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Results of a lichenological and bryological exploration of Cerro Guaiquinima (Guayana Highland, Venezuela)

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Abstract: 214 Lichen and 38 bryophyte species are reported from Cerro Guaiquinima, a sandstone table mountain in southeastern Venezuela, thus far almost unexplored for these groups and apparently undisturbed by man. Slightly over half of these species have also been reported from the north slope of Mount Roraima and surroundings, a nearby area with similar edaphic and climatological conditions. Altitudinal differences in the flora are probably largely dependent on differences in vegetation structure: the closed forests at the foot harbour more Thelotremataceae, whereas in the open vegetation of the rocky plains on the summit more Cladoniaceae and Trypetheliaceae are found. On the highest site bryophytes are more frequent. First descriptions are given for nine lichens and one moss: *Buellia bellardii* Sipman, *Hypotrachyna adaffinis* Sipman, *Myriotrema flavolucens* Sipman, *Myriotrema squamuloides* Sipman, *Ocellularia croceoisidiata* Sipman, *Ocellularia glaucoglyphica* Sipman, *Thelotrema carneoradians* Sipman, *Thelotrema guaiquinimae* Sipman, *Sphagnum sipmanii* Crum and *Ocellularia sinuosa* Sipman (in appendix, from Colombia). *Myriotrema guianense* is reduced to synonymy of *Myriotrema columellatum* (A. Zahlbr.) Sipman, comb. nov.

Resumen: Se comunica la presencia de 214 liquenes y 38 briófitos en el Cerro Guaiquinima, una meseta de arenisca en el SE de Venezuela. Hasta la fecha la flora de líquenes y briófitos de esta área, que parece nunca haber sufrido alguna influencia humana, era prácticamente desconocida. Un poco más que la mitad de esta flora también ha sido encontrada en la región del Monte Roraima, un área vecina muy similar. Es probable que las diferencias altitudinales de la flora dependen principalmente de las diferencias en la estructura de la vegetación: en los bosques cerrados en la base del Cerro hay más Thelotremataceae, mientras que en la sabana rocosa de la cumbre se encuentran más Cladoniaceae y Trypetheliaceae. En el sitio más alto ocurren más briófitos. Se presentan las primeras descripciones para nueve líquenes y un musgo: *Buellia bellardii* Sipman, *Hypotrachyna adaffinis* Sipman, *Myriotrema flavolucens* Sipman, *Myriotrema squamuloides* Sipman, *Ocellularia croceoisidiata* Sipman, *Ocellularia glaucoglyphica* Sipman, *Thelotrema carneoradians* Sipman, *Thelotrema guaiquinimae* Sipman, *Sphagnum sipmanii* Crum y *Ocellularia sinuosa* Sipman (en el apéndice, de Colombia). Además *Myriotrema guianense* esta incluida en *Myriotrema columellatum* (A. Zahlbr.) Sipman comb. nov.

Guayana Highland is the term often used in botanical literature for a number of isolated mountains in southeastern Venezuela, adjacent Brazil and Guyana with extensive rocky plains on their summits raising to about 1000-3000 m. They are mainly composed of sandstone (Roraima Sandstone), and many of them are of a very pronounced table shape, probably due to the presence of more resistant quartzitic layers. Owing to the very poor mineral content of the sandstone, most of the Highland has infertile, acid soils on which only a sparse, discontinuous vegetation occurs. The prevailing humid tropical climate frequently leads to bog-formation. The mountains emerge from extensive lowlands that hardly ever reach 500 m elevation, and their sides are often formed by vertical cliffs several hundred meters high. They thus constitute rather isolated habitats. Botanical exploration revealed the presence of a high degree of endemism in the phanerogam flora of the mountain summits (Maguire 1970). As an explanation it was supposed that during Pleistocene periods of drought the high table mountains constituted humid refugia that allowed for the survival of an ancient flora. Successive explorations, however, revealed that the local element in the flora is not restricted to the mountain tops and that there are strong relations between the mountain flora and the lowland flora of the area (Steyermark 1979, Huber 1988).

So far the lichen and bryophyte floras of the area have received little attention. The only paper dealing explicitly with lichens of the area concerns Cladoniaceae (Ahti 1987). It reports the presence of a surprisingly rich local element in this family, comprising a.o. *Cladina densissima* Ahti (Ahti 1984), *Cladonia steyermarkii* Ahti, *C. vareschii* Ahti (Ahti 1986), *Cladina argentea* Ahti (Ahti 1986a), *C. guianensis* Stenroos (Stenroos 1989), *C. sufflata* Ahti and *C. variegata* Ahti (Ahti 1990). The endemic species are not restricted to the mountain summits, however, but spread over the surrounding lowlands as well: Most endemic taxa are found on the table tops and in the surrounding white-sand savannas. Thus the view of Steyermark and Huber is confirmed.

For bryophytes more literature is available. An inventory of the slopes and surroundings of Mount Roraima is presented by Gradstein & Florschütz-de Waard (1989), who record 300 taxa, including 11 new species. Robinson (1986) discusses the endemic element of the Highland, and Schuster (1990) discusses the origins of hepatic flora. Gradstein et al. (1990) mention a Guayana Highlands element in a discussion of the bryophyte diversity in the Guianas.

As to the lichen and bryophyte flora of Cerro Guaiquinima, a short and probably incomplete literature search revealed only two reported species: *Cladonia pulviniformis* and *C. variegata* (Ahti 1990).

Material and methods

An international scientific expedition to Cerro Guaiquinima, organized in 1990 by the Fundacion para el Desarrollo de las Ciencias Físicas, Matemáticas y Naturales (FUDECI) in Caracas, Venezuela, provided a good opportunity for an investigation of the lichen flora of one of the table mountains. Facilities were made available which allowed for an investigation of the lichen and bryophyte flora in a range of different habitats and elevations.

