

## New taxa and new records of thelotremoid Graphidaceae

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**Abstract:** KALB, K. 2009. New taxa and new records of thelotremoid Graphidaceae. – Herzogia 22: 17–42.

In the course of an ongoing revision and identification of my tropical lichen collections the following results are presented: The monotypic genus *Amazonotrema* is described to accommodate the new species, *A. nigrum*. *Chapsa amazonica*, *C. graphidioides*, *C. lueckingii*, *C. pallidella*, *C. rhizophorae*, *C. rivis-platae*, *C. sorediata*, *Fibrillithecis inspersa*, *Gyrotrema album*, *Ocellularia soralifera*, *O. soredica*, *O. sorediigera* and *Thelotrema reunionis* are reported as new to science. For *Ampliotrema palaeoamplius*, *Chapsa albomaculata*, *Fibrillithecis confusa*, *Ocellularia mauritiana* and *Schizotrema cryptotrema*, new localities are reported significantly extending the range of some of these species.

**Zusammenfassung:** KALB, K. 2009. Neue Taxa und Neufunde thelotremoider Graphidaceae. – Herzogia 22: 17–42.

Im Verlauf einer fortlaufenden Revision und Bestimmung meiner tropischen Flechtensammlungen werden die folgenden Ergebnisse vorgelegt: Die monotypische Gattung *Amazonotrema* wird für eine neue Art, *A. nigrum*, beschrieben. *Chapsa amazonica*, *C. graphidioides*, *C. lueckingii*, *C. pallidella*, *C. rhizophorae*, *C. rivis-platae*, *C. sorediata*, *Fibrillithecis inspersa*, *Gyrotrema album*, *Ocellularia soralifera*, *O. soredica*, *O. sorediigera* und *Thelotrema reunionis* werden neu beschrieben. Für *Ampliotrema palaeoamplius*, *Chapsa albomaculata*, *Fibrillithecis confusa*, *Ocellularia mauritiana* und *Schizotrema cryptotrema* werden Neufunde mitgeteilt, die das Verbreitungsgebiet einiger dieser Arten beträchtlich erweitern.

**Key words:** *Amazonotrema*, *Chapsa*, *Fibrillithecis*, *Gyrotrema*, *Ocellularia*, *Schizotrema*, *Stegobolus*, Thelotremataceae, lichenized ascomycota.

### Introduction

Stimulated by the Thelotremataceae workshop in Thailand in 2008 and the return of an unprocessed loan of my Brazilian collections of chroodiscoid Graphidaceae (as well as some others), my longstanding interest in this group was rejuvenated and I started to re-evaluate this material myself. No less than 7 new species in the genus *Chapsa* were discovered as new for science. This originally monotypic genus was described to accommodate *Chapsa indica* by MASSALONGO (1860). Following this original description, the name was forgotten and even Hale in his many papers on the Thelotremataceae (HALE 1972, 1973, 1974a, 1974b, 1975, 1976, 1978a, 1978b, 1980, 1981) did not mention the genus *Chapsa* or the epithet *indica*. This also applied to AWASTHI's (1991) keys to Indian microlichens. Nevertheless, the relevant species were treated as distinct from other groups in thelotremoid Graphidaceae by more recent workers, e.g. SALISBURY (1972) as *Thelotrema platycarpum*-group and MATSUMOTO (2000) as *Thelotrema* subgen. *Asteristion*, but only FRISCH (2006) recognised its distinctness from *Thelotrema* sens. str. and provided a detailed description and circumscription at generic level. This view has been followed by all subsequent authors, e.g. MANGOLD (2008), FRISCH & KALB (2009), MESSUTI et al. (2009), and RIVAS PLATA et al. (2009), and is also followed in

this paper. In first molecular phylogenies (FRISCH et al. 2006), *Chapsa* was supposed to be monophyletic. But in subsequent studies with an enlarged dataset it turned out to be polyphyletic (MANGOLD 2008). However, no taxonomical consequences are so far drawn from these results and therefore we still describe the new species in this genus.

Sorediate species are rare in the thelotremoid Graphidaceae. HALE (1974b), who described *Ocellularia sorediata* as new, was not aware of any other sorediate species in the family, but he overlooked *Ocellularia discoidea* (Ach.) Müll.Arg. where the maculate soralia are so inconspicuous that they were not even mentioned in the protologue. Three further sorediate species were described by FRISCH (2006) and FRISCH & KALB (2006), namely *Ocellularia africana* Frisch, *O. flavisorediata* Frisch and *Stegobolus carneopustulatus* Frisch & Kalb ( $\equiv$  *Ocellularia baileyi* Müll.Arg.). Another four sorediate species, namely *Chapsa sorediata*, *Ocellularia soralifera*, *O. soredica* and *O. sorediigera* were discovered in the material studied for the present paper. The taxonomic impact of soralia is discussed controversially (LOHTANDER et al. 1998, POELT 1972). As long as molecular results are not available, we favour to treat sorediate specimens in Graphidaceae as distinct species.

## Material and methods

The present account is based on lichen material collected by the author mainly in Brazil and other tropical countries. In addition, the many specimens of Graphidaceae in the author's herbarium which were identified or revised by A. Frisch, the late M. Hale, H. T. Lumbsch or A. Mangold have been used for comparison. Hand cut or microtome cut sections mounted in water and/or in LCB were studied under a light microscope (Olympus BHA), external morphological observation were made using a dissecting microscope (Wild Z3). The standardised method of thin layer chromatography (WHITE & JAMES 1985) was employed to all the material mentioned for checking the presence of lichen substances.

## The genera and species

### *Amazonotrema* Kalb & Lücking **gen. nov.**

Genus novum ad familiam Graphidacearum pertinet. Generis *Chapsae* similis sed margine thallino radialiter non fisso et excipulo apicaliter leviter carbonisato differt.

**Typus generis:** *Amazonotrema nigrum* Kalb & Lücking

**Etymology:** The first part of the name (*Amazono*) refers to the region (Amazon basin) where the specimens were collected, the second part (*trema*) refers to the systematic position (thelotremoid Graphidaceae) of the new genus.

For a description of this monotypic genus see *A. nigrum*.

### *Amazonotrema nigrum* Kalb & Lücking **sp. nov.**

Similis *Chapsae calathiformis* sed ascosporis maioribus, excipulo apicaliter carbonisato et apotheciis non chroodiscoideis differt.

**Type: Brazil.** Amazonas: rainforest along the banks of the Rio Negro, about 150 km upstream from Manaus, 40 m. 02°30'S/61°10'W, K. Kalb (hb. Kalb 37595 – holotype).

**Etymology:** The epithet refers to the black discs of the apothecia.

**Illustrations:** Figures 1, 2

**Thallus:** Corticolous, lignicolous or growing on stems of tree ferns, epiphloeodal, indistinctly corticate, grey, continuous, c. 40  $\mu$ m thick, with a smooth to slightly verrucose, compact and  $\pm$  glossy surface. **Photobiont layer** 10–25  $\mu$ m thick, with inclusions of aggregates of calcium oxalate crys-



**Fig. 1:** *Amazonotrema nigrum* – habitus. Note the brown ascospores laying on the thalline margins. Total width of photo 3 mm.



**Fig. 2:** *Amazonotrema nigrum* – section through apothecium. Total width of photo 0.35 mm.

tals, which are also present in the thalline exciple. **Medulla** endophloeodal, indistinct. **Cortical layer** 5–15 µm thick, hyaline, indistinctly paraplectenchymatous. Isidia and soralia absent.

**Apothecia** dispersed, sometimes a few aggregated, strongly emergent, sessile with constricted base, 0.4–0.6 mm in diam., concolorous with the thallus, with ± steep flanks and a broadly rounded apex. Pore 0.2–0.4 mm wide. **Disc** black, not pruinose, when dry separated from the exciple by a split, fused when wet. **Columella** absent. **Proper exciple** *Thelotrema*-type, cupular, fused, with distinct lateral paraphyses, comprising a ± subparaplectenchyma formed from rather short-celled, strongly interwoven hyphae which is more distinctly paraplectenchymatic towards the lateral paraphyses, c. 25–90 µm wide at the sides, hyaline to brownish, carbonised towards the tips; **hypotheecium** hyaline to pale brown. **Lateral paraphyses** 10–15 µm long, strongly conglutinated and interspersed by fine granules. **Hymenium** 100–200 µm high, clear, I–. **Epithecium** 5–10 µm high, unpigmented, but slightly granular due to the incorporation of greyish to brownish granules adspersed to the tips of the paraphyses. **Paraphyses** 0.8–1 µm diam., simple, straight, well separated and embedded in a thick matrix, the tips formed from a single slightly thickened cell and interspersed with fine greyish to brownish granules. Approximately 10 µm below the apex, the paraphyses become strongly ramified and anastomosed, forming a true epithecium similar to that in *Diorygma*. **Asci** narrowly clavate, 120–180 × 20–30 µm, of the *Thelotrema*-type, I–. **Ascospores** (5–)6–8/ascus, 2–3 seriate, chestnut brown, muriform, 10–13 septate vertically and 0–5 septate horizontally, 28–45 × 11–16 µm, I–. Young ascospores are macrocephalic, not halonate.

**Pycnidia** not seen.

**Chemistry:** Stictic acid (major), constictic acid (submajor), cryptostictic acid (minor), menegazziaic acid (trace).

**Notes:** *Amazonotrema* is described to accommodate the above new species. The new genus is readily recognised by apothecia of the *Thelotrema*-type, paraphyses with branched and anastomosed tips, forming a true epithecium, asci of the *Thelotrema*-type and brown, muriform, nonamyloid ascospores. The cortical layer is indistinct paraplectenchymatic and the thallus contains stictic and constictic acids. In the structure of the hamathecium *Amazonotrema* shows some similarity with *Reimnitzia* Kalb, which also has a distinct epithecium. The two genera are readily separated by the alternative apothecia-types – thelotremoid in *Amazonotrema* and chroodiscoid in *Reimnitzia* – and the absence of a cortical layer in the latter.

On a world level there are seven other genera of thelotremoid Graphidaceae with lateral paraphyses, namely *Acanthotrema* Frisch, *Chapsa* Massal., *Melanotopelia* Lumbsch & Mangold, *Pseudoramonia* Kantvilas & Vězda, *Schizotrema* Mangold & Lumbsch, *Thelotrema* Ach. and *Topeliopsis* Kantvilas & Vězda. *Pseudoramonia* is separated from all other genera mentioned by its stipitate apothecia. In *Acanthotrema*, the paraphyses and the lateral paraphyses are apically spinose. Both, *Melanotopelia* and *Schizotrema* have an excipulum which is laterally dark brown to carbonized. *Chapsa* has chroodiscoid apothecia and in *Topeliopsis*, the apothecia are with ± regular teeth that remain incurved over the barely visible disc. Furthermore, there is no split between the thallus margin and the exciple in all the genera mentioned. In *Thelotrema*, there is a distinct split between the thallus margin and the proper exciple, in *Amazonotrema* however, the split is between the proper exciple with lateral paraphyses and the hymenium (Fig. 2), thus separating the new genus from all the others.

