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### **The Foliicolous Lichen Flora of Mexico. III. New Species from Volcán San Martín Tuxtla (Sierra de Los Tuxtlas), Veracruz, with Notes on *Fellhanera santessonii***

By

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With 3 Figures

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#### Summary

HERRERA-CAMPOS M. A., COLÍN P. M., PEÑA A. B. & LÜCKING R. 2004. The foliicolous lichen flora of Mexico. III. New species from Volcán San Martín Tuxtla (Sierra de Los Tuxtlas), Veracruz, with notes on *Fellhanera santessonii*. – *Phyton* (Horn, Austria) 44 (2): 167–183, 3 figures. – English with German summary.

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Collections of foliicolous lichenized *Ascomycota* made along a transect leading up the summit of San Martín Tuxtla Volcano in the State of Veracruz in Mexico revealed an unexpectedly high number of eleven species new to science: *Gyalectidium cinereodiscus* HERRERA-CAMPOS & LÜCKING and *G. sanmartinense* HERRERA-CAMPOS & LÜCKING (*Gomphillaceae*), *Byssolecania subvezdae* LÜCKING, *Fellhanera atrofuscatula* HERRERA-CAMPOS & LÜCKING, *F. obscurata* HERRERA-CAMPOS & LÜCKING, and *F. rubrolecanorina* B. PEÑA & COLÍN (*Pilocarpaceae*), *Porina subnitidula* COLÍN & B. PEÑA and *Trichothelium intermedium* LÜCKING (*Porinaceae*), and *Psoroglaena arachnoidea* HERRERA-CAMPOS & LÜCKING, *P. ornata* HERRERA-CAMPOS & LÜCKING, and *P. sorediata* HERRERA-CAMPOS & LÜCKING (*Verrucariaceae*). All species are described herein, and their diagnostic characters and taxonomic affinities are discussed. We also describe for the first time the pycnidia and conidia of *Fellhanera santessonii* BARILLAS & LÜCKING, their features confirming the placement of this species in the *F. fuscatula* group.

### Zusammenfassung

HERRERA-CAMPOS M. A., COLÍN P. M., PEÑA A. B. & LÜCKING R. 2004. Die foliikole Flechtenflora Mexikos. III. Neue Arten vom Vulkan San Martín Tuxtla (Sierra de Los Tuxtlas), Veracruz, mit Anmerkungen zu *Fellhanera santessonii*. – *Phyton* (Horn, Austria) 44 (2): 167–183, 3 Abbildungen. – Englisch mit deutscher Zusammenfassung.

Aufsammlungen foliikoler lichenisierter *Ascomycota* entlang eines Transektes zum Gipfel des Vulkans San Martín Tuxtla Volcano im Bundesstaat Veracruz in Mexiko erbrachten eine unerwartet hohe Zahl von elf als neu für die Wissenschaft erkannten Arten: *Gyalectidium cinereodiscus* HERRERA-CAMPOS & LÜCKING und *G. sanmartinense* HERRERA-CAMPOS & LÜCKING (*Gomphillaceae*), *Byssolecania subvezdae* LÜCKING, *Fellhanera atrofuscatula* HERRERA-CAMPOS & LÜCKING, *F. obscurata* HERRERA-CAMPOS & LÜCKING und *F. rubrolecanorina* B. PEÑA & COLÍN (*Pilocarpaceae*), *Porina subnitidula* COLÍN & B. PEÑA und *Trichothelium intermedium* LÜCKING (*Porinaceae*), sowie *Psoroglaena arachnoidea* HERRERA-CAMPOS & LÜCKING, *P. ornata* HERRERA-CAMPOS & LÜCKING und *P. sorediata* HERRERA-CAMPOS & LÜCKING (*Verrucariaceae*). Alle Arten werden hier beschrieben und ihre diagnostischen Merkmale und verwandten Spezies werden diskutiert. Ausserdem beschreiben wir zum ersten Mal die Pyknidien und Konidien von *Fellhanera santessonii* BARILLAS & LÜCKING, deren Merkmale die Einordnung dieser Art in die *F. fuscatula*-Gruppe bestätigen.

### 1. Introduction

Mexico is one of the regions with the highest biodiversity in the world, due to its location close to the Central American landbridge, its huge extension covering both the temperate and the tropical zone, and its variety of vegetation types (RAMAMOORTHY & al. 1993, TOLEDO 1997, TOLEDO & ORDÓÑEZ 1993). The lichen biota of this enormous country are just beginning to be inventoried (HERRERA-CAMPOS & NASH 2000), the total number of species being estimated at 3,000 to 4,000. Of the currently listed 1,600 species (RYAN & al. 1996, SIPMAN & WOLF 1998, NASH & al. 2001), most are foliose and fruticose macrolichens collected in the extratropical upper montane belt or in the subtropical deserts.

To increase our knowledge on the much neglected tropical crustose microlichens, the authors recently started a survey of foliicolous and crustose corticolous lichens in lowland and montane rainforest areas in the States of Veracruz, Oaxaca, and Puebla. Up to the present, nearly 300 species of foliicolous lichens were detected, including 200 new records for the country and 14 taxa new to science (HERRERA-CAMPOS & LÜCKING 2002, 2003). A detailed account, including an ecogeographical analysis of the foliicolous lichen biota, will be presented in a forthcoming paper. Following the description of nine new species from lowland rainforest in Veracruz (HERRERA-CAMPOS & LÜCKING 2002) and further five new species from montane rainforest in Oaxaca and Puebla (HERRERA-CAMPOS & LÜCKING 2003), we here introduce eleven new taxa which were collected along an altitudinal transect on San Martín Tuxtla volcano (800–1400 m) in Veracruz. In addition, pycnidia are described for the first time for *Fellhanera santessonii*.