Cerro Guaiquinima is a sandstone table mountain situated on the East bank of the Río Paragua in Estado Bolivar, Venezuela, in the western part of the Guayana Highland. It is one of the largest tepuis and at the same time one of the lowest. Its summit plain, which comprises about 1600 km², ranges in elevation from 800 m in the central part to c. 1600 m on the western rim. It is connected fairly well with the surrounding lowlands by a river canyon, which leads from the central part to the surrounding lowlands at c. 300 m. For a more detailed description see Steyermark and Dunkerville (1980).

During the expedition 7 numbered camps were made available, one at the southern foot of the mountain and 6 spread over the tablelands on top. The following 5 have been visited:

Camp 2: Situated near the NE edge of the summit plateau, c. 5°54' N, 63°27' W, c. 1100-1200 m. The area consists of rather dry and exposed rocky tableland with denudated rock flats, scarcely vegetated sand flats, boggy herb

vegetation and scrub. In a narrow valley up to c. 15 m tall forest occurs. Observation period: 7-10 February 1990.

Camp 3: Situated in the central part of the summit plateau, at the Río Carapó, c. 5°49' N, 63°32' W, c. 800 m. The area consists of a very rugged slope south of the river, with stunted forest in clefts between boulders, tall cliffs and rock flats, and some low, only periodically boggy vegetation on the rock flats. Observation period: 11-13 February 1990.

Camp 4: Situated in the central part of the summit plateau, c. 5°40' N, 63°34' W, c. 950-1000 m. The camp is situated in wet tableland largely covered with boggy *Stegolepis* vegetation and scattered scrub in fissures. On an adjacent rocky slope towards the upper part of Río Carapó stunted mossy forest was available. Observation period: 4-6 February 1990.

Camp 5: Situated in the highest part of the mountain, near the western rim of the summit plateau, c. 5°48' N, 63°40' W, c. 1500 m. The area consists largely of blanket bog with *Stegolepis*, which covers all gentle slopes. It is interrupted by some scattered rock outcrops, a small stream valley and mossy dwarf forest mainly on steeper slopes. Observation period: 13-15 February 1990.

Camp 7: Situated at the southern foot of the mountain, at the confluence of the rivers Carapó and Lima, c. 5°35' N, 63°32' W, c. 320-350 m. The area is completely covered by c. 15 m tall, light forest on poor soil, on both sides of the Carapó. A few rock outcrops were encountered on the river shore. Observation period: 31 January - 3 February, 16 February 1990.

Camp 8: The surroundings of Canaima, c. 6°15' N, 62°52' W, c. 600 m. This was not a official expedition camp. The area visited includes forest on a slope along the river, near the waterfall and the rocky plateau with scattered scrub, above the slope. Observation period: 30 January, 19 February 1990.

The collected samples were studied with the usual optical equipment (compound microscope, dissecting microscope) and chemical spot tests (described by e.g. White & James (1985). A number of samples were analyzed by thin-layer chromatography, following the usual standardized procedures (White & James 1985). Most samples were run with solvent system A only; for the distinction between fumarprotocetraric acid, protocetraric acid and the "cinchonarum" unknown, solvent system G (Culberson et al. 1981) was used; for the distinction between lecanoric and gyrophoric acid solvent system C. All plates were developed by sulphuric acid treatment. SEM-observations of air-dried specimens were made for the preparation of some illustrations.

Results

During the fieldwork 1002 samples of lichens and 106 samples of bryophytes were taken. They are deposited in VEN, with an almost complete set of duplicates in B. The lichen samples represent 214 identified species, of which 7 are described here for the first time, while about 370 samples are still unidentified. The bryophytes comprise 38 identified species, of which one is described as new, while 45 specimens remain unidentified.

The observed taxa are presented in the following, taxonomically arranged list, with indications of ecology and distribution, available samples (coll. Sipman) and sampling sites, and occasional annotations. For the lichens the taxonomical arrangement of Sipman & Aptroot (1992) is followed, for the bryophytes Gradstein & Florschütz-de Waard (1989). For chromatographed specimens the TLC results are included.

Lichenes

ASCOMYCETES

ARTHONIALES

Arthoniaceae

Arthonia accolens Stirt. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27279.

Arthonia aciniformis Stirt. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27279b.

Arthonia mira R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27278.

Arthonia trilocularis Müll. Arg. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27279c.

Cryptothecia candida (Kremp.) R. Sant. - Folii-

colous in undergrowth of forest, c. 320 m. Camp 7: 26426.

Cryptothecia rubrocincta (Ehrenb.) Thor - In scrub on exposed ridge and in mossy forest along streamlet, c. 1250-1500 m. Camp 2: 26775; camp 5: 27185.

In addition, 6 unidentified specimens, belonging to *Arthonia* and *Stirtonia*.

Opegraphaceae

"*Chiodecton*" *myrtillicola* Fée - On twigs of shrub at margin of stunted mossy forest in *Stegolepis* bog, c. 1500 m. Camp 5: 27233. This species is not included in the genus *Chiodecton* anymore in a recent revision (Thor 1990) and its correct position is uncertain.

Chiodecton sphaerale Ach. - In scrub on sandstone plateau or in clefts, c. 800-1000 m. Camp 3: 27058; camp 4: 26575.

Mazosia bambusae (Vainio) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27312.

Mazosia dispersa (Hedrick) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27334.

Mazosia melanophthalma (Müll. Arg.) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27309.

Mazosia pilosa Kalb & Vezda - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27310. The density of the hairs is very variable, very evident on some specimens, and scarce and restricted to small parts of the thallus on others.

Mazosia praemorsa (Stirt.) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27311.

Mazosia rotula (Mont.) Mass. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27314.

