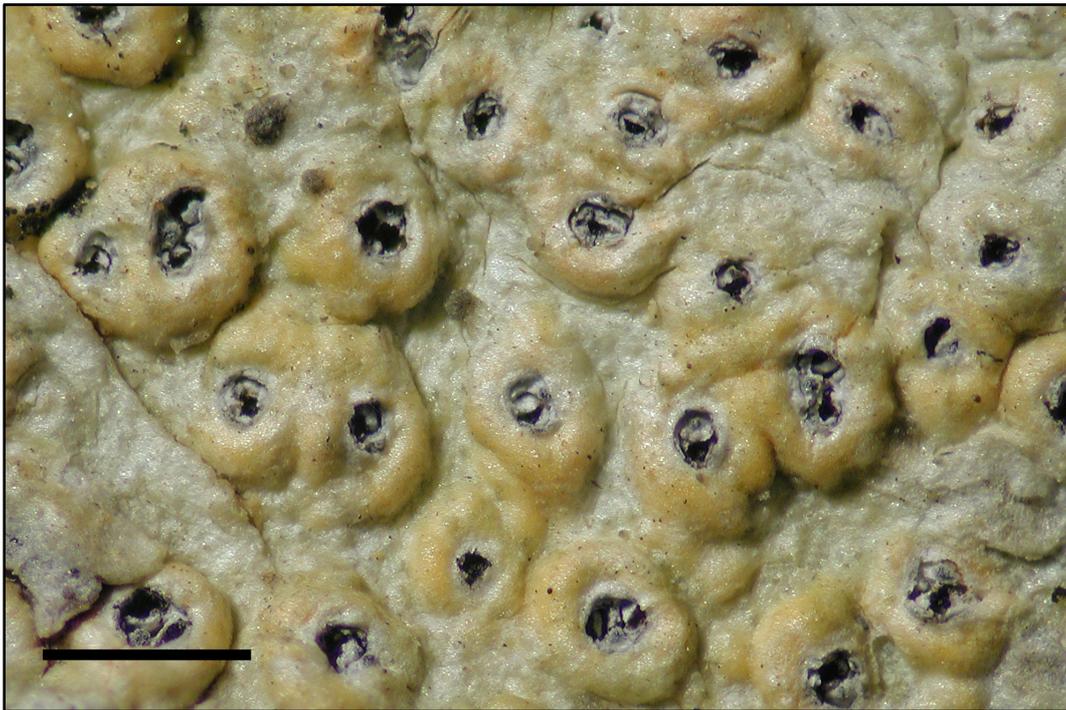
Differing from *Ocellularia jutaratae* Kalb from Brazil in having smaller ascospores (20–26 × 7–8 µm in *O. jutaratae*) and in lacking the characteristic purplish, K+ greenish pigment which is covering the remnants of the split proper exciple in *O. jutaratae*.

Type: THAILAND. **Phang-gna Province:** Takua Pa District; Tambon Kuekkhak, Samnangsong Bandokdank at Phetkasem Road (Road Nr. 4), a few km S of Bangsak Village, 8°45'35" N, 98°19'13" E, on bark of deciduous trees in a secondary rainforest, 45 m; 8 June 2015, leg. J. Sutjaritturakan & K. Kalb 41221 (RAMK, holotype).

Etymology: The specific name refers to the striate proper exciple of the ascomata.

Description: Thallus corticolous, whitish to beige-grey or light oliv-green, smooth to uneven, rarely with a few scattered warts, with dense, prosoplectenchymatous 1015  $\mu\text{m}$  thick cortex; photobiont layer 20–40  $\mu\text{m}$  thick, medulla indistinct, white, partly with an orange-yellow pigment; photobiont layer and medulla with clusters of calcium oxalate crystals. Apothecia prominent to sessile, rounded, 0.4–0.6 mm diam.; disc invisible, covered by narrow, 0.1–0.25 mm wide pore, which is filled with white remnants of old split proper exciple; thalline exciple entire, with deep orange-yellow pigment, K+ purple. Columella mostly absent, if present then finger-like, apically ca. 25  $\mu\text{m}$  thick, carbonized at the tip, brownish to hyaline down to the base. Exciple prosoplectenchymatous, upper half or rarely completely carbonized; periphysoids absent. Hymenium 75–120  $\mu\text{m}$  high, clear; paraphyses unbranched. Ascospores 8/ascus, 3–6-septate (most spores 5-septate), 15–23  $\times$  5–7  $\mu\text{m}$ , ellipsoid, sometimes one end tapering, with thick septa and lens-shaped lumina, colorless, I+ violet-blue (amyloid).