**Ecology:** *A. nigrum* is known from two collections from ± virgin rainforests in the Amazon valley where it was collected from a partly decorticated tree trunk and from the base of a big tree fern in rather humid and shady situations at 40 m.

ADDITIONAL MATERIAL STUDIED: **Brazil.** Amazonas: Flood plain of the Rio Preto shortly before the estuary into the Amazon, c. 80 km E of Manaus, 40 m. 03°10'S/59°50'W, 11.–18.VIII.1993, K. & A. Kalb (hb. Kalb 27053).

#### *Ampliotrema palaeoamplius* (Sipman & Aptroot) Kalb

FRISCH, A., Biblioth. Lichenol. 92: 81 (2006).

Since its description (APTROOT & SIPMAN 2001, as *Ocellularia palaeoamplior*) from Hong Kong, no further report of this lichen came to our knowledge. In the recent Outline of Ascomycota (LUMBSCH &

HUHDORF 2007), *Ampliotrema* is placed into synonymy with *Ocellularia*. However, in Graphidaceae considerable importance is attached to the structure of the exciple (Staiger 2002, Lüicking pers. comm.) which is prosoplectenchymatic in *Ocellularia* but paraplectenchymatic in *Ampliotrema*. Therefore we retain *Ampliotrema* as a separate genus and await further results of molecular phylogenetic investigations based on an extended dataset.

The collections cited below are new records for the neotropical (Brazilian) and Thai lichen biota.

**MATERIAL EXAMINED:** **Brazil.** Mato Grosso: between São Vicente and Aquas Quentes, c. 90 km ESE of Cuiaba, in a cerrado, 750 m. 15°50'S/55°20'W, 2.VII.1980, K. Kalb (hb. Kalb 31672, 32024, 37630). – dto. Serra dos Coroados; Chapada dos Guimarães, in a dark gallery forest along the river Coxipozinho, 600 m. 15°30'S/55°40'W, 575 m. 7.VII.1980, K. Kalb (hb. Kalb 35117, 35118). **Thailand.** Nakhon Rachasima Province, Khao Yai National Park: Khao Khieo, trail to 'Pha Dieo Dai' (= lonely cliff), in a moist but light, very disturbed secondary rainforest, 1150–1210 m. 14°22'0"N/101°24'19"E, 13.III.2008, K. Kalb (hb Kalb 36981, dupl. RAMK).

*Chapsa albomaculata* (Sipman) Sipman & Lüicking

RIVAS PLATA et al., Lichenologist 41: (2009).

**Illustrations:** Figures 3, 4

**Thallus** corticolous, whitish grey to off-white, smooth, but often with small papillae and ridges which are filled with clumps of large calcium oxalate crystals, continuous, c. 30–100 µm thick, dull. **Cortical layer** c. 5–8 µm thick, hyaline, formed predominantly from irregular hyphae. **Photobiont layer** 18–25 µm thick, with few photobiont cells and the inclusion of decomposed periderm cells and tiny calcium oxalate crystals. **Medulla** endophloeodal.

**Apothecia** dispersed or aggregated in loose groups, level with the thallus, roundish or slightly elongated, 0.3–0.7 mm in diam. **Margin** raised, fissured to lobed, upright to usually strongly recurved. In the apical parts with an extremely thick, felty, white inner surface; proper exciple fused. **Disc** very pale ochre to almost hyaline, covered by a thin to very thick, felty white pruina. **Lateral paraphyses** distinct, 15–25 µm long, interspersed with small colourless granules. **Hymenium** 75–100 µm high, clear. **Ascospores** 4–8/ascus, 2–3 seriate, hyaline, with (4–)5–7(–8) transverse septa, (11–)15–18(–20) × 4.5–5 µm, thick-walled, with subacute to rounded ends, I+ violet-blue. **Paraphyses** simple, straight, 2 µm wide; tips indistinctly moniliform to occasionally branched, adspersed with fine greyish granules, penetrating into the hymenium in part and imitating inspersion. **Epithymenium** unpigmented, c. 10–15 µm high.

**Pycnidia** not seen.

**Chemistry:** Constrictic acid (major), stictic acid (trace).

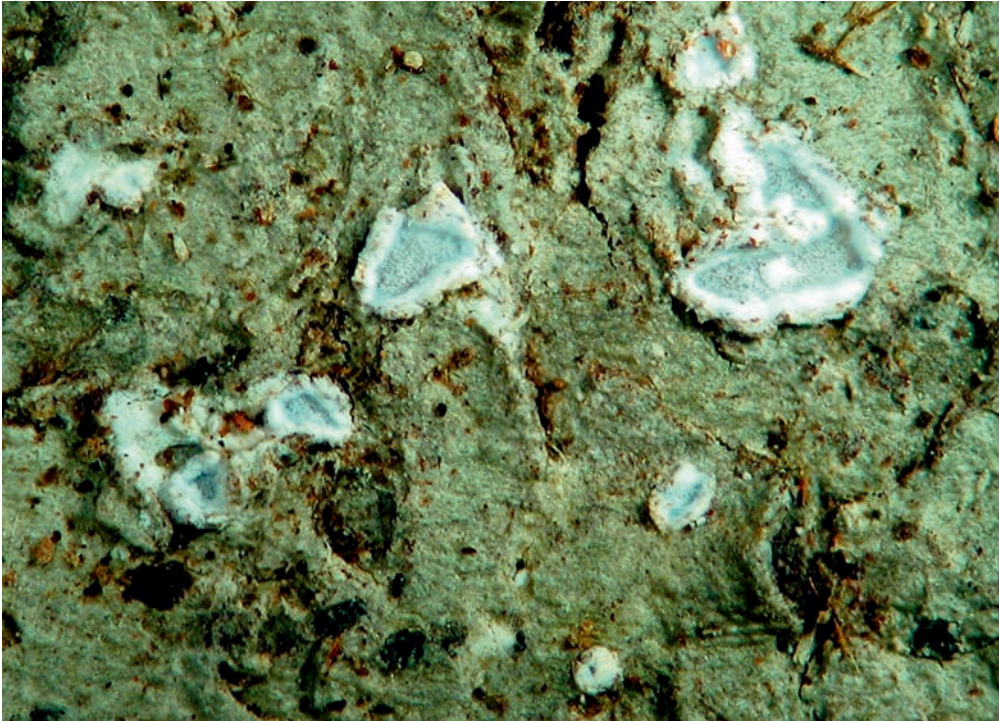
**Notes:** Another more detailed description of this species is given above since it complements the protologue. The description is presented in the same style as that for other species described in this paper to facilitate comparisons.

*C. albomaculata* is a conspicuous species characterised by small roundish to slightly elongated groups of apothecia, usually covered by a thick felty white pruina, with a fused proper exciple, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, transversely septate, amyloid ascospores with a well developed endospore. The whitish thallus is furnished with small papillae which are filled with calcium oxalate crystals and contains constrictic acid as a major metabolite.

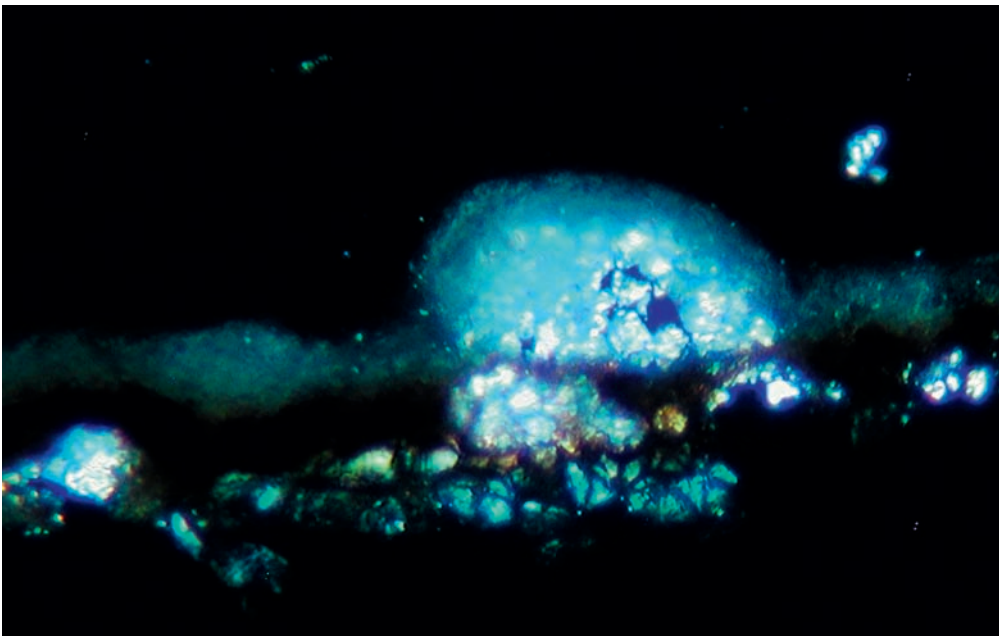
**Ecology:** *C. albomaculata* is known from several collections from ± virgin tropical rainforests in the Amazon Basin, in Guyana, Venezuela and Colombia (SIPMAN & APTROOT 1992) and interestingly also from a transitional formation between a light cerrado and a caatinga. It was collected from the smooth bark of young deciduous trees and lianas in rather shady situations.

The collections cited below are new additions to the Brazilian lichen biota.

**MATERIAL STUDIED:** **Brazil.** Amazonas: rainforest along Rio Negro, c. 160 km upstream from Manaus, 40 m. 02°12'S/61°02'W, 17.X.1980, K. Kalb. (hb. Kalb 32003, 31027, 31104, 33976) – dto., floodplain of the Rio Preto, shortly before the estuary into the Amazon, c. 80 km E from Manaus, 40 m. 03°10'S/59°50'W, 16.VIII.1993, K. & A. Kalb (hb. Kalb 27105) – Piauí: Parque Nacional de Sete Cidades shortly before the entrance into the park, in a transitional formation between a cerrado and a caatinga, 300 m. 04°08'S/41°45'W, 6.VIII.1993, K. & A. Kalb (hb. Kalb 30805).



**Fig. 3:** *Chapsa albomaculata* – habitus. Total width of photo 6 mm.



**Fig. 4:** *Chapsa albomaculata* – section through thallus wart observed in polarised light to show the calcium oxalate crystals. Total width of photo 0.45 mm.



**Fig. 5:** *Chapsa amazonica* – habitus. Total width of photo 4 mm.



**Fig. 6:** *Chapsa graphidioides* – habitus. Total width of photo 7 mm.

***Chapsa amazonica* Kalb sp. nov.**

Similis *Chapsae halei* sed sporis brevioribus et latioribus et apotheciis parvioribus differt.