## 2. Study Site

San Martín Tuxtla volcano belongs to the Sierra de Los Tuxtlas range, which in turn forms the easternmost part of the transversal volcanic belt in Mexico. San Martín Tuxtla volcano is the highest mountain in the Sierra de Los Tuxtlas, with an elevation of 1738 m above sea level. Due to its isolated position, one observes a complete transition, from lowland rainforest ('selva alta perenifolia') at the base of the volcano, to (lower) montane rainforest ('bosque mesófilo') at mid elevations, to upper montane or 'elfin' forest ('selva baja perenifolia') towards the summit (ALVAREZ DE CASTILLO 1977). This latter type of vegetation exists elsewhere in Mexico only in the state of Chiapas. Since foliicolous lichen communities are known to change along altitudinal gradients, and certain families with possibly endemic species, such as *Gomphillaceae* and *Pilocarpaceae*, become more dominant, this gradient from lowland rainforest to elfin forest within an altitudinal range of little more than 1000 m is especially interesting in terms of undescribed species to be detected.

## 3. The Species

### *Gomphillaceae*

*Gyalectidium cinereodiscus* HERRERA-CAMPOS & LÜCKING spec. nova

Diagnosis: Sicut *Gyalectidio fusco* sed apotheciis discis cinereis instructis differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 1300–1400 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype; F, isotype).

Icones: Fig. 1A–C.

Description: Thallus foliicolous, epiphyllous, crustose, in small, rounded patches 3–6 mm across and 20–30 µm thick, with cellular cortici-form layer, finely verrucose due to encrustation with calcium oxalate



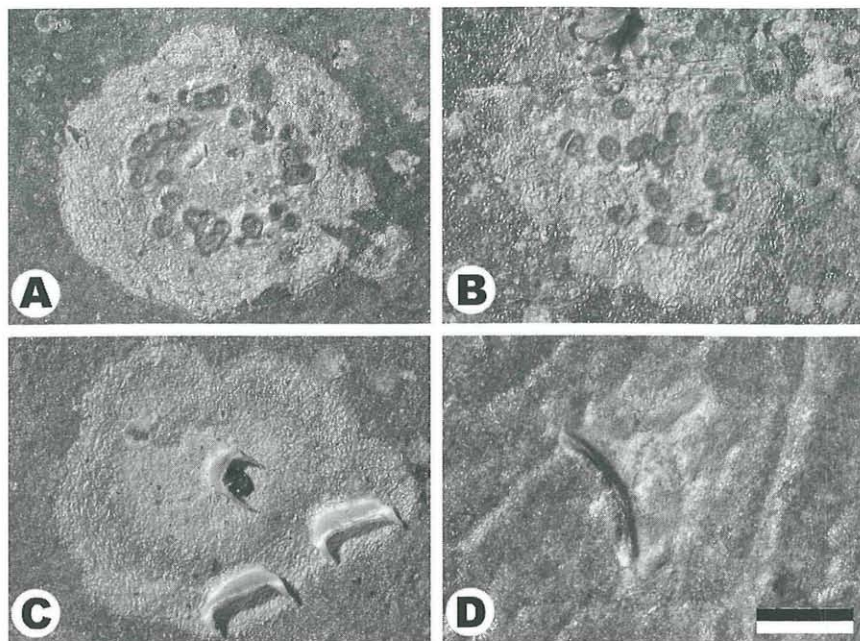


Fig. 1. – A–C. *Gyalectidium cinereodiscus* (A–B apothecia, C hyphophores). – D. *G. sanmartinense* (hyphophore). – Scale = 1 mm.

crystals, greyish green; verrucae 0.07–0.15 mm diam., whitish. Photobiont *Trebouxia*, cells 6–12  $\mu\text{m}$  diam. Apothecia immersed-erumpent, zeorine, rounded, 0.2–0.3 mm diam. and 60–90  $\mu\text{m}$  high; disc plane, grey; margin rather thin, slightly prominent, smooth, grey. Excipulum prosoplectenchymatous, 5–10  $\mu\text{m}$  broad, colorless. Hypothecium 10–15  $\mu\text{m}$  high, colorless; epithecium 15–30  $\mu\text{m}$  high, composed of irregular layer of densely packed algal cells 3–5  $\mu\text{m}$  diam., above which a paraplectenchymatous, 5–15  $\mu\text{m}$  high corticiform layer as continuation of thallus cortex. Hymenium 45–60  $\mu\text{m}$  high, colorless. Asci broadly clavate to oblong, 40–55  $\times$  17–22  $\mu\text{m}$ . Ascospores 1 per ascus, ellipsoid, muriform, with slight constrictions at septa, 35–45  $\times$  15–20  $\mu\text{m}$ , 2–3 times as long as broad, colorless. Hyphophores frequent, formed on thallus surface or near margin, obliquely upright, broadly squamiform with two acute, lateral projections, 0.5–1 mm broad and 0.4–0.6 mm high, white. Diahyphae branched throughout, moniliform, segments sausage-shaped, 4–7  $\times$  1.5–2.5  $\mu\text{m}$ , colorless, with abundant algal cells 3–5 mm diam.