Secondary chemistry: cinchonaric acid (major), concinchonaric acid (submajor), skyrin (in Kalb 2020a called "orange pigment with  $R_f$ -values 35/34/22").

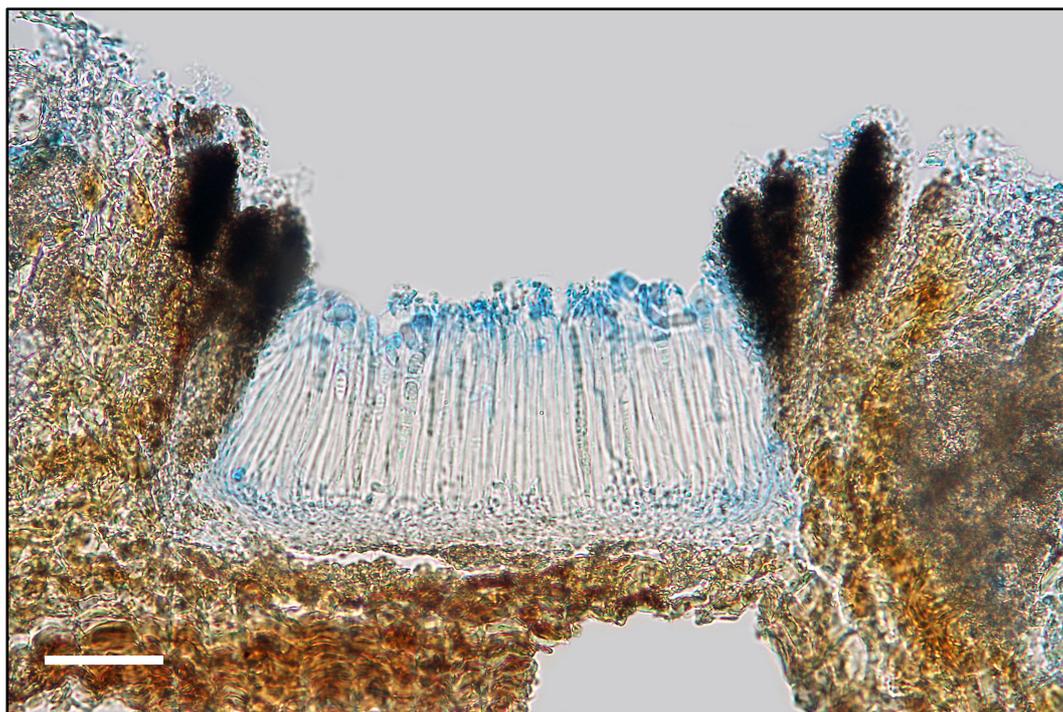


**Fig. 10:** *Ocellularia striata* (holotype); thallus with ascomata, bar 0.5 mm; note the pore which is filled with remnants of the split proper exciple.