**Type: Brazil.** Amazonas: rainforest along Rio Negro, c. 160 km upstream from Manaus, 40 m. 02°12'S/61°02'W, 17.X.1980, K. Kalb (hb. Kalb 32003 – holotype).

**Etymology:** The epithet refers to the region (Amazon valley) where the lichen was collected.

**Illustration:** Figure 5

**Thallus** corticolous, ashgrey, smooth, continuous, c. 20 µm thick, dull, in part glossy. **Cortical layer** not observed. **Photobiont layer** c. 15 µm thick, with scattered photobiont cells and the inclusion of decomposed periderm cells. Calcium oxalate crystals not seen. **Medulla** endophloeodal.

**Apothecia** dispersed, level with the thallus, roundish, 0.3–0.6 mm in diam. **Margin** strongly raised, deeply fissured to lobed, upright to usually strongly recurved, with a ± thin, whitish pruina; proper exciple fused. **Disc** black, covered by a thin, whitish crystalline pruina. **Lateral paraphyses** distinct, 10–20 µm long, heavily interspersed with tiny oil droplets. **Hymenium** 50–60 µm high, clear. **Ascospores** fusiform to ovoid, 6–8/ascus, 1–2(–3) seriate, hyaline, with 3(–4) transverse septa, 10–12 × 3.5–4 µm, thin-walled with a thin endospore; loci angular or rounded-rectangular, I–. **Paraphyses** simple, straight, 1.5 µm wide; tips indistinctly moniliform to occasionally branched, 2.5 µm wide, adspersed with fine greyish granules. **Epihymenium** unpigmented or partially greyish, 5–8 µm high.

**Pycnidia** not seen.

**Chemistry:** No secondary lichen products detected by TLC.

**Notes:** *C. amazonica* is a rather inconspicuous species characterised by the small ± roundish apothecia with a white pruinose disc, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, very small, 3-septate ascospores without a well developed endospore. The thallus is ± ash-grey and lacks secondary lichen products. *C. halei* Mangold from Australia is similar, but that species differs in having narrower ascospores (10–13 × 2–3 µm) and larger apothecia (0.8 mm in diam.) with an off-white to pale brownish disc. Furthermore, the locules of the ascospores in *C. halei* are ± rounded, subglobose to oblong while they are angular or rounded-rectangular in *C. amazonica*.

**Ecology:** *C. amazonica* is known from a single collection from the Amazon valley where it was collected from the smooth bark of an old deciduous tree in a humid and rather shaded situation.

***Chapsa graphidioides* Kalb sp. nov.**

Similis *Chapsae albomaculatae* sed thallo acidum consticticum deficienti, et apotheciis multo maioribus et saepe elongatis differt.

**Type: Brazil.** Mato Grosso: Serra dos Coroados, c. 20 km NE of Chapada dos Guimarães, in a gallery forest, 670 m. 15°30'S/55°40'W, 9.VII.1980, leg. K. Kalb & M. Marcelli (hb. Kalb 37629 – holotype).

**Etymology:** The epithet refers to the slightly elongate apothecia which resemble a *Graphis* (sens. lat.) species.

**Illustration:** Figure 6

**Thallus** corticolous, whitish to off-white, smooth, continuous, c. 150–200 µm thick, dull. **Cortical layer** not observed. **Photobiont layer** 100–125 µm thick, with few photobiont cells and the inclusion of decomposed periderm cells and tiny crystals in the upper part. **Medulla** endophloeodal.

**Apothecia** dispersed or aggregated in loose groups, level with the thallus, roundish or slightly elongated, from 0.5–2.5 mm in diam. to 2.5 mm long and 1 mm broad. **Margin** raised, fissured to lobed, upright to usually strongly recurved. In the apical parts, with an extremely thick, felty white inner surface; proper exciple fused. **Disc** ochre, covered by a thin to very thick, felty white pruina. **Lateral paraphyses** distinct, c. 20 µm long, interspersed with small colourless granules. **Hymenium** 80–100 µm high, clear. **Ascospores** 8/ascus, 1–2 seriate, hyaline, with 3–5 transverse septa, 9–11 × 3–4 µm, thin-walled, usually with one subacute and one rounded end, I–. **Paraphyses** simple, straight, 2 µm wide; tips indistinctly moniliform to occasionally branched, adspersed with fine greyish granules. **Epihymenium** unpigmented, c. 10–15 µm high.

**Pycnidia** not seen.

**Chemistry:** No lichen substances detected by TLC.



**Notes:** *C. graphidioides* is a conspicuous species characterised by the large roundish to often elongated groups of apothecia, an exciple usually covered by a thick, felty white pruina, a fused proper exciple, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, transversely septate, nonamyloid ascospores with thin septa. The thallus is whitish, lacks a cortex and contains no lichen acids. *C. albomaculata* is similar, but that species has a thallus with a cortical layer, larger ascospores (15–18 × 4.5–5 µm) which turn violet-blue with Lugol's solution. Furthermore, *C. albomaculata* produces constictic acid as a major metabolite.

**Ecology:** *C. graphidioides* is known from from ± virgin tropical rainforests in the Amazon basin and also from a transitional forest between a light cerrado and a caatinga. It was collected from the smooth bark of a conifer and deciduous trees in rather shady situations. The specimens from the Amazon region are included with some hesitation because of some minor anatomical differences, namely the non-split and not recurved thalline exciple and only indistinct lateral paraphyses.

ADDITIONAL MATERIAL STUDIED: **Brazil.** Amazonas: rainforest along Rio Negro, c. 160 km upstream from Manaus, on deciduous trees, 40 m. 02°12'S/61°02'W, 17.X.1980, K. Kalb. (hb. Kalb 32003, 31027, 31104, 33976).

***Chapsa lueckingii* Kalb sp. nov.**

Similis *Chapsae pseudoschizostomae* sed differt thallo olivaceo et corticato, et apotheciis margine thallino disticte lobulato et reflexo.

**Type: Brazil.** São Paulo: Serra do Mar; between Taubaté and Ubatuba, c. 150 km E of São Paulo, in a humid and dense rainforest, 800 m. 23°15'S/45°15'W, 18.VI.1978, K. Kalb & G. Plöbst (hb. Kalb 31094 – holotype).

**Etymology:** The epithet honours my friend and colleague, Dr. Robert Lücking, for his outstanding contributions to tropical lichenology.

**Illustrations:** Figures 7, 8

**Thallus** corticolous, pale olive-green, smooth, continuous, c. 30–100 µm thick, dull. **Cortical layer** c. 3–10 µm thick, hyaline, formed predominantly from irregular hyphae, partially flaking off caused by internal splitting. **Photobiont layer** 20–25 µm thick, with numerous photobiont cells, decomposed periderm cells and of a few calcium oxalate crystals. **Medulla** endophloeodal.

**Apothecia** dispersed, level with the thallus, roundish, 0.7–2 mm in diam. **Margin** strongly raised, deeply fissured to lobed, upright to usually strongly recurved. Apical parts with a thin, pale brown to felty white, slightly crystalline inner surface; proper exciple fused. **Disc** pale brown, covered by a thin to rather thick white pruina. Lateral paraphyses distinct, c. 20 µm long. **Hymenium** 80–100 µm high, inspersed. **Ascospores** 4–8/ascus, 2–3 seriate, hyaline, with 5–7(–8) transverse septa, 17–25 × 6–7 µm, thick-walled, with subacute to rounded ends, I+ violet-blue. **Paraphyses** simple, straight, 2–2.5 µm wide; tips indistinctly moniliform to occasionally branched, adspersed with fine greyish granules. **Epihymenium** unpigmented or partially greyish, c. 5–8 µm high.

**Pycnidia** not seen.

**Chemistry:** Stictic acid (major) and constictic acid (minor).

**Notes:** *C. lueckingii* is a conspicuous species characterised by large roundish apothecia with a fused proper exciple, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, transversely septate, amyloid ascospores with a well developed endospore. The thallus is pale olive-green and contains stictic and constictic acids. *C. pseudoschizistoma* (Hale) Sipman from Panama is probably closely related. This species differs in lacking a cortical structure and in having much smaller apothecia which lack a recurved margin.

**Ecology:** *C. lueckingii* is known from a single collection from a ± virgin tropical rainforest E of São Paulo (Mata Atlântica). It was collected from the smooth bark of an old deciduous tree in a rather shady situation.

***Chapsa pallidella* Kalb sp. nov.**

Similis *Chapsae alstrupii* sed ascosporis solum 5 × 0–1-septatis, minoribus et septis tenuibus differt.

**Type: Brazil.** Rio de Janeiro: Serra da Mantiqueira; Itatiaia, between Registro do Picú and Agulhas Negras, on the base of a free-standing deciduous tree along the road, 1700 m. 22°20'S/44°45'W, 12.VII.1979, K. Kalb. (hb. Kalb 31084 – holotype).

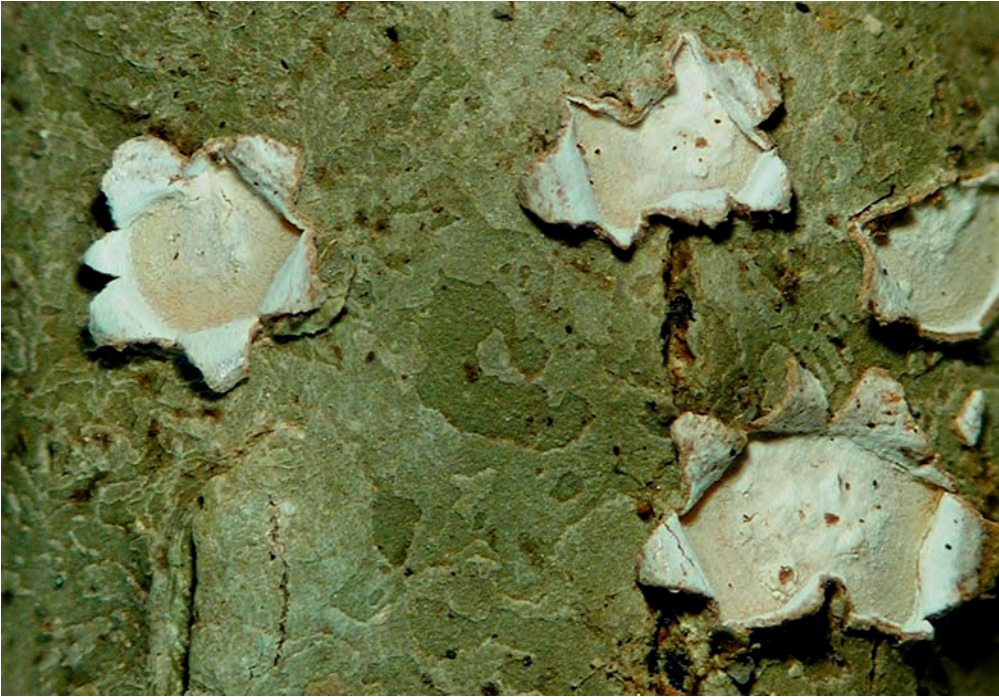


Fig. 7: *Chapsa lueckingii* – habitus. Total width of photo 8 mm.