Notes: This new species is most similar to the widespread and common *Gyalectidium filicinum* MÜLL. ARG., the type species of the genus. The only difference is found in the distinctly grey instead of yellowish green

apothecial disc, which is caused by the presence of a corticiform layer above the hymenium and the layer of epithelial algae. While absent in *G. filicinum*, this layer remains even in the fully mature apothecia of *G. cinereodiscus* and only ruptures punctually where ascospores are discharged together with epithelial algae. Such a corticiform layer above the hymenium is otherwise only known from the Paleotropical *G. fuscum* LÜCKING & SÉRUS. (FERRARO & al. 2001). In that species, however, the layer contains a brown pigment, and its hyphophores are much narrower. Nevertheless, both taxa are certainly closely related. Interestingly, both have been found in semiexposed situations at higher elevations, and the corticiform layer might be a protection of the hymenium against excessive UV radiation. The only other foliicolous lichen in which a cellular cortex covers the hymenium is *Asterothyrium rotuliforme* (MÜLL. ARG.) SÉRUS. in the *Asterothyriaceae*. HENSSEN & LÜCKING 2002 studied apothecial development in this species, which also features muriform ascospores and epithelial algae, and found that the cellular cortex dissolves while the apothecium reaches maturity. This behaviour is not observed in the two *Gyalectidium* species with such cortex.

*Gyalectidium sanmartinense* HERRERA-CAMPOS & LÜCKING spec. nova

Diagnosis: Sicut *Gyalectidio fantastico* sed thallo crystallis nullis differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 1300–1400 m, February 2003, *Herrera-Campos & al. s.n.* (MEXU, holotype; F, isotype).

I c o n : Fig. 1D.

Description: Thallus foliicolous, epiphyllous, crustose, in irregular patches 1–2 mm across and 10–20 µm thick, with cartilaginous, corticiform layer, smooth and lacking calcium oxalate crystals, dark silvery grey with olive tinge. Photobiont *Trebouxia*, cells 4–9 µm diam. Apothecia not observed. Hyphophores frequent, mostly 1 per thallus patch, formed at thallus margin, at first visible as thin split but eventually developing into horizontally projecting scale, crescent-shaped and resembling elongated dorsal fin, 0.7–1.5(–2) mm broad and 0.2–0.3 mm long, dark grey to almost black but whitish translucent at outer margin; scale formed by parallel, unbranched, 2–2.5 µm thick hyphae. Diahyphae branched throughout, moniliform, segments sausage-shaped, 5–8 × 1.5–2 µm, colorless, associated with algal cells 3–5 mm diam.

Notes: *Gyalectidium sanmartinense* resembles *G. fantasticum* FERRARO & LÜCKING in its extremely broad, rather dark, crescent-shaped hyphophore scales (FERRARO & al. 2001). The latter, however, differs in forming crystalline areoles in the thallus centre, and its hyphophore scales usually have two lateral, acute projections. The new species forms dense,

monospecific communities on the small, coriaceous leaves of shrubs in the subalpine zone close to the summit of San Martín Tuxtla volcano.

### *Pilocarpaceae*

#### *Bysssolecania subvezdae* LÜCKING spec. nova

Diagnosis: Sicut *Bysssolecania vezdae* sed apotheciis fuscis et ascosporis 3-septatis differt.

Typus: MEXICO. Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 800–900 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype; F, isotype). – Paratypes: Same locality, 1000–1100 m, HERRERA-CAMPOS & al. s.n. (MEXU); same locality, 1100–1200 m, HERRERA-CAMPOS & al. s.n. (MEXU).

I c o n : Fig. 2A.

Description: Thallus foliicolous, epiphyllous, continuous, smooth, greenish to bright green, 5–20 mm across. Photobiont chlorococcoid; cells globose, 5–8 µm diam., with green contents. Apothecia adnate but slightly prominent, rounded, 0.3–0.8 mm diam. and 100–150 µm high; disc flat to slightly convex, dark brown to blackish brown; margin thin but usually persistent, visible as a whitish, marginal zone. Excipulum strongly reduced, composed of short, loosely woven hyphae, colorless; between excipulum and hymenium a narrow zone of palisadic paraphyses without asci. Hymenium 50–70 µm high, colorless. Paraphyses unbranched, marginally up to 3 µm thick, in central parts thinner and indistinct. Asci clavate, 45–65 × 8–12 µm. Ascospores 4–8 per ascus, oblong, 3-septate, with slight constrictions at septa, 20–24 × 3.5–4.5 µm, colorless. Pycnidia not observed.

Notes: *Bysssolecania subvezdae* resembles *B. fumosonigricans* (MÜLL. ARG.) R. SANT. in the rather dark, slightly convex apothecia with thin marginal zone, and the 3-septate ascospores. Sections through apothecia, however, reveal certain differences: the paraphyses are rather thin and indistinct in the inner parts of the hymenium, the hypothecium is distinctly higher, the lateral excipulum features short, byssoid hyphae, and the ascospores are larger. Apothecial anatomy of this new species is therefore close to the South American *B. vezdae* KALB & LÜCKING (LÜCKING & KALB 2000), but that species has a pale greenish grey thallus, almost black apothecia and predominantly 5–7-septate ascospores. Both taxa are somewhat transitional between *Bysssolecania* and the related genus *Byssoloma*.