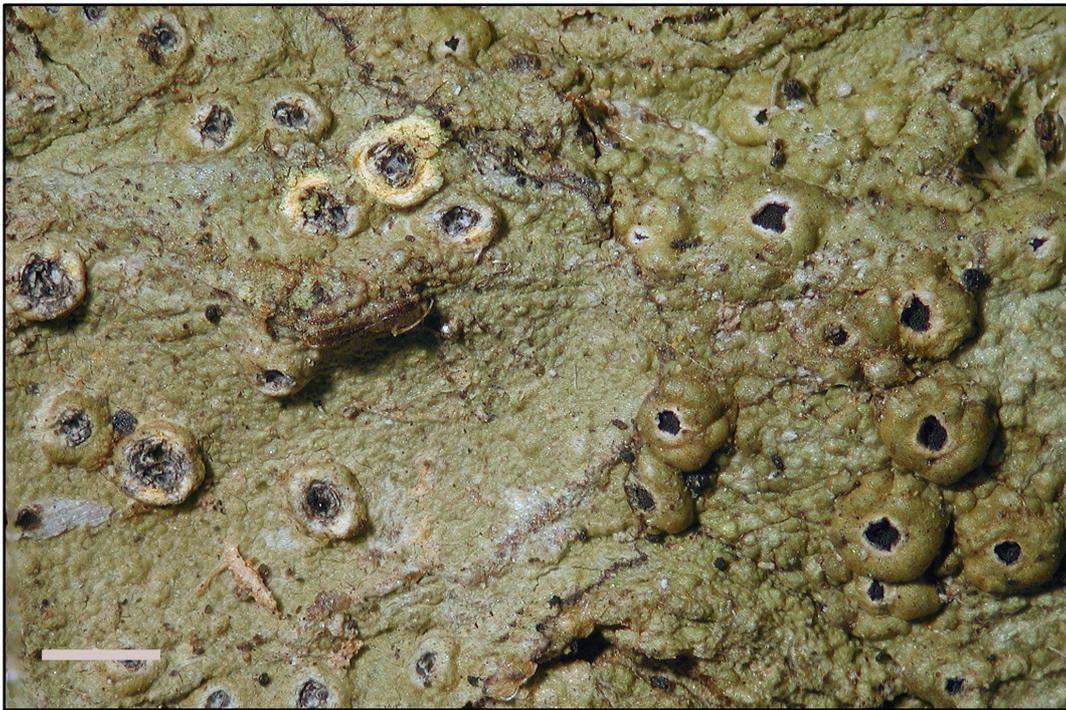
Remarks: This species belongs in *Ocellularia* s. str. and is close to the generic type, *O. cavata*. Contrary to the latter, in *O. striata* the proper exciple is typically fissured-lobulate (Fig. 11). *Ocellularia jutaratiae* is also similar, but this species differs in having larger ascospores and a purplish pruina, turning greenish with K, covering the remnants of the split proper exciple. Hale published collections from Panama (Hale 1978), which are very similar to *Ocellularia striata*, as *O. crocea*. Kalb (2020a) discussed the latter species described from Borneo, which however lacks a striate proper exciple and has a distinct, carbonized columella.

Cochromatography of some *Ocellularia* species with a deep orange-yellow pigment together with a pure sample of skyrin in solvents A, B' and C showed identical  $R_f$ -values in all three solvents. Skyrin as a metabolite in *Ocellularia* is a new report for the chemistry of the genus. We could prove its occurrence in *Ocellularia crocea*, *O. jutaratiae*, *O. macrocrocea*, *O. striata*, *O. xanthostromiza*, *O. zenkeri* and from neotropical specimens which we have preliminary identified as *O. cavata*.

Additional specimen examined: THAILAND. **Satun Province:** Khuan Kalong District; Tambon Thung Nui, surroundings of Panan Waterfall, 06°51'27" N, 100°09'36" E, on bark of an unidentified deciduous tree, in a tropical rainforest, 130 m; 19 December 2016, leg. J. & K. Kalb (hb. K. & J. Kalb 41831).



**Fig. 11:** *Ocellularia striata* (holotype), section through ascoma stained with lactophenol-anilineblue, showing the split proper exciple, bar 50  $\mu$ m;



**Fig. 12:** *Ocellularia striata* (left), growing together with *Ocellularia macrocrocea* (right), bar 0.5 mm).

*Ocellularia macrocrocea* Kalb was only recently described from Malaysia/Borneo (Kalb 2020a), but it seems also rather common in Thailand. The localities reported below are new additions to the Thai lichenobiota.

THAILAND. **Satun Province:** Khuan Kalong district; Tambon Thung Nui, surroundings of Panan Waterfall, 06°51'27" N, 100°09'36" E, on bark of unidentified deciduous trees in a tropical rainforest, 130 m; 19 December 2016, leg. J. & K. Kalb s.n. (hb. K. & J. Kalb 41836). **Trang Province:** Yantakhao District; Tambon Thung Khai, close to Peninsular Botanic Garden Thung Khai, 07°28' N, 99°38' E, on bark of unidentified deciduous trees in a tropical rainforest, 25 m; 17 December 2016, leg. J. & K. Kalb (hb. K. & J. Kalb 42015). **Chumphon Province:** Lamae District; Tambon Suan Taeng, Community forest, 09°43' N, 99°08' E, on bark of unidentified deciduous trees in a dense coastal mixed deciduous forest, 10 m; 04 April 2012, leg. K. Kalb, P. Mongkolsuk, V. Poengsungnoen, M. Sodamuk & K. Pamchawang s.n. (RAMK 39021).