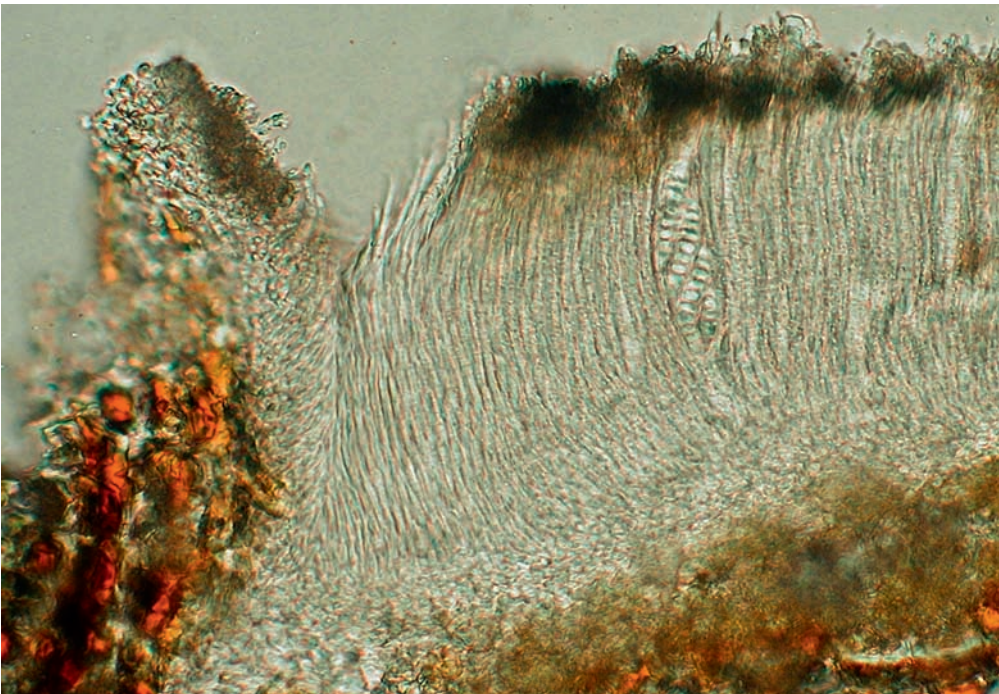


Fig. 8: *Chapsa lueckingii* – section through apothecium, showing the inspersed hymenium. Total width of photo 0.3 mm.



**Fig. 9:** *Chapsa pallidella* – habitus. Total width of photo 3 mm.



**Fig. 10:** *Chapsa rhizophorae* – habitus. Total width of photo 7 mm.

**Etymology:** The epithet refers to the pale ochre to light brown, epruinose or slightly pruinose apothecia.

**Illustration:** Figure 9

**Thallus** corticolous, white to off-white, smooth, continuous, c. 70 µm thick, dull. **Cortical layer** c. 5–20 µm thick, hyaline, formed predominantly from irregular hyphae which partially flake off due to internal splitting. **Photobiont layer** 30–40 µm thick, with few photobiont cells and the inclusion of decomposed periderm cells. Calcium oxalate crystals not observed. **Medulla** endophloeodal.

**Apothecia** dispersed, level with the thallus, roundish or slightly elongated, 0.3–0.5 mm in diam. **Margin** raised, fissured to lobed, inclined to upright, usually not recurved; proper exciple fused. **Disc** ochre, usually not pruinose, rarely covered by a very thin, whitish pruina. **Lateral paraphyses** distinct, c. 20 µm long, interspersed with small colourless granules. **Hymenium** 80–100 µm high, clear. **Ascospores** 4/ascus, 1–2 seriate, hyaline, with 5 transverse and 0–1 longitudinal septa, 16–19 × 6–8 µm, thin-walled, usually with two rounded ends, seldom with one subacute and one rounded end, I–. **Paraphyses** simple, straight, 2 µm wide; tips indistinctly moniliform to occasionally branched, adspersed with fine greyish granules. **Epihymenium** unpigmented, c. 10–15 µm high.

**Pycnidia** not seen.

**Chemistry:** No lichen substances detected by TLC.

**Notes:** *Chapsa pallidella* is an inconspicuous species characterised by dispersed, relatively small roundish to sometimes elongated apothecia, an epruinose exciple, a fused proper exciple, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, submuriform, nonamyloid ascospores with thin septa. The thallus is whitish without a distinct cortical layer and lacks lichen acids. This new species is somewhat intermediate between the genera *Chapsa* and *Chroodiscus*. The lateral paraphyses and the corticolous thallus are typical of *Chapsa* species and the thin-walled ascospores of *Chroodiscus*. *Chapsa alstrupii* Frisch is similar, but that species has longer ascospores (28–31 × 7.5–9 µm) with up to 10 transverse and 0–2 longitudinal septa with a well developed endospore.

**Ecology:** *C. pallidella* is only known from the type locality. It was collected from the smooth bark of an old deciduous tree in an open, rather humid situation.

### *Chapsa rhizophorae* Kalb sp. nov.

Similis *Chapsae dilatatae* sed differt sporis non amyloideis, solum 4–8-septatis.

**Type: Brazil.** São Paulo: mainland opposite of Ilha da Cananéia, at the edge of a mangrove forest, on *Rhizophora mangle*, 2 m. 25°00'S/48°00'W, 15.VII.1979, leg. K. Kalb & G. Plöbst. (hb. Kalb 37583 – holotype).

**Etymology:** The epithet refers to the tree from which the lichen was often collected.

**Illustration:** Figure 10, 11

**Thallus** corticolous, pale grey to whitish or cream coloured, smooth, continuous to irregularly cracked, c. 100–200 µm thick, dull. **Cortical layer** c. 10 µm thick, hyaline, formed predominantly from irregular hyphae. **Photobiont layer** up to 125 µm thick, with numerous photobiont cells, the inclusion of decomposed periderm cells and clusters of large calcium oxalate crystals. **Medulla** endophloeodal.

**Apothecia** dispersed, seldom loosely aggregated in small groups of two or three, level with the thallus, roundish, angular to elongated, 0.7–2 mm in diam. **Margin** strongly raised, deeply fissured to lobed, incurved to upright, strongly recurved in the apical parts, with a thin, white inner surface; proper exciple fused. **Disc** pale brown, covered by thick white pruina. **Lateral paraphyses** distinct, 15–20 µm long. **Hymenium** 60–80 µm high, clear. **Ascospores** 5–8/ascus, 2–3 seriate, hyaline, with 3–7(–9) transverse septa, 23–25 × 7–8 µm, thick-walled, with subacute to rounded ends, I–. **Paraphyses** simple, straight, 2–2.5 µm wide; tips indistinctly moniliform to occasionally branched, adspersed with fine greyish granules; small calcium oxalate crystals incorporated in the pruina of the disc. **Epihymenium** unpigmented, c. 5–8 µm high.

**Pycnidia** not seen.

**Chemistry:** Stictic acid (major), constictic acid (major), cryptostictic acid (minor), menegazziaic acid (minor) and hypoconstictic acid (submajor to trace).

**Notes:** *C. rhizophorae* is a conspicuous species characterised by large roundish to angular, elongated apothecia with a fused proper exciple, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, transversely septate, nonamyloid ascospores with a well developed endospore. The thallus is whitish to grey and contains substances in the stictic acid aggregate. *C. dilatata* (Müll. Arg.) Kalb, with which the new species co-occurs in mangrove forests, is probably closely related. This species however differs in having longer, and amyloid ascospores with 8–12 septa (Fig. 12).

**Ecology:** *C. rhizophorae* is known from old mangrove forests E and SE of São Paulo where it was collected from *Rhizophora mangle*.

**ADDITIONAL MATERIAL STUDIED:** **Brazil.** São Paulo: between São Lourenço and Juquiá, c. 65 km W of São Sebastião, around the river mouth of Rio Guaratuba, on *Rhizophora mangle*, in a mangrove forest, 2 m. 23°47'S/45°55'W, 19.II.1980, K. Kalb (hb. Kalb 31177, 32616).

***Chapsa rivas-platae* Kalb & Lücking sp. nov.**

Similis *Chapsae pulchrae* sed thallo acidum sticticum continenti, apotheciis ochraceis pruinosis et ascis solum 2–4-sporis differt.

**Type:** **Brazil.** Mato Grosso: c. 35 km SE of Cuiaba, on an old deciduous tree in a cerrado with rocky ironstone outcrops, 120 m. 15°50'S/56°00'W, 4.VII.1980, K. Kalb & M. Marcelli. (hb. Kalb 31180 – holotype).

**Etymology:** The epithet honours Eimy Rivas Plata for generously sharing her vast knowledge on (thelotremoid) Graphidaceae and for her outstanding contributions to the Ostropales.

**Illustration:** Figure 13

**Thallus** corticolous, whitish to off-white, smooth, continuous, c. 50–100 µm thick, dull, partly glossy and shining. **Cortical layer** not observed. **Photobiont layer** 45–90 µm thick, with scattered photobiont cells and the inclusion of decomposed periderm cells. Calcium oxalate crystals not seen. **Medulla** endophloeodal.

**Apothecia** dispersed, level with the thallus, roundish, 0.5–1.5 mm in diam. **Margin** strongly raised, deeply fissured to lobed, upright to usually strongly recurved, with a ± thick, creamy, ochre or orange pruina; proper exciple fused. **Disc** covered by a rather thick creamy, ochre or orange pruina. **Lateral paraphyses** distinct, 20–45 µm long, heavily inspersed with tiny crystals. **Hymenium** 90–110 µm high, clear. **Ascospores** 2–4(–6)/ascus, 2–3 seriate, hyaline, with 11–25 transverse septa, 45–80 × 7–10 µm, thin-walled with a thin endospore; loci angular, roundish-rectangular to depressed-rectangular, usually with hemispherical end cells, I+ violet-blue. **Paraphyses** simple, straight, 2–2.5 µm wide; tips indistinctly moniliform to occasionally branched, adspersed with fine greyish granules. **Epihymenium** unpigmented or greyish in part, 10–20 µm high.

**Pycnidia** not seen.

**Chemistry:** Stictic acid (major) and constictic acid (minor).

**Notes:** *C. rivas-platae* is a conspicuous species characterised by large ± roundish apothecia with an ochre pruinose disc, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, large, transversely septate, amyloid ascospores without a well developed endospore. The thallus is ± whitish and



**Fig. 11** (left): *Chapsa rhizophorae* – ascospore. Total width of photo 8 µm.

**Fig. 12** (right): *Chapsa dilatata* – ascospore. Total width of photo 12 µm.



Fig. 13: *Chapsa rivis-platae* – habitus. Total width of photo 7 mm.