#### *Fellhanera atrofuscatula* HERRERA-CAMPOS & LÜCKING spec. nova

Diagnosis: Sicut *Fellhanera fuscata* sed ascosporis maioribus et parte basali apotheciorum atrofusco differt.



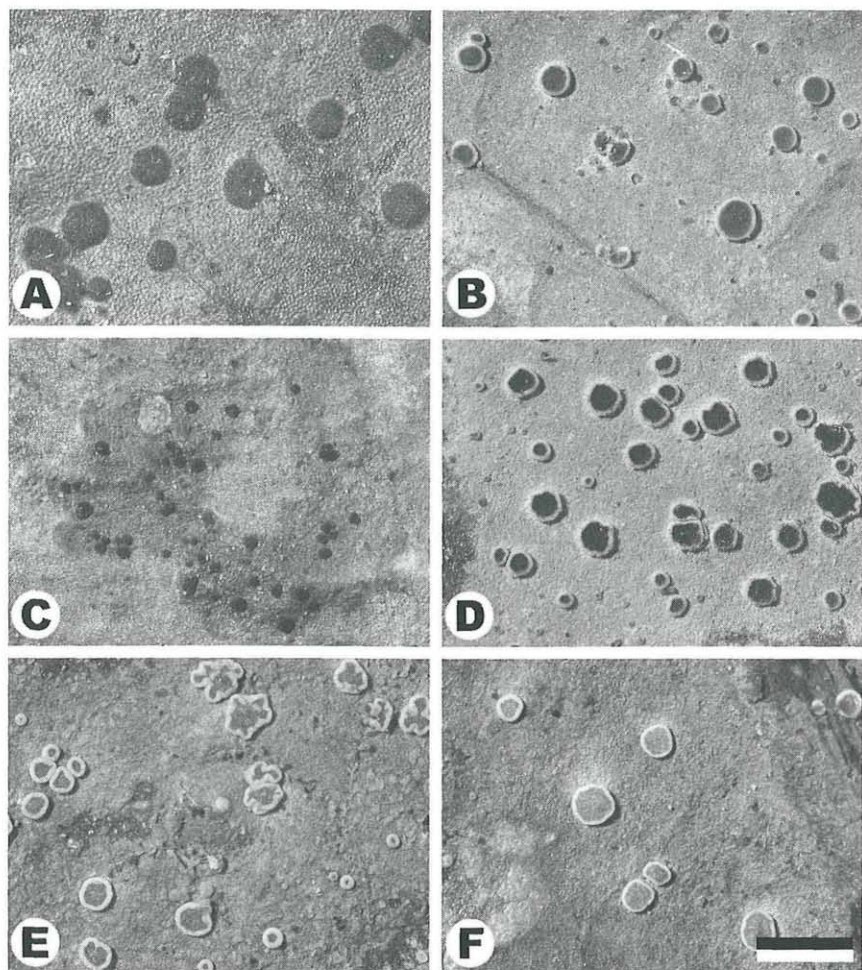


Fig. 2. – A. *Byssolecania subvezdae*. – B. *Fellhanera atrofuscatula*. – C. *F. obscurata*. – D. *F. rubrolecanorina*. – E–F. *F. santessonii* (all showing apothecia). – Scale = 1 mm.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 1000–1100 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype; F, isotype). – Paratypes: Same locality, 800–900 m, HERRERA-CAMPOS & al. s.n. (MEXU); same locality, 1200–1300 m, HERRERA-CAMPOS & al. s.n. (MEXU); same locality, 1300–1400 m, HERRERA-CAMPOS & al. s.n. (MEXU).

Icon: Fig. 2B.

Description: Thallus foliicolous, epiphyllous, crustose, continuous, 5–15 mm across and 10–20  $\mu$ m thick, smooth, pale greenish to bright green.

Photobiont cells 5–9  $\mu\text{m}$  diam. Apothecia sessile, rounded, 0.25–0.5 mm diam. and 140–200  $\mu\text{m}$  high; disc plane to slightly convex, reddish brown; margin thin but usually persistent, chamois-colored. Excipulum paraplectenchymatous, 25–40  $\mu\text{m}$  broad. Hypothecium 20–50  $\mu\text{m}$  high, orange to reddish brown, K–; apothecial base brownish black, K–; epithecium indistinct, 3–5  $\mu\text{m}$  high, very pale yellowish. Hymenium 50–70  $\mu\text{m}$  high, colorless. Asci clavate, 45–65  $\times$  8–13  $\mu\text{m}$ . Ascospores 8 per ascus, oblong-fusiform to cylindrical, (5–)7–9(–11)-septate, with constrictions at septa, (20–)25–35  $\times$  3–5  $\mu\text{m}$ , 7–9 times as long as broad, colorless. Pycnidia abundant, sessile, cupuliform to subglobose, 0.07–0.15 mm diam. and 50–100  $\mu\text{m}$  high, dark grey to almost black; wall paraplectenchymatous. Conidia oblong-bacillar, non-septate, 4–6  $\times$  0.7–1  $\mu\text{m}$ , colorless.