Mazosia rubropunctata R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27313.

Mazosia tumidula (Stirt.) Müll. Arg. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27315.

In addition, 26 unidentified specimens, provisionally placed in the genera *Chiodecton*, *Enterographa*, *Helminthocarpon*, *Melaspilea*, *Opegrapha* and *Schismatomma*.

CALICIALES

Caliciaceae

Tylophoron protrudens Nyl. - Epiphyte in 15 m tall or lower forest, c. 320-800 m. Camp 3: 26982, 26987 (anamorph); camp 7: 26307.

Coniocybaceae

Chaenotheca brunneola (Ach.) Müll. Arg. - In c. 15 m tall forest, c. 320 m. Camp 7: 26434.

DOTHIDEALES

Arthopyreniaceae

3 unidentified specimens, probably in the genera *Arthopyrenia* and *Mycomicrothelia*.

GRAPHIDALES

Graphidaceae

Graphina marcescens (Fée) Müll. Arg. - Epiphyte in c. 15 m tall forest and in low, mossy forest, c. 320-1100 m. Camp 2: 26859, 26884; camp 7: 26405.

Graphis grammitis Fée - Epiphyte in c. 15 m tall forest, c. 350 m. Camp 7: 26363.

Phaeographis exaltata (Mont. & v.d. Bosch) Müll. Arg. - Epiphytic on smooth bark in mossy stunted forest, c. 1500 m. Camp 5: 27159, 27182, 27221.

In addition, 20 unidentified specimens of *Graphina*, 43 of *Graphis*, 5 of *Phaeographina* and 6 of *Phaeographis*. This family forms the main gap in the knowledge of the lichen flora.

Thelotremataceae

Chroodiscus coccineus (Leight.) Müll. Arg. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27298.

Myriotrema calvescens (Fée) Hale - Epiphyte, mostly on treetrunks, in mostly well-developed forest, c. 320-1500 m. Camp 2: 26862; camp 5: 27158a, 27206, 27220; camp 7: 26413, 26482. TLC: psoromic acid.

Myriotrema clandestinum (Fée) Hale - Epiphyte in stunted, more or less mossy forest, c. 950-1250 m. Camp 2: 26784, 26856; camp 4: 26663. TLC: psoromic acid and un-

known substances.

Myriotrema columellatum (Zahlbr.) Sipman, *comb. nov.* Basionym: *Ocellularia columellata* A. Zahlbruckner 1909, Denkschr. math.-naturw. Kl. K. Akad. Wiss. Wien 83: 117. *syn.*: *Myriotrema guianense* Sipman, Tropical Bryology 5: 83 - Epiphyte in understorey of c. 15 m tall forest, c. 320-600 m. Camp 7: 26374, 26436, 26468; camp 8: 27275. TLC: psoromic acid. After finishing the treatment of Roraima lichens (Sipman & Aptroot 1992) the author had the opportunity to investigate the probable type of *Ocellularia columellata* Zahlbr., preserved in W. This specimen bears the locality information mentioned by Redinger (1936: 58) but lacks any original notes by Zahlbruckner. Since no other specimen seems to be present in W, it might well be the holotype, and otherwise should be considered as lectotype. The specimen appeared to contain psoromic acid (annotation of TLC-result by Hale 1972), and its spores have the same shape and iodine-reaction as *M. guianense*. Consequently it falls within the morphological range of variation of the latter, and this has to be reduced into synonymy. As explained by Sipman & Aptroot (1992), the reason to include the species in *Myriotrema* lays in its close similarity with *M. wrightii* and *M. subwrightii*.

Myriotrema concretum (Fée) Hale - Epiphyte in stunted forest, c. 1200-1500 m. Camp 2: 26854; camp 5: 27209. TLC: psoromic acid and unknown substances.

Myriotrema congestum (Hale) Hale - Epiphyte in understorey of c. 15 m tall forest and in stunted, more or less mossy forest, and on quartzite outcrops in scrub, c. 320-1200 m. Camp 2: 26709, 26865, 26903; camp 4: 26593, 26681; camp 7: 26443, 26479. TLC: hypoprotocetraric acid, sometimes with additional traces, in saxicolous specimens (26593, 26709) with lichexanthone.

Myriotrema flavolucens Sipman, *sp. nov.*
Fig. 1.
Type: Venezuela, Estado Bolivar, Cerro Guaiquinima, surroundings of Camp 2, near NE edge of upper plateau, coord. c. 5°54' N, 63°27' W, alt. c. 1200 m, rocky sandstone area with scattered scrub, 9 February 1990, H. Sipman 26822 (VEN holotypus, B).

Diagnosis: Thallus corticola, epiphloeodes, 10 cm diametro vulgo superans, pallide flavocinereus, laevis, opacus, continuus, lichexanthonum continens. Apothecia immersa vel paululo emersa, frequentia, margine non carbonaceo plano, columella absenti, c. 0.3 mm diam., poro a circula excipulari nigra constricta; hymenium 75-80 µm altum, hyalinum; sporae hyalinae, transversaliter 5-(3-6-)septatae, octonae, I+ purpureae, c. 18-25 x 7-8 µm.

Thallus corticolous, epiphloeodal, up to at least 10 cm diam., pale yellow-grey, smooth but slightly mealy, dull, continuous, without vegetative propagules, c. 60-80 µm thick; cortical layer of loose hyphae c. 40 µm thick, filled with small crystals (lichexanthone); TLC: lichexanthone only; algae subglobose, c. 6 µm diam.; medulla with or without groups of large crystals. Apothecia immersed or very slightly emergent, in the upper tree bark layer, frequent, single, without carbonized margin or columella, round, c. 0.3 mm diam., pore filled by blackish excipular material, rim same as the thallus; excipulum browned, multi-layered, without periphyses; hymenium c. 75-80 µm high, clear; paraphyses not thickened at apex; spores hyaline, transversely 5(3-6)-septate, 8 per ascus, I+ purplish, 18-25 x 7-8 µm.