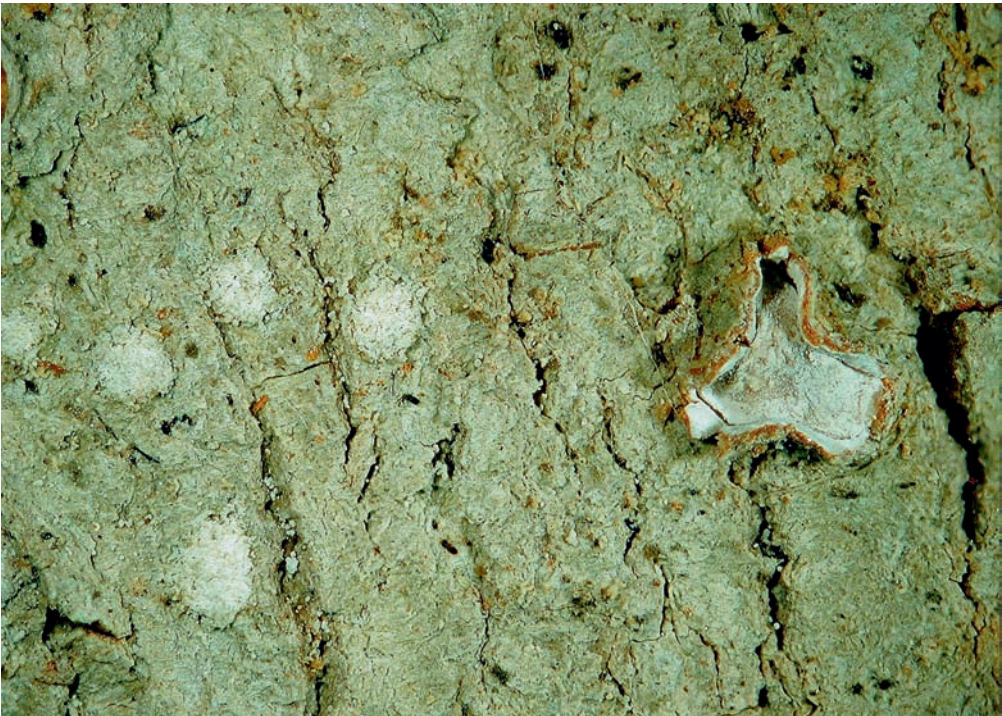


Fig. 14: *Chapsa soreciata* – habitus. Total width of photo 7 mm.

contains stictic and constictic acids. *C. pulchra* (Müll. Arg.) Mangold from Australia is probably closely related but differs in lacking secondary lichen products and the ochre pigment on the apothecia.

**Ecology:** *C. rivas-platae* is known from a single collection from Panama and two from Brazil. The latter collections originated from humid cerrados in Mato Grosso. This species occurs on ± smooth bark of old deciduous trees in rather light situations.

**ADDITIONAL MATERIAL STUDIED:** **Panama.** sine loco (FH). – **Brazil.** Mato Grosso: Pantanal, c. 40 km S of Poconé, in a cerrado which is temporarily flooded ('varzea'), 100 m. 17°30'S/56°40'W, 22.VIII.1993, K. & A. Kalb (hb. Kalb 32820).

***Chapsa sorediata* Kalb sp. nov.**

Similis *Chapsae dilatatae* sed differt thallo soraliis instructo.

**Type:** **Brazil.** São Paulo: Serra do Mar; Serra do Garrãozinho between Moji das Cruzes and Bertioaga in a very humid and dark primary rainforest, 850 m. 23°45'S/46°10'W, 29.III.1980, K. Kalb & G. Plöbst. (hb. Kalb 31105 – holotype).

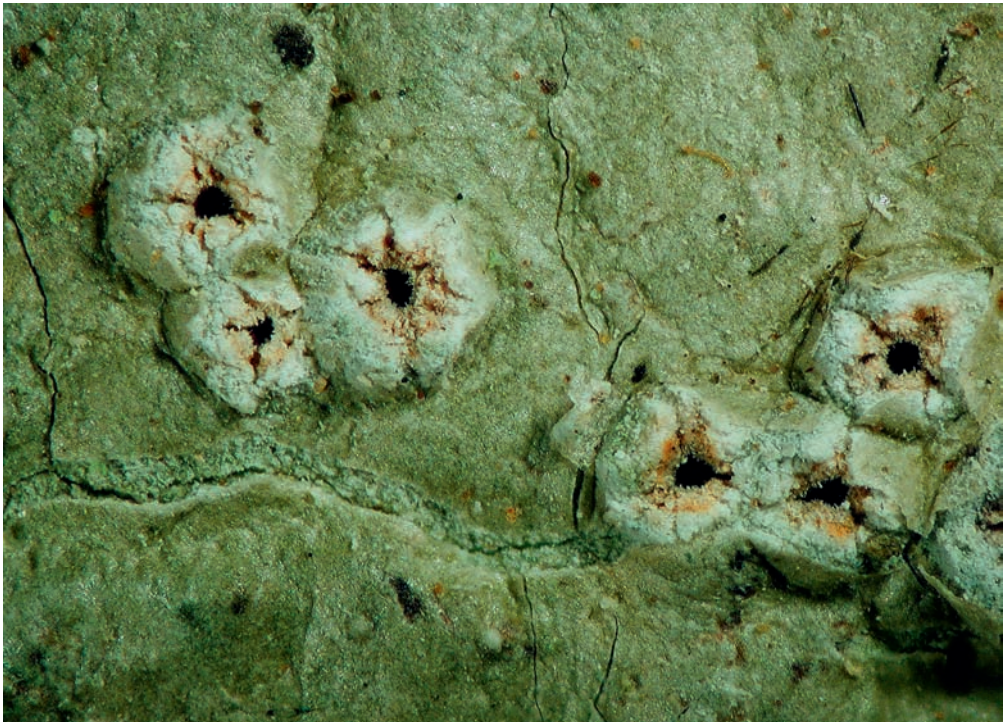
**Etymology:** The epithet refers to the soreciate thallus.

**Illustration:** Figure 14

**Thallus** corticolous, whitish grey, smooth, continuous, c. 25–50 µm thick, dull, soreciate. **Soralia** maculate, raised, ± roundish in outline, 0.3–1 mm in diam., soredia granular, whitish. **Cortical layer** c. 3–5 µm thick, hyaline, formed predominantly from irregular hyphae, or often absent. **Photobiont layer** c. 10 µm thick, with sparse photobiont cells and the inclusion of decomposed periderm cells. Calcium oxalate crystals not observed. **Medulla** endophloeodal.

**Apothecia** dispersed, level with the thallus, 0.5–2 mm in diam., roundish or angular to elongated.

**Margin** strongly raised, deeply fissured to lobed, upright to usually strongly recurved. In the apical



**Fig. 15:** *Fibrillithecis inspersa* – habitus. Note the pores of the apothecia with fibrillate rims. Total width of photo 3.5 mm.

parts, with a thick, felty white inner surface; proper exciple fused. **Disc** pale, covered by a thin to rather thick white pruina. **Lateral paraphyses** distinct, c. 10 µm long. **Hymenium** 70–85 µm high, clear. **Ascospores** 6–8/ascus, 2–3 seriate, hyaline, with 7–9 transverse septa, 22–27 × 6.5–7.5 µm, thick-walled, with subacute ends, I+ violet-blue. **Paraphyses** simple, straight, 2 µm wide; tips indistinctly moniliform to occasionally branched, adspersed with fine greyish granules. **Epithymenium** unpigmented or greyish in part, c. 5–8–12 µm high.

**Pycnidia** not seen.

**Chemistry:** Stictic acid (major) and constictic acid (major).

**Notes:** *C. sorediata* is a conspicuous species being characterised by the soreciate thallus, large angular or elongated apothecia with irregularly recurved thalline margins, a fused proper exciple, paraphyses with indistinctly moniliform or slightly branched tips and hyaline, transversely septate, amyloid ascospores with a well developed endospore. The thallus is whitish grey and contains stictic and constictic acids. The new species is morphologically and chemically very similar to *Chapsa dilatata*, except for the soreciate thallus. It can therefore be regarded as the secondary species of that taxon.

**Ecology:** *C. sorediata* is known from a single collection from a ± virgin tropical rainforest E of São Paulo (Mata Atlântica). It was collected from the smooth bark of an old deciduous tree in a rather shady situation.

***Fibrillithecis confusa*** Lücking, Kalb & Rivas Plata

RIVAS PLATA et al., Lichenologist 41: (2009).

The holotype of this recently described species originates from a mangrove forest in the state of São Paulo. As no other collections are mentioned in RIVAS PLATA et al. (2009), some additional localities are cited below.

ADDITIONAL MATERIAL STUDIED: **Brazil.** São Paulo: estuary of Rio Itaguapé, c. 20 km E of Bertioiga, in a dense mangrove forest with dominant *Laguncularia racemosa*, 1 m. 23°50'S/46°00'W, 13.IV.1980, K. Kalb (hb. Kalb 37612). – dto. between São Lourenço and Juquiá, c. 65 km W of São Sebastião, around the river mouth of Rio Guaratuba, on *Rhizophora mangle*, in a mangrove forest, 2 m. 23°47'S/45°55'W, 19.II.1980, K. Kalb (hb. Kalb 34001). – Rio de Janeiro: Serra da Mantiqueira; Itatiaia, Parque Nacional do Itatiaia, in a humid and dark primary rainforest, 1100 m. 22°20'S/44°35'W, 21.VII.1978, K. Kalb & G. Plöbst (hb. Kalb 37611).

***Fibrillithecis inspersa*** Kalb *sp. nov.*

Similis *Fibrillithecis carneodiscus*, sed imprimis hymenio insperso differt.

**Type:** **Venezuela.** Merida: Distr. Libertador; Monte Zerpa, a few km N of Mérida, above “Hechincera”, in an ± undisturbed cloud forest, 2200 m. 8°40'N/71°10'W, 14.VIII.1989, K. & A. Kalb & M. Lopez-Figueiras (hb. Kalb 34678 – holotype).