Notes: This new species combines features of the common *Fellhanera fuscata* (MÜLL. ARG.) VEZDA and *F. longispora* LÜCKING (LÜCKING 1997). Its apothecia are very similar to *F. fuscata* in their reddish brown color, but the ascospores of the latter are shorter (18–24  $\mu\text{m}$ ) and regularly 7-septate; in addition, its apothecial base is aeruginous. The larger, mostly 7–9-septate ascospores and the blackish brown apothecial base agree with those of *F. longispora*, but that species has greyish brown apothecial discs and a thinner, dark brown to blackish brown hypothecium without any reddish or orange tinge. Furthermore, while pycnidia are abundant in the new taxon, they have not been found in the many collections of *F. longispora* known so far. Typical specimens of the latter occur abundantly at the type locality, and the morphological and anatomical differences are constant throughout the material.

*Fellhanera obscurata* HERRERA-CAMPOS & LÜCKING spec. nova

Diagnosis: Sicut *Fellhanera emarginata* sed ascosporis 5-septatis maioribusque differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 1200–1300 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype; F, isotype).

I c o n : Fig. 2C.

Description: Thallus foliicolous, epiphyllous, crustose, continuous, 5–10 mm across and 10–15  $\mu\text{m}$  thick, smooth to slightly farinose, greenish; a dark greenish grey marginal zone often present. Photobiont chlorococcoid, cells 5–10  $\mu\text{m}$  diam. Apothecia adnate to sessile, rounded, 0.15–0.25 mm diam. and 80–130  $\mu\text{m}$  high; disc convex, dark greyish brown; margin absent. Excipulum indistinct. Hypothecium 15–25  $\mu\text{m}$  high, brown, K–; apothecial base blackish brown, K–; epithecium indistinct. Hymenium 45–55  $\mu\text{m}$  high, colourless. Asci clavate, 45–50  $\times$  12–15  $\mu\text{m}$ . Ascospores 8 per ascus, ellipsoid, 5-septate, with constrictions at septa, 16–25  $\times$  4–6  $\mu\text{m}$ , 4–4.5 times as long as broad, colourless. Pycnidia not observed.



Notes: This new species is very similar and closely related to *Fellhanera emarginata* LÜCKING (LÜCKING 1997). Both share the emarginate apothecia and rather broad ascospores, which in the latter are smaller and constantly 3-septate. *F. obscurata* has also been found in the montane rainforest of Costa Rica.

*Fellhanera rubrolecanorina* B. PEÑA & COLÍN spec. nova

Diagnosis: Sicut *Fellhanera lecanorina* sed excipulo crystallis fuscorubris instructo differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 800–900 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype; F, isotype).

I c o n : Fig. 2D.

Description: Thallus foliicolous, epiphyllous, crustose, continuous, 8–25 mm across and 10–20 µm thick, smooth, pale bluish to aeruginous. Photobiont cells 5–8 µm diam. Apothecia sessile, rounded to slightly irregular in outline, 0.3–0.5 mm diam. and 130–180 µm high; disc plane to slightly convex, dark brown; margin distinct and slightly prominent, pale grey. Excipulum paraplectenchymatous, 20–30 µm broad, almost completely encrusted with brownish red granules that only partially dissolve in KOH and give a slight K<sup>+</sup> reddish reaction. Hypothecium 10–20 µm high, pale yellowish to very pale brownish, K<sup>–</sup>; apothecial base blackish brown, K<sup>–</sup>; epithecium 3–6 µm high, orange brown to brownish red. Hymenium 60–70 µm high, colorless. Asci clavate, 50–60 × 8–12 µm. Ascospores 8 per ascus, oblong-ellipsoid, 3-septate, with very slight constrictions at septa, 12–16 × 12 4–5 µm, 3–3.5 times as long as broad, colorless. Pycnidia not observed.

Notes: As the name suggests, *Fellhanera rubrolecanorina* is re-minescent of and very closely related to *F. sublecanorina* (NYL.) VEZDA. The main difference is found in the brownish red granules filling the excipulum almost completely, while *F. sublecanorina* has an excipulum devoid of any crystals. Another closely related species is *F. submicrommata* (VEZDA) LÜCKING & KALB (LÜCKING & al. 2001). It has the same thallus and apothecial morphology and anatomy but differs in having an excipulum which is nubilous by strong encrustation of colorless crystals dissolving completely in KOH. *F. rubrolecanorina* should not be confused with *Byssoloma anomalum* KALB & VEZDA (KALB & VEZDA 1990). This taxon looks somewhat similar and also has brownish crystals in the excipulum, but its excipulum structure is different, since it is composed of densely woven hyphae with cylindrical cells lacking constrictions at the septa. In addition, its apothecia are usually pruinose and have a very thin, indistinct margin.

*Fellhanera santessonii* BARILLAS & LÜCKING

Mexico, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 1100–1200 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, F).

Icones: Fig. 2E–F.

Notes: This is a rather widespread but usually uncommon species in the Neotropics. In the present collections, it was extremely abundant and represented by numerous, well-developed thalli, featuring the characteristic grey-pruinose apothecia with rather thick margin. A few specimens also produced pycnidia, thus far unknown in that species; they are 0.07–0.15 mm diam., light to dark grey with wide ostiole, and produce oblong-bacillar, non-septate, colorless conidia  $5\text{--}7 \times 1\text{--}1.3 \mu\text{m}$  in size. While the pycnidia are of a type widespread in the *Pilocarpaceae* and often found in *Fellhanera*, *Byssoloma* and *Byssolecania* species, the conidia resemble those found in the *Fellhanera fuscata* group and in *Byssolecania*. Their finding in *Fellhanera santessonii* thus confirms the close relationship of that species and its allies with *F. fuscata*, the type species of the genus, as already suspected by LÜCKING 1997.