*Ocellularia kohphanganensis* Papong, Mangold & Lücking

Fig. 13

Remarks: The lichen was collected in Thailand on the famous island Ko Pha-ngan (also Koh Pha Ngan or Ko Phangan) and named after it. In the original description (Mangold *et al.* 2014: 235) it was spelled *O. kohphangensis* and in the caption to the relevant

photograph, it was spelled *O. kohphanganensis*. We therefore correct these typos to the epithet given above.

In the protologue, the chemistry is given as "Two lower cinchonarum unknowns (medulla and section C–, K–, P–)". This was doubtful, because the cinchonarum unknowns react distinctly P+ red. Therefore, we reinvestigated the type and found a grey spot in solvent A near protocetraric acid. But cochromaty with a lichen-free piece of the bark revealed the same spot. So the spot is not a lichen metabolite but comes from the bark. With the revised chemistry, *O. kohphanganensis* keys out in the key to Thai *Ocellularia* species (Sut-jaritturakan & Kalb 2015) at couplet 21 (*O. albomaculata* Hale), but it differs from that species in having shorter and broader ascospores (15–20 × 10–12 μm) and a finger-like, only 150 μm wide columella.



**Fig. 13:** *Ocellularia kohphanganensis* (holotype), thallus with ascomata, bar 0.75 mm; note the whitish-rimmed pore; inlay: section from TLC plate 384 run in solvent A (Elix 2018) after H<sub>2</sub>SO<sub>4</sub> and charring, run 23: from lichen inclusive bark; run 24: bark without lichen; run X: standards, Prot = protocetraric acid, Sala = salazinic acid, Nor = norstictic acid.

***Intraspecific variation in Ocellularia thelotremoides* (Leight.) Zahlbr.**

Figs. 14, 15, 16, 17, 18

Description: Thallus corticolous, whitish to beige-grey, smooth to uneven, rarely with a few scattered warts, with dense, prosoplectenchymatous 1025 μm thick cortex; photobiont layer 20–50 μm thick, medulla indistinct, white; photobiont layer and medulla with clusters of calcium oxalate crystals. Apothecia immersed, prominent or sessile,

rounded, 0.4–0.6 mm diam.; disc invisible, covered by narrow, 0.05–0.25 mm wide pore; thalline exciple entire or rarely lacking due to protuberant proper exciple. Columella sometimes absent, if present then finger-like, apically ca. 25 µm thick, carbonized, yellow brown or dark brown at the tip, hyaline down to the base or rarely ± completely carbonized. Exciple prosoplectenchymatous, hyaline or yellowish brown, usually not carbonized, rarely dark brown or very weakly carbonized. Hymenium 130–200 µm high, clear; paraphyses unbranched. Ascospores 4–8/ascus, (3) 5–8 (mostly 7) × 0–1 (2)-loculate, 15–32 × 8–12 µm, ellipsoid, sometimes one end tapering, with thick septa and lens-shaped lumina, colorless, I+ violet-blue (amyloid).

Chemistry: protocetraric acid (major to absent) fumarprotocetraric acid (major to absent).

THAILAND. **Chiang Mai Province:** Mae On District; Tambon Huai Kaeo, surroundings of Mae Kampong Waterfall, 18°51'33" N, 99°21'22" E, on bark of unidentified deciduous trees in a tropical rainforest, 1115 m; 13 December 2016, leg. J. Kalb & K. Kalb 42076 (hb. K. & J. Kalb); Chiang Dao District; Tambon Chiang Dao, surroundings of Wat Tham Chiang Dao, 19°23'43" N, 98°55'46" E, on bark of unidentified deciduous trees in a very disturbed light hill evergreen forest, 440 m; 02 December 2016, leg. J. Kalb & K. Kalb 41770 (hb. K. & J. Kalb).—SRI LANKA (type locality!). **Western Province:** Kalatura District; Morapitiya, logging area (Ambalam-pole), 300 m; 13 March 1978, leg. M. E. Hale 51074 (US!); **Sabaragamuwa Province:** Ratnapura District; Sinharaja Forest Reserve near Weddagala, in unlogged area, 300 m; 14 March 1978, leg. M. E. Hale 50379 (US!).