**Etymology:** The epithet refers to the heavily inspersed hymenium of this species.

**Illustration:** Figure 15, 16

**Thallus** corticolous, moderately thick, 180–250 µm high, grey to pale olive grey. Surface ± shiny, smooth, continuous or rarely cracked. **True cortex** present, continuous to sometimes discontinuous, up to 15 µm thick, consisting of irregular to periclinal hyphae. **Photobiont layer** ± well developed, up to 50 µm high, continuous, only rarely with calcium oxalate crystals. **Vegetative propagules** absent. **Apothecia** variable, usually conspicuous, large, up to 1 mm in diam., roundish, becoming somewhat irregular in fused ascomata, predominantly perithecioid to rarely apothecioid, solitary to fused, rarely somewhat clustered in groups, immersed to strongly emergent, then with constricted base. **Disc** usually not visible from the surface, in open to gaping ascomata partly visible, pale flesh-coloured, not pruinose. Pores 0.05–0.1 mm wide, but opening at late maturity to 0.4 mm wide. **Pore margin** entire to fibrous, formed by the apical proper exciple. **Thalline rim margin** moderately thin to thick, roundish, entire to often ± eroded, and then exposing the conspicuously flesh coloured medulla. **Proper exciple** conspicuous, predominantly fused, rarely becoming ± free, thick to very thick, forming lateral paraphyses-like structures by apically distinctly radiating hyphae, hyaline internally to yellowish-brown or orange-reddish marginally, non-amyloid. **Hymenium** c. 100 µm high, densely inspersed (Fig. 16), highly conglutinated, paraphyses unbranched, parallel, straight, tips not thickened, lateral paraphy-



ses and **columellar structures** lacking. **Subhymenium** 20–25 µm high, hyaline, not interspersed. Epihymenium not developed. **Ascospores** 6–8/ascus, small, 3–4 transverse septa, cell walls moderately thick, endospore thick, in younger ascospores sometimes with thin halo, hyaline, distinctly amyloid, oblong with rounded ends, loci predominantly lenticiform, 13–18 × 7–8.5 µm, I+ purplish-blue.

**Pycnidia** not seen.

**Chemistry:** Psoromic acid (major), 2'-O-demethylpsoromic (minor).

**Notes:** This taxon is characterised by the corticate thallus, large, usually perithecioid, ± emergent ascomata, the thick, fibrous proper exciple, small, usually 4-loculate, transversely septate, thick-walled, hyaline, amyloid ascospores, the presence of the psoromic acid chemosyndrome and especially the densely interspersed hymenium. *Fibrillithecis carneodiscus* (Hale) Rivas Plata & Lücking is similar, but that species lacks lichen acids and an interspersed hymenium and has narrower ascospores (4–6 µm) with more transverse septa (5–7-septate).

At present there are only three known species in thelotremoid Graphidaceae with an interspersed hymenium and psoromic acid, namely *Myriotrema khuntanense* Homchantara & Coppins, *Ocellularia dehiscens* (Leight.) Zahlbr. and *Thelotrema saxicola* (Vain.) G. Salisb. *M. khuntanense* is the most similar to *Fibrillithecis dispersa*, but differs in having longer, 6–8-loculate ascospores (21–27 µm long), which become brown at maturity, and by a colourless columella, absent in *F. dispersa*. In *Ocellularia dehiscens* the ascospores are 10-septate and in *Thelotrema saxicola* they are 1/ascus, densely muriform and 150–250 µm long.

**Ecology:** This new species was collected on an old deciduous tree in a dense, virgin cloud forest at 2200 m.

#### *Gyrotrema album* Kalb sp. nov.

Similis *Gyrotrematis sinuosi*, sed pruina apotheciorum alba et sporis brevioribus differt.

**Type:** Brazil. Amazonas: rainforest along Rio Negro, c. 150 km upstream from Manaus, 40 m. 02°30'S/61°10'W, 16.X.1980, K. Kalb. (hb. Kalb 37588 – holotype).

**Etymology:** The specific name refers to the white pruina of the apothecia.

**Illustration:** Figure 17

**Thallus** corticolous, pale to moderately dark olive-brown or ochre, rimose or fissured with the substrate, 15–25 µm thick, smooth to slightly rugulose, with a compact, glossy surface; a medullary layer is not developed. **Cortical layer** 5–10 µm thick, strongly conglutinated, formed predominantly from periclinal hyphae. **Photobiont layer** ± endophloeodal, c. 20 µm thick, with scattered photobiont cells and rare inclusions of calcium oxalate crystals. **Medulla** endophloeodal, indistinct.

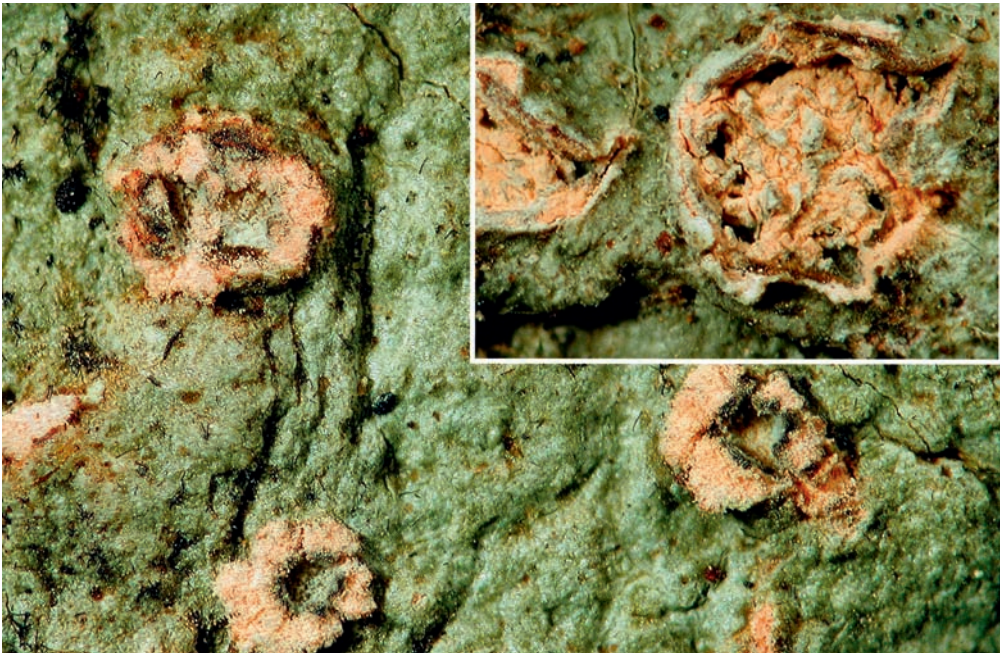
**Apothecia** dispersed, rounded-angular to irregularly elongated, c. 1–7 mm in diam. **Margin** strongly raised, lobed, recurved, with a brown inner surface that is covered by a thick white pruinose hyphal felt. **Disc** flat, exposed, filled with brown, irregular strands of exciple; the strands of the columella covered by a thick white pruina. **Hymenium** clear, present in small pockets along the edges of the apothecial margin, blackish, covered by thin white pruina. **Proper exciple** cupular, c. 10–15 µm deep and hyaline at base, laterally up to 40 µm wide, apically carbonised, brown at the base. **Columella** formed from c. 30–50 µm wide strands composed of old proper exciple and remnants of the periderm layer; pockets in-between empty or filled with hyaline, sterile hyphae. **Subhymenium** c. 15 µm high. **Hymenium** 75–125 µm high, clear. **Ascospores** 8/ascus, 2(–3) seriate, hyaline, transversely septate, (7–)8 loculate, 22–30 × 7 µm, with one round and one subacute end, I+ purplish-blue, halonate when young, macrocephalic. **Paraphyses** simple, straight, c. 2 µm wide; tips hardly thickened, adspersed with fine greyish to brownish granules. **Epihymenium** 5–7 µm high.



**Fig. 16:** *Fibrillithecis dispersa* – hymenium with ascospores, showing the distinct interspersion. Total width of photo 35 µm.



**Fig. 17:** *Gyrotrema album* – habitus with young apothecia; inset: an older, well developed apothecium, c. 2 mm wide. Total width of photo 7 mm.



**Fig. 18:** *Gyrotrema sinuosum* – habitus with young apothecia; inset: an older, well developed apothecium, c. 2 mm wide. Total width of photo 7 mm.

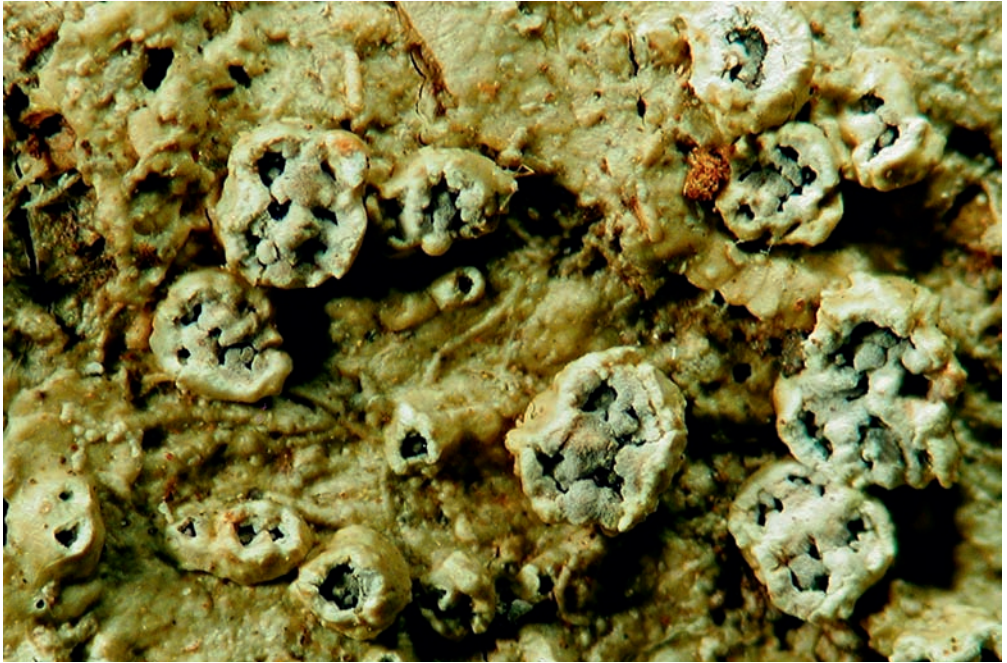


Fig. 19: *Ocellularia mauritiana* – habitus. Total width of photo 8 mm.