*Porinaceae**Porina subnitidula* COLÍN & B. PEÑA spec. nova

Diagnosis: Sicut *Porina nitidula* sed peritheciis maioribus parte basali expanditis differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 1300–1400 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype; F, isotype).

Icones: Fig. 3A–B.

Description: Thallus foliicolous, epiphyllous, crustose, marginally dispersed into minute, rounded to irregular patches, with thin corticiform layer, smooth, 5–20 mm across and 7–12  $\mu\text{m}$  thick, brownish grey, slightly nitidous. Photobiont possibly *Trentepohlia*, cells rounded to angular-rounded,  $7\text{--}13 \times 5\text{--}8 \mu\text{m}$ , with orange-yellow contents, in irregular plates with interspaces or forming short, irregular threads. Perithecia sessile, hemispherical with base slightly spreading, 0.3–0.6 mm diam. and 150–200  $\mu\text{m}$  high, glabrous, greyish black to pure black, slightly nitidous. Excipulum basally up to 40  $\mu\text{m}$ , laterally up to 20  $\mu\text{m}$  thick, dark purplish brown to almost black, K– or K+ black; involucrellum in upper part 40–70  $\mu\text{m}$  thick, laterally 20–40  $\mu\text{m}$  thick, bluish black, K– or K+ black, exposed or externally covered by very thin layer of hyaline hyphae. Asci fusiform,  $80\text{--}120 \times 8\text{--}12 \mu\text{m}$ . Ascospores 8 per ascus, fusiform, 5-septate, without constrictions at septa,  $25\text{--}35 \times 5\text{--}7 \mu\text{m}$ , 4.5–5.5 times as long as broad, colourless. Pycnidia not observed.

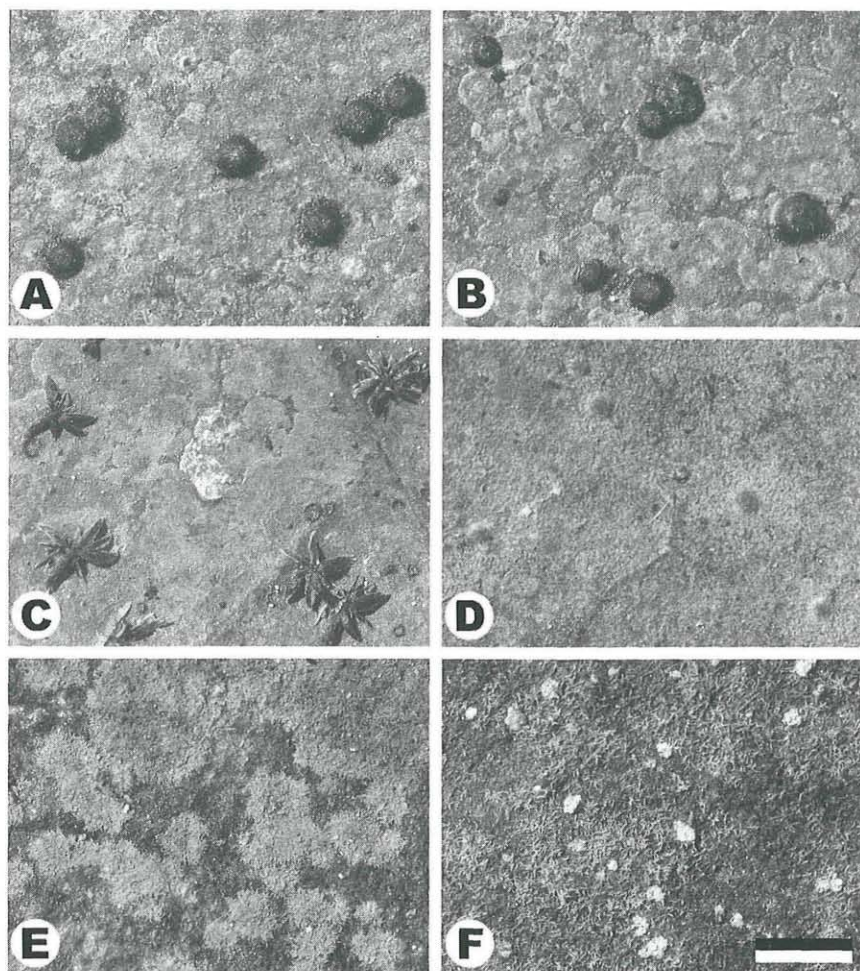


Fig. 3. – A–B. *Porina subnitidula* (perithecia). – C. *Trichothelium intermedium* (perithecia). – D. *Psoroglaena arachnoidea* (thallus and apothecia). – E. *P. ornata* (thallus). – F. *P. sorediata* (thallus with soralia). – Scale = 1 mm.

Notes: This new species is closely related to *Porina nitidula* MÜLL. ARG., but differs in its larger, basally spreading, hemispherical perithecia lacking a whitish tomentum, its *Trentepohlia*-like photobiont, and its slightly larger ascospores. Typical *P. nitidula* was collected at the same locality, and the differences were very obvious. *P. deremensis* F. SCHILL. (= *P. aspera* VEZDA) might look similar to *P. subnitidula*, but has an irregular perithecial surface, an algal layer between excipulum and involucrellum, and 7-septate ascospores.