Remarks: Mangold *et al.* (2009) list no less than eight names as heterotypic synonyms of *Ocellularia thelotremoides*, viz. *Thelotrema albidopallens* Nyl. from Australia, *Thelotrema australiense* Müll. Arg. from Australia, *Ocellularia psathyroloma* Müll. Arg. from Vietnam, *Thelotrema microphthalmum* Müll. Arg. from Australia, *Thelotrema secernendum* Harm. from New Caledonia, *Thelotrema leucocheilum* Vain. from the Philippines, *Thelotrema subsimile* Hale from Trinidad and *Myriotrema viride* Nagarcar & Hale from Malaysia. Papong *et al.* (2010) added *Myriotrema thailandicum* Homchantara & Coppins from Thailand. This extremely high number, even if forthcoming DNA-based phylogenies should confirm the autonomy of some of these names, reflect a high degree of variability. Lücking *et al.* (2016) however retained this species in *Myriotrema*. If we disregard the variability of the colour of the columella and the proper exciple as well as the variability of the spore size, *Ocellularia thelotremoides*, a member of the *perforata*-group (Frisch 2006), is well characterized by its submuriform ascospores and the presence of protocetraric and/or fumarprotocetraric acid. In a recent attempt to provide a key for Thai *Ocellularia* species (Sutjaritturakan & Kalb 2015), some corrections are necessary. We here propose corrections for the couplets 11 to 13.

- 11 Thallus with protocetraric acid and/or with fumarprotocetraric acid, exposed meddulla P+ orange-red.....12  
 11\* Thallus lacking protocetraric acid and/or fumarprotocetraric acid, chemistry variable .....15  
 12 Ascospores 1/ascus, columella absent, fumarprotocetraric acid major metabolite .....***O. microstoma*** (Müll.Arg.) Mangold, Elix & Lumbsch (syn. *O. kansriae* Homchant. & Coppins, *O. peremergens* Homchant. & Coppins)

- 12\* Ascospores 4–8/ascus, columella present or absent, protocetraric acid and/or fumarprotocetraric acid present major metabolite ..... 13
- 13 Columella complex, i. e. divided into several radiating strands, light brown and not carbonized, protocetraric and virensisic acids present; thallus conspicuously folded, forming a brain-like surface; ascomata prominent  
..... *O. cerebriformis* Papong, Lücking & Lumbsch
- 13\* Columella sometimes absent, if present entire, hyaline, light brown or rarely weakly carbonized at the tip, protocetraric acid and/or fumarprotocetraric acid present; thallus even to uneven; ascomata immersed-erumpent .....  
..... *O. thelotremoides* (Leight.) Hale  
..... (syn. *O. subsimilis* (Hale) Hale

In the literature (e. g. Hale 1981; Mangold 2009 *et al.*) the spore number per ascus is reported as eight. However, in our sample J. Kalb & K. Kalb 41770, we found many asci with only four spores. This fact can partly explain the great varion of spore size in *Ocellularia thelotremoides* even within one collection.

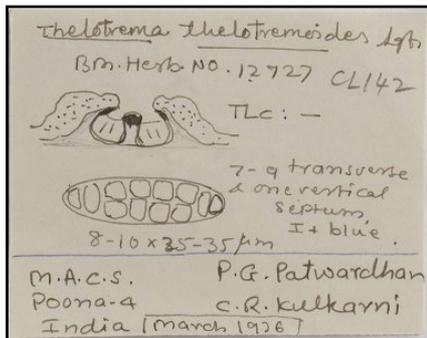
Figures 14, 17 and 18 demonstrate also a great variability of the thallus and size and position of the ascomata.



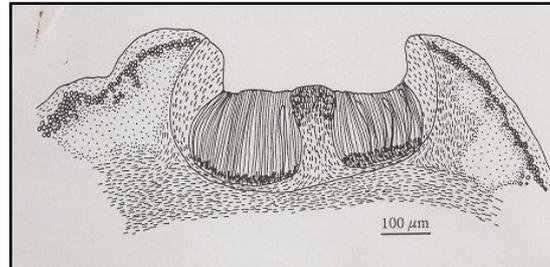
**Fig. 14:** *Ocellularia thelotremoides* (KK 42076), thallus with ascomata, bar 0.25 mm; inset: ascospores, bar 10  $\mu$ m; note the relatively small ascospores.