Myriotrema flavolucens agrees with e.g. *M. squamuloides* (see below) in apothecium structure, therefore it has been included in *Myriotrema*. It differs by the spore pigmentation and I-reaction, and by its thallus structure and chemistry. The nature of the crystals in the cortical layer was determined as lichexanthone by dissolving the crystals with acetone: the residue fluoresces UV+ yellow. Few Thelotremataceae seem to have lichexanthone as only substance, none very similar to *M. flavolucens*.

Distribution and ecology: So far known from three collections from the tableland on Cerro Guaiquinima, Guyana Highlands, Venezuela. It

grows on twigs or somewhat thicker trunklets of shrubs in humid savannah vegetation on very oligotrophic sandstone flats at 1000-1500 m alt.

Additional material: Camp 4: 26571; Camp 5: 27235.

Myriotrema insigne (Zahlbr.) Hale - Epiphyte in stunted, mossy forest, c. 950 m. Camp 4: 26631. TLC: psoromic acid, unknown substance.

Myriotrema myrioporoides (Müll. Arg.) Hale - Epiphyte in c. 15 m tall forest, c. 320 m. Camp 7: 26462. TLC: hypoprotocetraric acid.

Myriotrema neofrondosum Sipman - Epiphyte in stunted forest, c. 1200 m. Camp 2: 26855. TLC: hypoprotocetraric acid, div. unknown substances.

Myriotrema squamuloides Sipman, *sp. nov.* Fig. 2.

Type: Venezuela, Estado Bolivar, Cerro Guaiquinima, surroundings of Camp 7, at confluence of rivers Carapo and Lima, coord. c. 5°35' N, 63°32' W, alt. c. 320 m, c. 15 m tall, light forest on poor soil on W-bank of Carapo, 3 February 1990, H. Sipman 26477 (VEN holotypus, B).

Diagnosis: Thallus corticola, epiphloeodes, 10 cm diametro vulgo superans, olivaceocinereus ad olivaceoviridis, rugulosus vel subsquamoso-areolatus, opacus, minute reticulatofissus, acidum lichenicum ignotum continens. Apothecia immersa, frequentia, singula vel bina vel terna, margine non carbonaceo plano, columella absenti, c. 0.2 mm diam., poro a circula excipulari fusca constricta; hymenium c. 60 µm altum, hyalinum; sporae fuscae, transversaliter 5-septatae, octonae, I-negativae, c. 12-20 x 6-7 µm.

Thallus corticolous, epiphloeodal, up to at least 10 cm diam., olivaceous green-grey, rugulose to subsquamulose-areolated, dull, minutely reticulate-cracked, without vegetative propagules, c. 50-100 µm thick; cortical layer composed of densely agglutinated hyphae, c. 15 µm thick, in the depressions between the areoles much thinner, internally splitting (cf. Hale 1981: 236, fig. 4d); areoles c. 0.2 mm diam., usually with convex surface, with thickened cortex, in part geotropically directed and subsquamulose, especially near the apothecia; TLC: unknown substance (spot in Rf class 1-2 with solvent system A, pale greenish after charring); algal cells subglobose, c. 6 µm diam.; medulla without crystals. Apothecia immersed in the thallus, frequent, single or in small groups of 2-3, without carbonized margin or columella, round, c. 0.2 mm diam., with pale brownish excipular ring usually filling most of the pore, surrounded by geotropically oriented thallus areoles; excipulum without periphyses; hymenium c. 60 µm high, clear; paraphyses not thickened at apex; spores brown, transversely 5-septate, 8 per ascus, I-negative, when young slightly I+ purplish, 12-20 x 6-7 µm.

This new species seems to be a close relative of *M. subdactyliferum* Sipman as shown by its apothecium structure and spores. The subsquamulose thallus is not known from other members of the family, and together with the chemistry it makes the species well characterized. The unknown substance gives a greenish spot in class 1-2 with solvent system A and sulphuric acid-treatment.

Distribution and ecology: A rather common component of the lichen flora on smooth thin treetrunks on low forest on poor soil at the foot of Cerro Guaiquinima; also found in a similar situation at the foot of Cerro La Neblina. Both localities are in southern Venezuela, their elevation ranges from c. 140-320 m.

Additional specimens: Camp 7: 26460, 26483a. VENEZUELA, Depto. Río Negro, Cerro de la Neblina, along Río Mawarinuma, just outside Cañon Grande, 21 February 1984, W. R. Buck 11047 (NY), pr. p. (main part is *Thelotrema sinuosa*, see below).

Myriotrema subwrightii (Hale) Hale - Epiphyte in understorey of c. 15 m tall, more or less mossy forest, c. 320-1100 m. Camp 2: 26900; camp 7: 26373, 26414. TLC: psoromic acid with traces of stictic acid agg. (a.o. hypostictic acid?)