*Trichothelium intermedium* LÜCKING spec. nova

Diagnosis: Sicut *Trichothelium annulato* sed ascosporis minoribus differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 800–900 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype; F, isotype).

I c o n : Fig. 3C.

Description: Thallus foliicolous, epiphyllous, crustose, dispersed into rounded, sometimes confluent patches, smooth, pale greyish green, up to 10 mm across. Photobiont *Phycopeltis*, cells rectangular, in radiate rows. Perithecia subglobose, 0.2–0.3 mm diam., black with a very slight brownish tinge; setae 4–7, forming horizontal crown, fin-shaped to lanceolate, 0.4–0.6 mm long and 70–150 µm broad at base, black to brownish black with pale tips; involucrellum black, K–; excipulum prosoplectenchymatous, blackish, K–. Asci obclavate, 80–100 × 13–18 µm. Ascospores 8 per ascus, bacillar to tapering, (7–)9–11(–13)-septate, without constrictions at septa, colourless, 50–60 × 4.5–5.5 µm, 11–13 times as long as broad. Pycnidia not observed.

Notes: *Trichothelium intermedium* closely resembles *T. epiphyllum* MÜLL. ARG. and *T. annulatum* (P. KARST.) R. SANT. externally. All three species have few, typically fin-shaped setae which are brownish black to black but might have pale tips. The ascospores of *T. intermedium* are exactly intermediate between the other two species: while those of *T. epiphyllum* are constantly 7-septate, 35–45 × 4–5 µm large, and 8–11 times as long as broad, *T. annulatum* has (13–)15-septate, 60–90(–100) × 4.0–5.5 µm large ascospores which are 15–17 times as long as broad. The ascospores of *T. intermedium* are of the same type as those found in *T. bipindense* F. SCHILL. and *T. juruense* (P. HENN.) F. SCHILL. These two taxa differ, however, in their perithecial morphology, *T. bipindense* having smaller perithecia with more numerous (6–11), typically acute setae, whereas the setae in *T. juruense* are mostly brush-shaped and whitish.

*Verrucariaceae**Psoroglaena arachnoidea* HERRERA-CAMPOS & LÜCKING spec. nova

Diagnosis: Sicut *Psoroglaena perminuta* sed thallo tomentoso et parietibus perithecorum cellulis algarum instructis differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 800–900 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype).

I c o n : Fig. 3D.

Description: Thallus foliicolous, epiphyllous, continuous, 7–15 mm across and 20–30 µm thick, distinctly arachnoid-tomentose, pale yellowish



to greenish with a greyish tinge. Photobiont cells almost globose, 5–7  $\mu\text{m}$  diam., not in plates but very irregularly arranged in several layers, bright green; thallus hairs solitary or more often in irregular tufts of 5–10, erect, formed by mostly unbranched, colorless hyphae 30–50  $\mu\text{m}$  long and 2–3  $\mu\text{m}$  thick. Perithecia erumpent, subglobose to globose, 0.1–0.15 mm diam. and 100–150  $\mu\text{m}$  high, yellowish with a pale reddish brown tinge. Excipulum prosoplectenchymatous with narrow, thin-walled cells, 10–15  $\mu\text{m}$  thick, laterally colorless but basally and apically pale yellowish brown; above excipulum a continuous, 10–15  $\mu\text{m}$  thick algal layer almost up to ostiolum, forming continuation of algiferous thallus; above algal layer a paraplectenchymatous, colorless, 10–15  $\mu\text{m}$  thick secondary involucrellum reaching down laterally from ostiolum halfway down the perithecium. Periphyses unbranched, 20–50  $\times$  12 1–2  $\mu\text{m}$ . Asci clavate to almost cylindrical, 40–50  $\times$  10–13  $\mu\text{m}$ . Ascospores 8 per ascus, oblong-fusiform, 3-septate, without constrictions at septa, 15–25  $\times$  3–5  $\mu\text{m}$ , 4.5–5.5 times as long as broad, colorless. Pycnidia not observed.

Notes: This new species is distinguished from all other species of the genus and from all species of the related genus *Phylloblastia* by its tomentose thallus, which somewhat resembles the arachnoid prothallus of *Lasioloma* species in the *Pilocarpaceae*, and is formed by irregular tufts of colorless hyphae. Otherwise, *Psoroglaena arachnoidea* is very similar to *P. perminuta* (VEZDA) HARADA with regard to its perithecial anatomy and ascospore dimensions. However, while *P. perminuta* has completely exposed perithecia not covered by algiferous thallus tissue, those of *P. arachnoidea* have a distinct algal layer between the excipulum and a paraplectenchymatous outer layer, which is here called secondary excipulum. Such a wall structure is unknown in other species of *Psoroglaena* and *Phylloblastia*, but occurs rather frequently in species of *Porina* in the *Porinaceae*.

*Psoroglaena ornata* HERRERA-CAMPOS & LÜCKING spec. nova

Diagnosis: Sicut *Psoroglaena costaricensis* sed thallo maculis applanatis circularis differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 800–900 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype).

Icones: Fig. 3E.