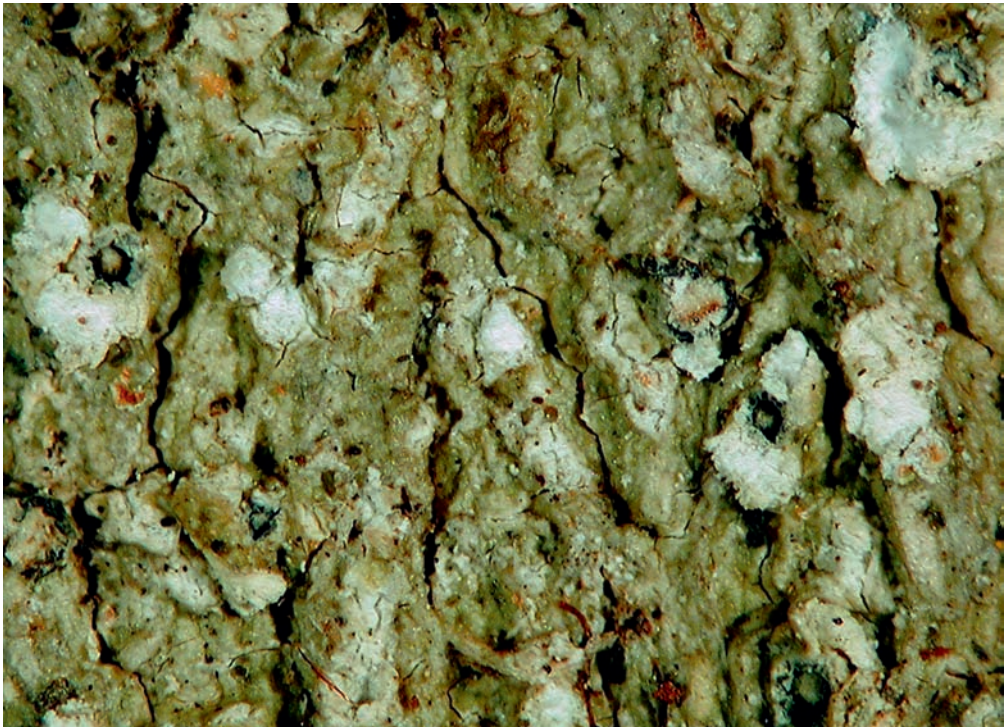


Fig. 20: *Ocellularia soralifera* – habitus. Total width of photo 5 mm.

**Pycnidia** not seen.

**Chemistry:** Hypoprotocetraric acid (major), 4-*O*-demethylnotatic acid (minor).

**Notes:** *G. album* is readily distinguished by its large apothecia with an open white pruinose disc, the characteristic columella and hypoprotocetraric acid. The photographs of *G. sinuosum*, the type species of the genus, in SIPMAN (1992) and FRISCH & KALB (2006) show only over-mature apothecia. Therefore a photograph with younger, typical apothecia of *G. sinuosum* (Fig. 18) is presented here to illustrate the similarity with *G. album*.

**Ecology:** Corticolous on smooth to slightly rough bark of old trees in lowland rainforests. It is known from several collections along the (left) bank of the Rio Negro between 100 and 200 km upstream from Manaus.

ADDITIONAL MATERIAL STUDIED: **Brazil.** Amazonas: rainforest along Rio Negro, between 100 and 200 km upstream from Manaus, 40 m. 02°30'S/61°10'W, 16.X.1980, K. Kalb. (hb. Kalb 31661, 37584, 37585, 37586, 37587, 37624).

### *Ocellularia mauritiana* Hale

HALE, M. A., Mycotaxon 3: 175 (1975).

This species was previously known from Mauritius, Tanzania, Panama and Brazil. It is distinguished by its small, (3–)4–6-locular ascospores and the chemistry (protocetraric acid). *O. mauritiana* is easily misidentified as a *Stegobolus* species due to its reticulate columella. FRISCH & KALB (2006) however retain it in *Ocellularia* for chemical reasons, the structures of the exciple and the thallus.

**Illustration:** Figure 19

One of the collections cited below is a new addition to the lichen biota of Réunion.

**Brazil.** Amazonas: Flood plain of the Rio Preto shortly before the estuary into the Amazon, c. 80 km E of Manaus, 40 m. 03°10'S/59°50'W, 11.–18.VIII.1993, K. & A. Kalb (hb. Kalb 27053). – **Mascarene Islands.** Réunion: Forêt de Bébour, few km NW of la Plaine-des Palmistes, Sentier botanique, in a primary tropical rainforest, 1300 m. 21°20'08"S/55°35'30"E, 31.VIII.1991, K. & A. Kalb (hb. Kalb 25496).

### *Ocellularia soralifera* Kalb sp. nov.

Similis *Ocellulariae flavisorediatae*, sed medulla alba, columella latiore, thallo non granuloso-inaequale et hymenio insperso differt.

**Type:** **Brazil.** Amazonas: rainforest along Rio Negro, c. 150 km upstream from Manaus, 40 m. 02°30'S/61°10'W, 16.X.1980, K. Kalb. (hb. Kalb 32030 – holotype).

**Etymology:** The specific epithet refers to the sorediate thallus.

**Illustration:** Figure 20

**Thallus** corticolous, olive-grey, continuous to slightly fissured, c. 50–100 µm thick, smooth, with a compact and ± glossy surface. **Soralia** erumpent to hemispherical, flat or raised, rounded to undulate or slightly lobate in outline, surrounded by erect and recurved thalline lobules, 0.3–0.5 mm in diam., with a white medulla; the leprose to mostly granular soredia are white. **Cortical layer** c. 5–10 µm thick, continuous, moderately dense, conglutinated, formed predominantly from irregular hyphae and short lumina in section. **Photobiont layer** 40–80 µm thick, with few inclusions of large calcium oxalate crystals. **Medulla** thin or endophloeodal.

**Apothecia** dispersed, rounded, nearly immersed in the thallus to moderately emergent, rarely slightly constricted at the base, with ± steep flanks and a rounded apex, c. 0.4–1 mm in diam. **Margin** entire at first, concolorous with the thallus, incurved, thalline exciple bursting open with age and exposing the white medulla giving the impression of soralia. **Columella** 0.3 mm broad, 0.25 mm high, black with an off white tip, carbonised to the base, with a thin apical layer of hyaline hyphae, strongly raised above the hymenium. **Proper exciple** laterally carbonised. **Disc** depressed, not visible through the open pore. **Subhymenium** 15–20 µm high. **Hymenium** 110–125 µm high, inspersed by small granules. **Ascospores** 4–8/ascus, 1–2 seriate, hyaline, transversely septate, (6–)10–12 loculate, 25–35 × 8–9 µm, with one round and one subacute end, I+ purplish-blue. **Asci** clavate, c. 100–125 × 16–20 µm. **Paraphyses** sim-

ple, straight, 2–2.5 µm wide; tips with a single slightly thickened cell, adspersed with fine greyish to brownish granules. **Epihymenium** unpigmented, 7–8 µm high.

**Pycnidia** not seen.

**Chemistry:** Hypoprotocetraric acid (major), 4-O-demethylnotatic acid (minor to trace).

**Notes:** *Ocellularia soralifera* is distinguished by an olive-grey, smooth and shiny sorediate thallus, moderately emergent apothecia with a distinct, broad stumped columella, an inspersed hymenium and hypoprotocetraric acid as the major metabolite. At the world level, currently only 4 sorediate *Ocellularia* species are known namely *O. africana* Frisch, *O. discoidea* (Ach.) Müll.Arg., *O. flavisorediate* Frisch, and *O. sorediate* Hale. *O. africana* can be separated by its hyaline to pale brownish proper exciple, the non-inspersed hymenium, smaller ascospores (16–22 × 6–7 µm) and protocetraric acid as major metabolite. *O. discoidea* also lacks an inspersed hymenium and has psoromic acid as major metabolite, while *O. flavisorediate* with hypoprotocetraric acid, can be separated by its warty (almost isidiate) thallus with a white to yellow medulla, the clear hymenium, the absent or narrow columella and longer ascospores (28–47 × 7–8 µm). *O. sorediate* produces no secondary products and has only 3–4 loculate ascospores. The cross section of an apothecium of *Ocellularia pyrenuloides* Zahlbr. is almost identical to that of *O. soralifera* (see FRISCH 2006: 253), but this species is not sorediate, produces stictic acid as a major compound and has only 5–6 loculate ascospores, 18–4 × 6–7 µm.

**Ecology:** *O. soralifera* was collected on an old deciduous tree in a ± virgin, dense rainforest along the banks of Rio Negro, approximately 150 km upstream from Manaus.

#### *Ocellularia soredica* Kalb sp. nov.

Similis *Ocellulariae soraliferae*, sed columella angustiore, hymenio non insperso et thallo acidum psoromicum continente differt.

**Type:** Brazil. Amazonas: rainforest along Rio Negro, c. 150 km upstream from Manaus, 40 m. 02°30'S/61°10'W, 16.X.1980, K. Kalb. (hb. Kalb 37627 – holotype).

**Etymology:** The specific epithet refers to the sorediate thallus.

**Illustration:** Figure 21

**Thallus** corticolous, pale olive-grey, continuous to slightly fissured, c. 40–70 µm thick, smooth, with a compact and ± glossy surface. **Soralia** suborbicular, raised, rounded to undulate or irregular in outline, 0.3–0.5 mm in diam., with a white medulla; the leprose to mostly granular soredia are white.

**Cortical layer** c. 7–10 µm thick, continuous, moderately dense, conglutinated, formed predominantly from irregular hyphae and short lumina in section, sometimes with a split towards the photobiont layer. **Photobiont layer** 30–40 µm thick, with few inclusions of aggregates of small calcium oxalate crystals. **Medulla** thin or endophloeodal.

**Apothecia** dispersed, rounded, nearly immersed in the thallus to moderately emergent, rarely slightly constricted at the base, with ± steep flanks and a rounded apex, c. 0.3–0.8 mm in diam. **Margin** first entire, concolorous with the thallus, incurved, thalline exciple bursting open with age and exposing the white medulla giving the impression of soralia. **Columella** 0.1 mm broad, 0.25–0.3 mm high, black with an off white tip, carbonised to the base, with a thin apical layer of hyaline hyphae, strongly raised above the hymenium. **Proper exciple** only apically carbonised. **Disc** depressed, hardly visible through the open pore, blackish with a thin whitish pruina. **Subhymenium** 20–25 µm high. **Hymenium** 110–125 µm high, clear. **Ascospores** 2–4/ascus, 1–2 seriate, hyaline, transversely septate, (6–)8–10 loculate, 23–32 × 7–10 µm, with two round ends, I+ purplish-blue. **Asci** clavate, c. 100–125 × 16–20 µm. **Paraphyses** simple, straight, 1 µm wide; tips not thickened. **Epihymenium** unpigmented, 5–7 µm high.

**Pycnidia** not seen.

**Chemistry:** Psoromic acid (major), 2'-O-demethylpsoromic acid (minor to trace).

**Notes:** *Ocellularia soredica* is distinguished by the pale olive-grey, smooth, shiny, sorediate thallus, moderately emergent apothecia with a distinct, small columella, a clear hymenium, conspicuous white soralia and psoromic acid as the major metabolite. *O. discoidea* also shares a clear hymenium and the same chemistry, but is readily distinguished by flat, even excavated greyish soralia which are not at all



Fig. 21: *Ocellularia soreдика* – habitus. Total width of photo 5 mm.