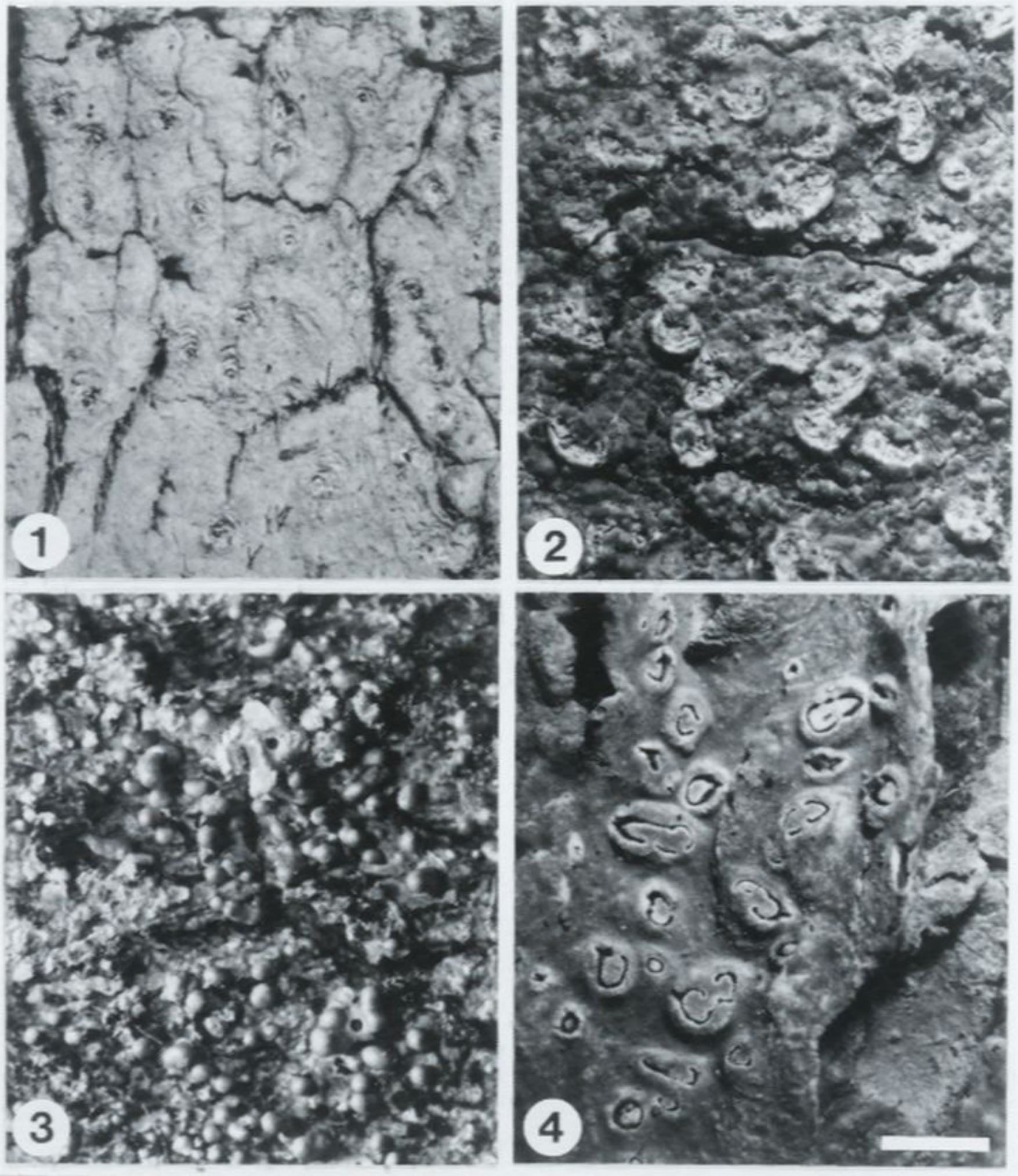

Fig. 1-4. New Thelotremataceae. 1. *Myriotrema flavolucens*, habitus of type. 2. *M. squamuloides*, habitus of type. 3. *Ocellularia croceoisidiata*, habitus of type. 4. *Ocellularia glaucoglyphica*, habitus (Sipman 26352). All same magnification, scale = 1 mm.

Nadvornikia hawaiensis (Tuck.) Tibell - Epiphyte in scrub on sandstone plateau and in mossy stunted forest on rocky slope, c. 950-1000 m. Camp 4: 26623, 26688.

Ocellularia amplior (Nyl.) Redgr. - Epiphyte in stunted forest on and in clefts of sandstone plates, c. 800-1100 m. Camp 2: 26864, 26870; camp 3: 26939, 26955; camp 4: 26684. TLC: protocetraric acid

Ocellularia astrolucens Sipman - Epiphyte in stunted forest on rocky slope, c. 800 m. Camp 3: 26951. TLC: lichexanthone.

Ocellularia auberiana (Mont.) Hale - Epiphyte in understorey of c. 15 m tall forest, c. 320-600 m. Camp 7: 26312, 26315, 26321, 26335, 26356, 26361, 26362, 26376, 26456, 26459; camp 8: 27275a. TLC: psoromic acid with several unknown substances, usually in traces.

Ocellularia aurata (Tuck.) Hale - Epiphyte in scrub on exposed ridge, c. 1250 m. Camp 2: 26757. TLC: protocetraric acid, pigment.

Ocellularia cavata (Ach.) Müll. Arg. - Epiphyte in scrub and stunted forest, c. 800-1500 m. With yellow pigment: Camp 2: 26828, 26832; camp 3: 26946, 26954, 27027, 27044, 27049; camp 4: 26579, 26585; camp 5: 27161, 27196, 27242. TLC: "cinchonarum unknown". Three specimens deviate by the presence of a red rather than a yellowish pigment: 26579, 27161 and 27242. This pigment makes them resemble *O. gracilis* Müll. Arg., which differs by the presence of hypoprotocetraric acid rather than the "cinchonarum" unknown substance. Since the pigment seems the only difference with typical *O. cavata*, and the specimens show the same ecological preferences, they have been included in *O. cavata*

Ocellularia comparabilis (Kremp.) Müll. Arg. - Epiphyte in understorey of c. 15 m tall forest, c. 320-1100 m. Camp 2: 26863; camp 7: 26304, 26311, 26401. TLC: psoromic acid, unknown traces.

Ocellularia croceoisidiata Sipman, *sp. nov.* Fig. 3.