Many researchers (e. g. Matsumoto, Patwardhan, and others) have studied the lectotype specimen of *O. thelotremoides* and reported their results on labels, attached to the sheet with the specimen at BM. Hale (1981) found "the exciple carbonized" but Patwardhan &

Kulkarni (1977) report it "dark brown but not carbonized" (Fig. 15) and the columella "partially carbonized". The drawing by Matsumoto (Fig. 16) shows a hyaline exciple and a slightly darkened tip of the columella.



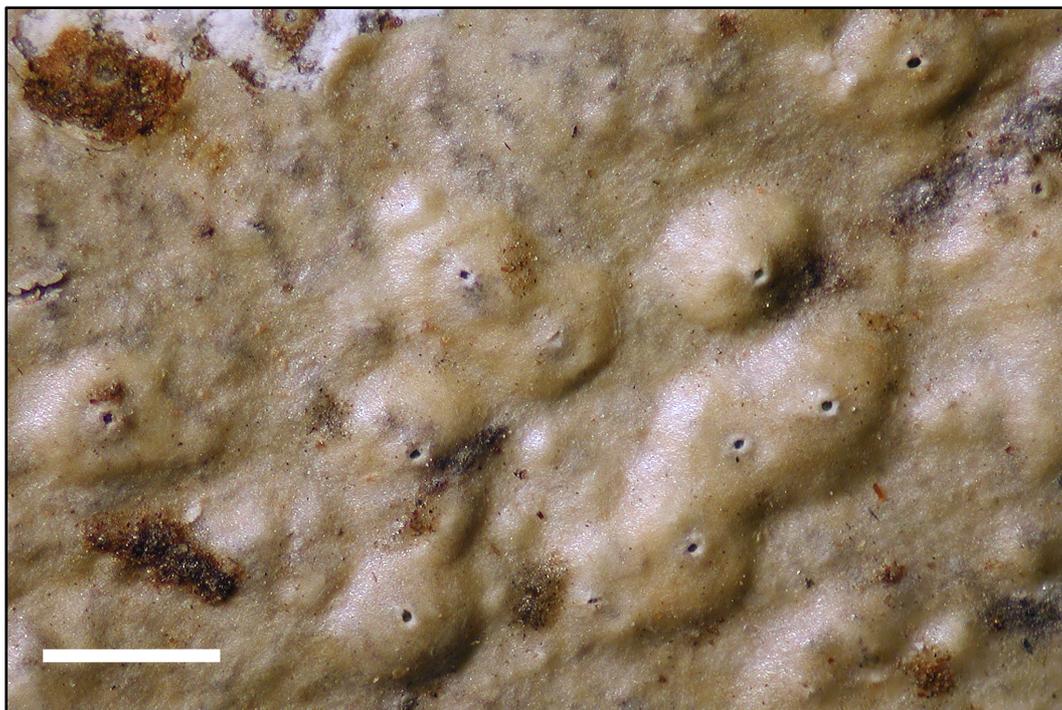
**Fig. 15:** Label drawn by Patwardhan from lectotype of *Ocellularia thelotremoides*.



**Fig. 16:** Label drawn by Matsumoto from lectotype of *Ocellularia thelotremoides*.



**Fig. 17:** *Ocellularia thelotremoides* (Hale 51074; US), thallus with ascomata, bar 0.5 mm.



**Fig. 18:** *Ocellularia thelotremoides* (Hale 51074; US), thallus and ascomata, bar 0.6 mm; note the small pores of the ascomata.

***Rhabdodiscus exutus*** (Hale) Kalb & Schumm, *comb. nov.*

Figs. 19, 20

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Basionym: *Ocellularia exuta* Hale, Bulletin of the British Museum (Natural History), Botany series 8 (3): 305 (1981).

Description: Thallus corticolous, light olive-grey, smooth to uneven,  $\pm$  glossy with a dense, prosoplectenchymatous 5–10  $\mu\text{m}$  thick cortex; photobiont layer 30–40  $\mu\text{m}$  thick, medulla indistinct, white; photobiont layer and medulla with clusters of calcium oxalate crystals. Apothecia immersed to erumpent, rounded, 0.4–1 mm diam.; disc invisible, covered by narrow, 0.1–0.25 mm wide pore, which is almost completely filled with a thick, apically white pruinose columella; thalline exciple entire or apically abraded, Columella always present, ca. 210  $\mu\text{m}$  high, apically ca. 200  $\mu\text{m}$  wide, basally up to 400  $\mu\text{m}$  wide, completely carbonized. Proper exciple prosoplectenchymatous, upper half or rarely completely carbonized. Hymenium 80–110  $\mu\text{m}$  high, clear; paraphyses unbranched. Ascospores 8/ascus, uniseriate, transversely 3–6-septate (most spores 5-septate), 13–19  $\times$  7–9  $\mu\text{m}$ , ellipsoid, with thick septa and lens-shaped lumina, young colorless and I+ violet-blue (amyloid), chocolate brown with age and I–. Chemistry: psoromic acid (major).