Description: Thallus foliicolous, continuous, 10–30 mm across and 20–40  $\mu\text{m}$  thick, appressed filamentous, pale greenish to bright green; blackish prothallus present; filaments richly branched, forming regularly rounded rosettes resting on dark prothallus. Photobiont cells rectangular, 4–7  $\times$  3–6  $\mu\text{m}$ , in richly branched, uniseriate filaments, pale greenish to bright green, wrapped in thin, indistinctly paraplectenchymatous, pa-

pillose cortex formed by fungal hyphae. Perithecia not observed. Pycnidia not observed.

Notes: *Psoroglaena ornata* is one of several new, foliicolous species of the genus, which have been found in collections from the Neotropics. They differ chiefly in their perithecial and thallus morphology and anatomy and the absence or presence of soralia or isidia. Among these species, *P. ornata*, which has also been collected abundantly in the lowland rainforest of nearby Los Tuxtlas Tropical Biological Station, is characterized by the very regular, bright green thallus rosettes resting on a dark prothallus. The much branched thallus filaments resemble those of the corticolous *P. costaricensis* HENSSEN, but that taxon has an erect, almost squamulose thallus. *P. epiphylla* LÜCKING, another new species currently being described from Costa Rica, has almost unbranched thallus filaments which form dense mats on the leaf surface, without being organized in distinct rosettes.

*Psoroglaena sorediata* HERRERA-CAMPOS & LÜCKING spec. nova

Diagnosis: Sicut *Psoroglaena costaricensis* sed thallo maculis applanatis circularis differt.

Typus: MEXICO, Veracruz: Sierra de Los Tuxtlas, Volcán San Martín Tuxtla, 18° 34' N, 94° 55' W, 800–900 m, February 2003, HERRERA-CAMPOS & al. s.n. (MEXU, holotype).

Icones: Fig. 3F.

Description: Thallus foliicolous, continuous, 10–20 mm across and 20–50 µm thick, appressed filamentous, sorediate, dark green; filaments moderately branched, forming dense, irregular mats with somewhat 'flaky' branchlets; soralia maculate, rounded, 0.07–0.2 mm diam., very pale greenish; sorediate granules formed by one or several algal cells wrapped with irregularly paraplectenchymatous layer of bulging, thin-walled, sparsely papillose cells formed by fungal hyphae. Photobiont cells rectangular, 3–6 × 12–3–5 µm, in moderately branched, uniseriate filaments, pale greenish to yellowish green, wrapped in thin, indistinctly paraplectenchymatous, papillose cortex formed by fungal hyphae. Perithecia sessile, subglobose to ovoid and usually with short neck, 0.2–0.3 mm diam. and 200–300 µm high, pale yellowish to brownish. Excipulum consisting of a single layer only, paraplectenchymatous with thin-walled (leptodermatous) cells, 30–50 µm thick, colourless but peripheral part brown; involucrellum absent. Periphyses unbranched, 20–40 × 1.5–2 µm. Asci fusiform, 80–110 × 20–30 µm. Ascospores 8 per ascus, fusiform, muriform, without constrictions at septa, 35–40 × 9–11 µm, 3.5–4 times as long as broad, colourless. Pycnidia not observed.

Notes: This new species is obviously closely related to the above mentioned *Psoroglaena epiphylla* and differs mainly in its distinct soralia. Sorediate granules are also reported from *P. stigonomoides* (ORANGE)

HENSSEN (ORANGE 1989, HENSSEN 1995), but in that species they are diffuse and not produced in well-delimited soralia. Moreover, *P. stigonemoides* differs in its erect filamentous to almost fruticulose thallus with biseriate photobiont filaments. The thallus of *P. sorediata* resembles that of *P. epiphylla*, but in the abundant material of the latter, soralia or sorediate granules are completely absent. Although the perithecia of *P. sorediata* look the same as in other species, their walls differ in being parapectenchymatous throughout, while the prosoplectenchymatous inner layers found in other species are not observed.

#### 4. Notes on the Foliicolous Lichen Diversity of San Martín Tuxtla Volcano

San Martín Tuxtla volcano forms a part of the Sierra de Los Tuxtlas Special Biosphere Reserve, which is composed of seven volcanoes. It is the area with the second highest precipitation level in Mexico, with an average of 4700 mm per year. The region includes one of the largest undisturbed portions of rainforests in the country. More than 1000 vascular plant species and more than 800 vertebrate taxa have been recorded, and many of them are unique to Mexico or endemic to the region (ALVAREZ DE CASTILLO 1977).

Foliicolous lichens are known to exhibit low degrees of endemism (LÜCKING & KALB 2001, LÜCKING 2003). New Caledonia, an area known for its high degree of endemism in vascular plants, exhibits a proportion of endemic foliicolous lichen species of less than four percent. Accordingly, sites with a high proportion of potentially endemic species of foliicolous lichens are quite unusual in the Neotropics, especially if they are not geographically isolated. Therefore, the relatively high number of nine new foliicolous lichen species so far only known from San Martín Tuxtla (the other two have also been collected elsewhere), among a total of 121 taxa (more than seven percent), underlines the importance of this region for the conservation of Mexican biodiversity. Indeed, the Sierra de Los Tuxtlas is also a refuge for many rare and threatened vascular plant and mammal species. Despite the fact that Los Tuxtlas is one of the best studied rainforest areas in Mexico, nearly 90% of the original forest cover has been eliminated over the past three decades. With the current deforestation rate, more than half of the biodiversity of this region is expected to be lost within the next seven years.

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