Type: Venezuela, Estado Bolivar, Cerro Guaiquinima, in central part of upper plateau, along Rio Carapo (near camp 3-nuevo), coord. c. 5°49' N, 63°32' W, alt. c. 800 m, rocky slope with low forest in deep clefts and along the river, 11 February 1990, H. Sipman 26948 (VEN holotype, B).

Diagnosis: Thallus corticola, epiphloeodes, ad 8 cm diametro, croceocinereus, laevis, opacus, continuus, isidiosus, acidum lichenicum ignotum "cinchonarum" continens. Apothecia ascidioidea, emergentia, basi constricta, medulla ochracea, frequentia, c. 1 mm diam., margine carbonaceo, columella carbonacea rotunda c. 0.2 mm lata, nigra vel laeviter alboprinosa, poro c. 0.15 mm diam. albomarginato; hymenium c. 170 µm altum, hyalinum; sporae hyalinae, transversaliter 11-15-septatae, octonae, I+ purpureae, c. 35-50 x 8 µm.

Thallus corticolous, epiphloeodal, up to at least 8 cm diam., brownish grey, smooth, dull, continuous, isidiate, c. 40 µm thick; cortical layer composed of weakly agglutinated hyphae, c. 8 µm thick; TLC: cinchonarum unknown and pigment; algal cells subglobose, c. 6 µm diam., medulla in part endophloeodal; isidia cylindrical with irregular shallow constrictions, c. 0.15 mm wide, to c. 0.5 mm long, glossy, with yellow medulla. Apothecia ascidioid, emergent, basally constricted, with yellow medulla, rather frequent, single, with carbonized excipular margin and columella, round, c. 1 mm diam.; pore c. 0.15 mm wide, often showing a blackish columella top, with whitish rim; excipulum carbonized, especially in its upper part, without periphyses; columella carbonized, c. 0.2 mm wide, with rounded, black, scarcely prainose top; hymenium c. 80 µm high, clear; paraphyses not thickened at apex; spores hyaline, transversely 11-15-septate, 8 per ascus, I+ purplish, c. 35-50 x 8 µm.

Both isidia and the "cinchonarum" unknown substance are rather unusual characters in Thelotremataceae, and therefore the combination is sufficient to distinguish *Ocellularia croceoisidiata* from other members of its genus. In addition the yellow-pigmented medulla of isidia and apothecial warts makes it a conspicuous spe-

cies. The chemistry and apothecium structure relate it most closely to *Ocellularia cavata*. The latter also has a yellow medullary pigment, and could be considered as its "parent species".

Distribution and ecology: Known only from the type, from a thin tree trunk in stunted forest on a steep rocky slope along a river in the very oligotrophic sandstone tableland of Cerro Guaiquinima, Venezuela, at c. 800 m. alt.

Ocellularia glaucoglyphica Sipman, *sp. nov.*
Fig. 4.
Type: Venezuela, Estado Bolivar, Cerro Guaiquinima, surroundings of Camp 7, at confluence of rivers Carapo and Lima, coord. c. 5°35' N, 63°32' W, alt. c. 320 m, c. 15 m tall, light forest on poor soil on E-bank of Carapo, 31 January 1990, H. Sipman 26325 (VEN holotypus, B).

Diagnosis: Thallus corticola, epiphloeodes, 10 cm diametro vulgo superans, glaucoviridis, laevis, opacus, partim pruinosus, continuus, sine acidos lichenicos. Apothecia immersa vel paulo emersa, frequentia, margine carbonaceo, columella lata carbonacea rotunda vel elongata vel stellatim divisa, albopruinosa, margine alba vulgo plana vel leviter elevata, 0.3-0.5 x 0.5-1 mm diam.; hymenium 80-125 µm altum, hyalinum; sporae fuscae, transversaliter 3-septatae, octonae, I-negativae, c. 14-16 x 6-8 µm.

Thallus corticolous, epiphloeodal, to over 10 cm diam., pale glaucous green, in part glaucous-white pruinose, smooth, dull, continuous, without vegetative propagules, c. (20-)50-80 µm thick; no distinct cortex; TLC: no lichen substances found; algal cells subglobose, c. 6-9 µm diam.; medulla with scattered large crystals. Apothecia immersed or slightly emergent, frequent, with carbonized margin and wide, often elongated columella, rounded or often becoming elongated, sometimes stellate-branched, 0.3-0.5 x 0.5-1 mm; columella wide and filling the pore, with flat, white-pruinose top which often becomes greenish by acquiring an algal layer; margin white-rimmed, flat or slightly raised, occasionally strongly raised to recurved and exposing a blackish inner side; hymenium 80-125 µm high, clear; spores brown, transversely 3-septate, 8 per ascus, I-negative except when very young, c. 14-16 x 6-8 µm.

Ocellularia glaucoglyphica seems to be closest to *O. glyphica* (Nyl.) Hale by the structure of its apothecia and its spores. It differs from this species by its dull, pruinose thallus and the absence of lichen substances. The Guyana specimen is somewhat deviant because of its erect to recurved apothecial margin and slightly warty spores when ripe.

Distribution and ecology: Most specimens are from Cerro Guaiquinima, a very limited area in the Guayana Highland, and the only specimen from outside this spot is slightly deviating. Therefore it is unclear whether the species is restricted to the Guayana Highland or is more widespread. It has been found on rather shady treetrunks in virgin forest, at (10-)c. 300 m. alt.

Additional specimens: Camp 7: 26326, 26352, 26464. GUYANA, East Demerara District, Timehri, 2 February 1985, H. Sipman & A. Aptroot 17989 (B).

Ocellularia latilabra (Tuck.) Müll. Arg. - Epiphyte in understorey of c. 15 m tall forest, c. 350 m. Camp 7: 26372. TLC: psoromic acid, unknown traces. The specimen is very similar to material in G.