Remarks: This species was described in the genus *Ocellularia* from Sri Lanka by Hale (1981), but the broad stump-shaped, carbonized columella with a thick

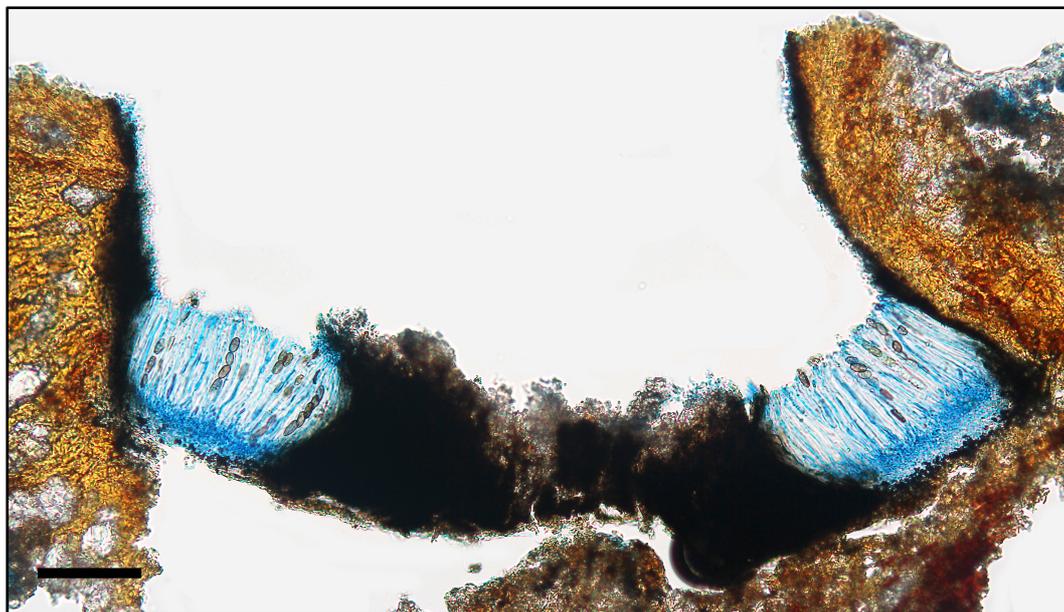
apical layer of hyaline hyphae and especially the brown ascospores with a distinct ornamentation by undulating ridges place this species in the genus *Rhabdodiscus*. It is very close to *R. crassus* (Müll. Arg.) Rivas Plata, Lücking & Lumbsch, but this species differs in having at least some submuriform ascospores and erumpent to prominent ascomata.



**Fig. 19:** *Rhabdodiscus exutus* (K.K. 37030), thallus with ascomata, bar 1 mm; inset: ascus with ascospores, bar 10  $\mu$ m.

Specimen examined: THAILAND. **Nakhon Rachasima Province:** Pak Chong District; Khao Yai National Park; 14°22'00" N, 101°24'19" E, on bark of a deciduous tree in a moist and light, very disturbed secondary rainforest, from 11501210 m, 13 March 2008, leg. K. Kalb (RAMK 37030).

*Rhabdodiscus exutus* is known from Sri Lanka, Malaysia (Borneo) and Australia (Mangold *et al.* 2009). The collection cited above is the first report for Thailand.



**Fig. 20:** *Rhabdodiscus exutus* (KK 37030); section through apothecium, stained with lactophenol-anilineblue, bar 100  $\mu\text{m}$ .

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Dr. Andreas Frisch (Trondheim) provided important material of Graphidaceae from Africa for identification and helpful discussions. As always, special thanks go to Dr. habil. Robert Lücking (Berlin), who spared much time to answer my many questions, provided liberally images of type specimens for comparison and for reviewing the manuscript and providing helpful discussions, and last but not least, Prof. Peter Poschold (Regensburg), Chair of Ecology and Conservation Biology, placed the TLC equipment at our disposal.

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