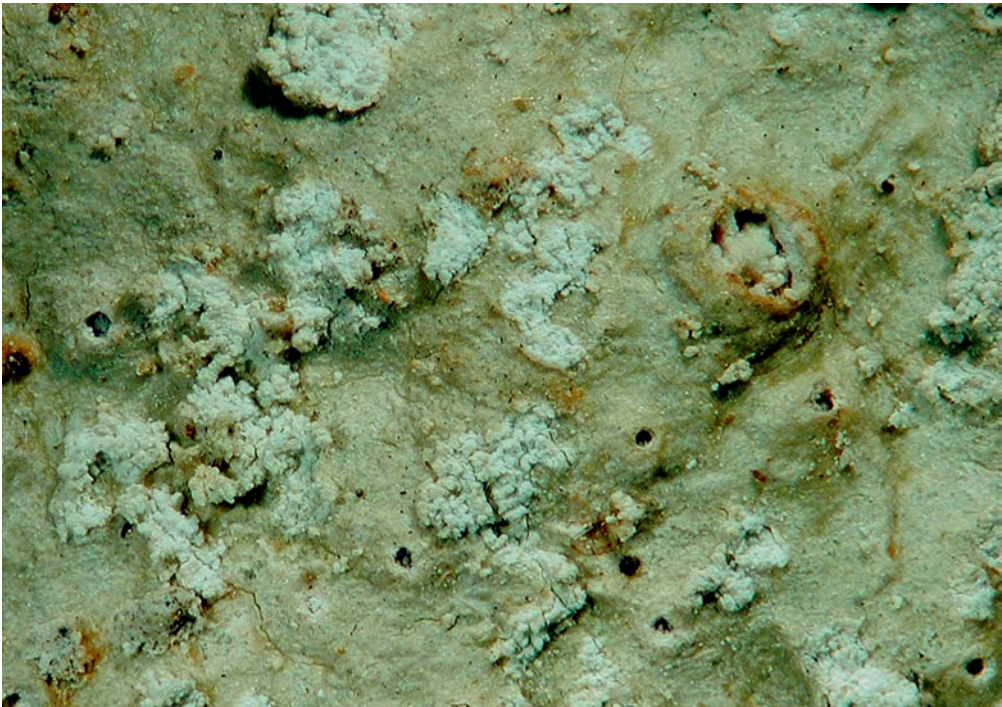


Fig. 22: *Ocellularia soreদিগেরা* – habitus. Total width of photo 5 mm.



**Fig. 23:** *Thelotrema reunionis* – habitus. Total width of photo 5 mm.

conspicuous, and overlooked by many lichenologists. Furthermore, the apothecia in *O. discoidea* are more robust (0.8–1.4 mm in diam.) and the columella is much broader (0.3–0.4 mm wide).

**Ecology:** *O. soredica* was collected on an old deciduous tree in dense, ± virgin, rainforest along the banks of Rio Negro, approximately 150 km upstream from Manaus.

***Ocellularia soredigera* Kalb sp. nov.**

Similis *Ocellulariae auberianoidis*, sed thallo soralii instructo differt.

**Type:** Greater Antilles. Jamaica: St. Elitabeth Parish, “Y.S.Waterfalls”, c. 10 km N of Black River, 50 m, 18°06'N/78°12'W, 15.IV.1992, K. & A. Kalb. (hb. Kalb 36394 – holotype).

**Etymology:** The specific epithet refers to the sorediate thallus.

**Illustration:** Figure 22

**Thallus** corticolous, pale grey to pale olive-fawn, continuous, c. 100–250 µm thick, smooth, with a compact and ± matt to slightly glossy surface, sometimes with an opaque punctuate patches caused by numerous calcium oxalate crystals. **Soralia** suborbicular, raised (flat when soredia are abraded), rounded to undulate or irregular in outline, 0.5–2 mm in diam., with a white medulla; the leprose to mostly granular soredia are white. **Cortical layer** c. 10–15 µm thick, continuous, moderately dense, conglutinated, formed predominantly from irregular hyphae and short lumina in section. **Photobiont layer** 60–150 µm thick, with aggregates of large calcium oxalate crystals. **Medulla** thin or endophloeodal, also with large calcium oxalate crystals.

**Apothecia** dispersed, rounded, nearly immersed in the thallus to moderately emergent, c. 0.3–0.8 mm in diam. **Margin** entire, concolorous with the thallus, incurved. **Columella** simple or forming separate strands and becoming reticulate, 0.1–0.15 mm broad, 0.18–0.22 mm high, pale brown to brown with a thick apical layer of hyaline hyphae, filled with numerous small calcium oxalate crystals, strongly raised above the hymenium. **Proper exciple** hyaline to pale brown, not carbonised. **Disc**



**Fig. 24:** *Thelotrema reunionis* – ascospores. Total width of photo 35  $\mu$ m.

depressed, hardly visible through the open pore, blackish with a thin whitish pruina. **Subhymenium** 10–15  $\mu$ m high. **Hymenium** 110–160  $\mu$ m high, clear. **Ascospores** 4–8/ascus, 1–3 seriate, hyaline, transversely septate, 6–8 loculate, 16–20  $\times$  5–6  $\mu$ m, with two subacute to round ends, 1+ purplish-blue. **Asci** clavate, c. 80–135  $\times$  12–16  $\mu$ m. **Paraphyses** simple, straight, 1  $\mu$ m wide; tips with a slightly thickened end cell. **Epihymenium** unpigmented, 5–7  $\mu$ m high.

**Pycnidia** not seen.

**Chemistry:** Protocetraric acid.

**Notes:** *Ocellularia soreidiigera* resembles *O. auberianoides* (Nyl.) Müll.Arg. in all respects except for the presence of soralia, and can be considered the sorediate counterpart of this species. Despite its reticulate columella, *O. auberianoides* was not included in the genus *Stegobolus* by FRISCH & KALB (2006) for chemical and anatomical reasons.

**Ecology:** *O. soreidiigera* was collected on old deciduous trees in  $\pm$  virgin, dense forests in humid, shady situations from sea level to 400 m.

**ADDITIONAL MATERIAL STUDIED:** **Guatemala.** Petén: surroundings of Tikal, in a humid and dark primary rainforest, 300 m. 17°13'N/89°24'W, 10.I.1979, K. Kalb & G. Plöbst (hb. Kalb 31785, 31777, 31700) – **Hispaniola.** Dominican Republic: La Altigracia; El Macao, at the end of the road from La Cruz del Isleño to Punta Macao, in a coastal rainforest, 5 m. 18°47'N/68°33'W, 26.VIII.1996, K. Kalb (hb. Kalb 36318) – **Brazil.** Bahia: c. 10 km N of Rui Barbosa, in a dense rainforest, 400 m. 12°10'S/40°25'W, 18.VII.1980, K. Kalb & M. Marcelli (hb. Kalb 31144, 31171); opposite Porto Seguro, in a very old coastal forest not subject to flooding (restinga) near the river Baranhaém, 3 m, 16°27'S/39°03'W, 23.VII.1980, K. Kalb & M. Marcelli (hb. Kalb 37628).

### *Schizotrema cryptotrema* (Nyl.) Rivas Plata & Mangold

RIVAS PLATA et al., Lichenologist 41: (2009).

This species, described by Nylander as *Thelotrema cryptotrema* was previously known from French Guiana, Brazil and Costa Rica (NYLANDER 1867, REDINGER 1936, UMAÑA TENORIO et al. 2002).

The collection cited below is a new addition to the Venezuelan lichen biota.

**Venezuela.** Yaracuy: Distr. Bolívar; Sierra de Aroa, Quebrada de Oro, c. 15 km SW of Aroa, in a rather undisturbed elfin forest, 1500 m. 10°18'N/69°00'W, 20.VIII.1989, K. Kalb & R. Smith (hb. Kalb 34925).

### *Thelotrema reunionis* Kalb sp. nov.

Similis *Thelotrematis rockii*, sed acidum hyposticticum et acidum hypoconsticticum continet.

**Type:** Mascarene Islands. Réunion: Walking trail around “Le Grand Étang”; in a  $\pm$  humid secondary forest, 550 m. 21°05'S/55°39'E, 28.VIII.1991, K. & A. Kalb (hb. Kalb 25521 – holotype).

**Etymology:** The epithet refers to the island where the lichen was found.

**Illustrations:** Figures 23, 24

**Thallus** epi- to hypophloedal, thin, 70–100  $\mu$ m high, whitish-grey. Surface dull to slightly shiny, smooth, continuous. Thallus cover variable, **cortical layer** absent or formed by an discontinuous cortical layer. Photobiont layer not well developed, often discontinuous. Vegetative propagules absent.

**Apothecia** inconspicuous, small, up to 0.5 mm in diam., roundish, solitary, immersed to emergent, then conical. **Disc** visible from surface. Pores small, give size range c. 250  $\mu$ m wide, roundish, entire, upper parts of proper exciple usually visible from surface, free, whitish to greyish, incurved. Thalline rim margin roundish to roundish-irregular, small, entire, moderately thin to moderately thick, incurved, concolorous with thallus to pale brownish. Proper exciple fused, becoming apically detached in older stages, hyaline internally, pale yellowish and usually with substrate particles incorporated marginally. Hymenium 200–250  $\mu$ m high, clear, paraphyses  $\pm$  bent and wavy, interwoven, unbranched, tips not or slightly thickened, lateral paraphyses present only in the upper part, inconspicuous, up to 10  $\mu$ m long,



appearing coarse, columellar structure absent. Epihymenium distinct, hyaline, with many granules. **Ascospores** 3–8/ascus, large, with 12–23 transverse septa, cell walls and endospore thick, without a halo, hyaline at first, soon becoming greyish to dark brownish, outer wall distinctly ornamented by dots and/or small ridges, 60–100 × 13–14 μm, I+ violet-blue.

**Pycnidia** not seen.

**Chemistry:** Hypostictic acid (submajor to major), hypoconstictic acid (major) and an unknown yellow spot with Rf-values 38, 34, 20 in solvents A, B' and C respectively.

**Notes:** This new species is characterised by a smooth continuous whitish-grey thallus, ascomata with a free proper exciple, a clear hymenium, undistinct, coarse lateral paraphyses, 3–8-spored asci with large, transversely, brown, amyloid, thick-walled ascospores and particularly the presence of hypostictic and hypoconstictic acids (= "quinaria unknowns"). Similar species include *T. lacteum* Kremp., *T. pachysporum* Nyl., *T. pidurutalagalum* Hale, *T. rockii* (Zahlbr.) Hale and *T. subtile* Tuck. *T. lacteum*, *T. pachysporum*, *T. pidurutalagalum* and *T. subtile* are readily distinguished by the absence of lichen acids while *T. rockii* contains stictic acid. Only one other *Thelotrema* species with hypostictic and hypoconstictic acids is known, namely *T. euphorbiae* Frisch, chemical strain II. But this species is readily distinguished by its I–, hyaline and smaller ascospores (21–27 × 5.5–6.5 μm) with 7–8 transverse septa.

**Ecology:** *T. reunionis* was collected on small branches of ± young trees in a secondary copse in a light but rather humid situation.

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