Ocellularia lepadinoides (Leight.) A. Zahlbr. - Epiphyte in understorey of 5-15 m tall forest, c. 320-800 m. Camp 3: 26938, 26964; camp 7: 26323, 26389, 26404, 26470. TLC: protocetraric acid.

Ocellularia metaphorica (Nyl.) Hale - Epiphyte in mossy forest in narrow valley, c. 1100 m. Camp 2: 26877, 26892. TLC: no substances detected. The specimens fit the description by Hale (1978: 53) quite well, but lichexanthone is absent.

Ocellularia nigropuncta Hale - Epiphyte on smooth bark of trunklets in stunted mossy forest on steep slope, c. 1500 m. Camp 5: 27158, 27199, 27210. TLC: protocetraric acid. The material fits the description of this hitherto Caribbean species (Hale 1974: 22) quite well. The black rim of the apothecium pores develops when the thallus cover

wears off from the carbonized excipulum margin. It is not yet present in young apothecia.

Ocellularia papillata (Leight.) A. Zahlbr. - Epiphyte in understorey of c. 15 m tall forest, c. 320-350 m. Camp 7: 26302, 26319, 26350, 26358, 26392, 26395, 26407, 26418, 26428, 26455. TLC: no substances detected.

Ocellularia perforata (Leight.) Müll. Arg. - Epiphyte in understorey of 10-15 m tall, more or less mossy forest, c. 350-1100 m. Camp 2: 26868; camp 7: 26342, 26369, 26371, 26445, 26457, 26475. TLC: protocetraric acid or cinchonarum unknown. Five specimens deviate by the presence of the "cinchonarum" unknown substance instead of protocetraric acid. Since they do not differ otherwise, they have been treated as a chemical strain.

Ocellularia recondita (Stirt.) A. Zahlbr. - Epiphyte in understorey of c. 15 m tall forest, c. 320-350 m. Camp 7: 26308, 26368. TLC: unknown substance resembling salazinic acid.

Ocellularia rhodostroma (Mont.) A. Zahlbr. - Epiphyte in c. 10 m tall mossy forest in narrow valley, c. 1100 m. Camp 2: 26878. TLC: no substances detected.

Ocellularia tenuis (Hale) Hale - On decaying mossy logs in c. 10 m tall mossy forest in narrow valley, c. 1100 m. Camp 2: 26909, 26927. TLC: no substances detected.

Ocellularia xanthostroma (Nyl.) Müll. Arg. - Epiphyte in c. 15 m tall forest, c. 320 m. Camp 7: 26292, 26386. TLC: no substances detected. The material fits the description by Hale (1978: 34) quite well, except that the spores are considerably larger: 220-250 x 20 µm, c. 50-celled. This difference might be explained by the way in which the spores were investigated (if material allows), viz. by soaking a whole apothecium. In this way the chance to find fully developed spores is larger than by investigation of a section only. The iodine-reaction of the spores is purplish, and the medullary pigment shows the K+ dark violet reaction typical for anthraquinones.

Thelotrema albomaculatum Sipman - Epiphyte on usually thin and smooth treetrunks in understorey of c. 15 m tall forest, c. 320-350 m. Camp 7: 26305, 26313, 26367, 26423, 26446, 26448, 26463. TLC: unknown substance resembling salazinic acid.

Thelotrema alborosellum (Nyl.) Tuck. - Epiphyte on twig in scrub on sandstone tableland, c. 1000 m. Camp 4: 26685. TLC: no substances detected.

Thelotrema carneoradians Sipman, *sp. nov.*
Fig. 5, 6.

Type: Venezuela, Estado Bolivar, Cerro Guaiquinima, surroundings of Camp 7, at confluence of rivers Carapo and Lima, coord. c. 5°35' N, 63°32' W, alt. c. 350 m. c. 15 m tall, light forest on poor soil on W-bank of Carapo, 1 February 1990, H. Sipman 26355 (VEN holotypus, B).

Diagnosis: Thallus corticola, epiphloeodes, 10 cm diametro vulgo superans, cinereoviridis, laevis, nitidiusculus, continuus, sine acidos lichenicos. Apothecia chroodiscoidea, sessilia, frequentia, margine non carbonaceo, stellato-recurvato, disco carneorufo, columella absenti, c. 1.5-2.5 mm diam.; hymenium c. 55-70 µm altum, hyalinum; paraphyses apicibus incrassatis verruculosis; sporae hyalinae, transversaliter 3-septatae, octonae, leptodermaticae, I-negativae, c. 10-14 x 4 µm.

Thallus corticolous, epiphloeodal, to over 10 cm diam., greyish green, smooth, slightly glossy, continuous, without vegetative propagules, 30-50 µm thick; cortical layer composed of conglutinated hyphae, c. 5 µm thick; TLC: no recognizable quantities of lichen substances found; algae subglobose, c. 7-10 µm diam., concentrated in a c. 20 µm thick layer under the cortical layer; medulla without crystals, 5-20 µm thick, rather compact. Apothecia chroodiscoid, sessile, frequent, single, without carbonization, without columella, wide-stellate with few radii (usually 2-5), c. 1.5-2.5 mm diam.; margin erect to recurved, thin, laciniate, concolorous with the thallus on the outside and with the disc on the inside, internally slightly brownish by included bark cell remains, on the inside with short, to 5 µm long periphyses with verrucose tips (like paraphyses); disc reddish carneous, dull, slight-

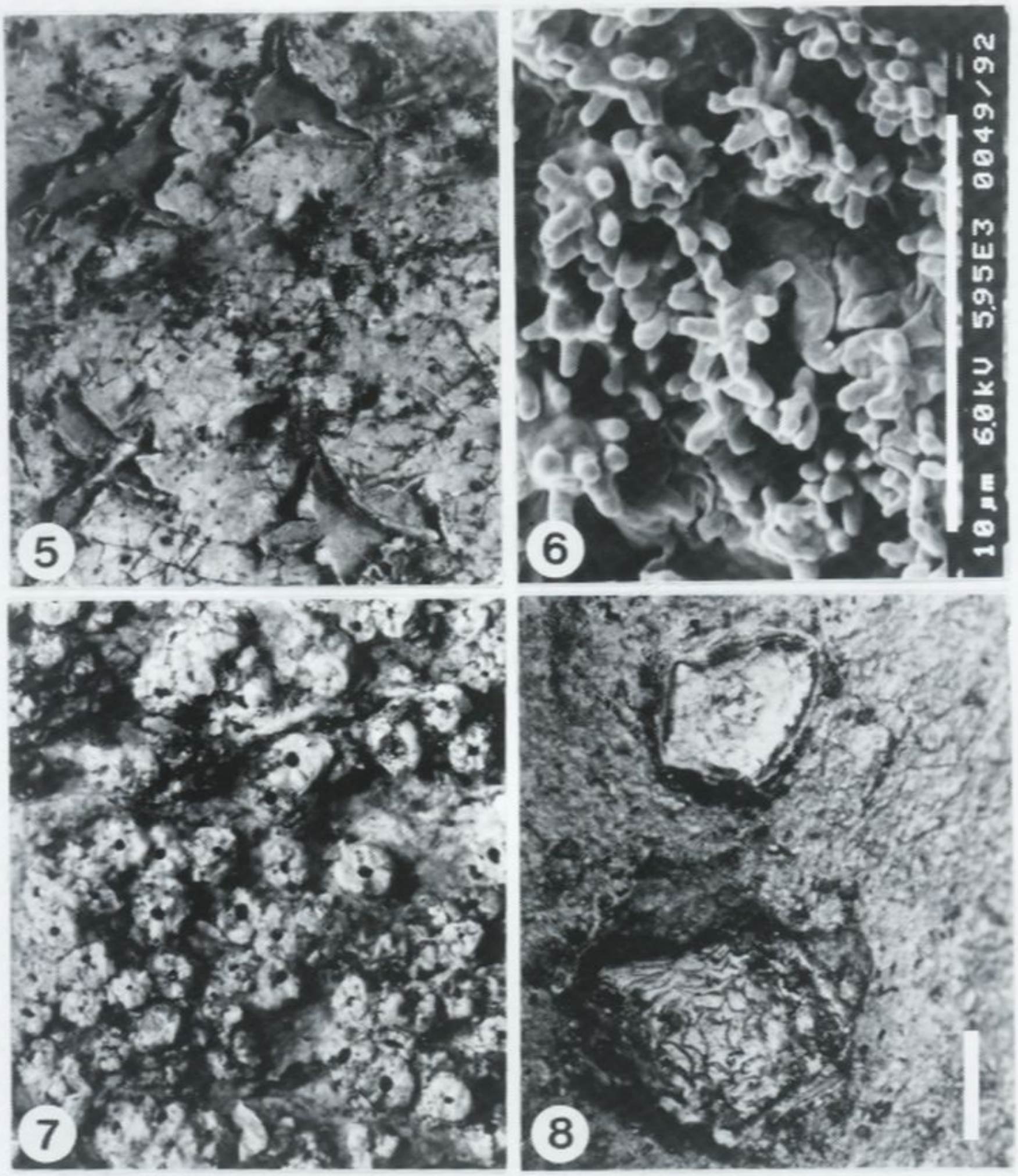

Fig. 5-8. New Thelotremataceae. 5. *Thelotrema carneoradians*, habitus of type. 6. *T. carneoradians*, SEM photograph of hymenium surface, showing the verruculose paraphyse tips. 7. *Thelotrema guaiquinimae*, habitus (Sipman 26904). 8. *Ocellularia sinuosa*, habitus (Buck 11453). All, except 6, same magnification as fig. 1-4, scale = 1 mm.

ly white-pruinose; hymenium c. 55-70 µm high, clear; paraphyses c. 1.5 µm thick, at tips swollen to 2 µm, exserting about 2 µm above the hymenial gelatin and verrucose by c. 0.5 µm diam. granules; spores hyaline, transversely 3-septate, with thin wall and septa, 8 per ascus, I-negative, c. 10-14 x 4 µm.

The closest relative of *Thelotrema carneoradians* seems to be *T. alborosellum* (Nyl.) Tuck. It differs by the more rounded apothecia with paler and smaller disc, and by the paler, less differentiated thallus.

The type specimen contains numerous glossy, cylindrical isidia, which are grouped together mainly on bark cracks. No young isidia have been observed which develop on thallus evidently belonging to *Thelotrema carneoradians*. Therefore it is concluded that the isidia belong to a different lichen which has become almost completely overgrown by the *Thelotrema*.

The verrucose paraphyse and periphyse tips are a feature not frequently observed. It reminds of the genus *Acanthotheciopsis*, a genus included in the Graphidaceae because of its lirelliform ascocarps (Zahlbruckner 1926: 117). This genus appears to have several characters in common with the chroodiscoid species of *Thelotrema*: presence of periphyses; I-negative, hyaline spores. It is perhaps better included in the Thelotremataceae.

Distribution and ecology: Known from a single collection from the base of Cerro Guaiquinima, Venezuela, on a smooth palm stem in low forest, alt c. 350 m.

Thelotrema guaiquinimae Sipman *sp. nov.*
Fig. 7.
Type: Venezuela, Estado Bolivar, Cerro Guaiquinima, near NE edge of upper plateau (near camp 2), coord. c. 5°54' N, 63°27' W, alt. c. 1200 m, low, well-lit forest on slope of narrow valley, 9 February 1990, H. Sipman 26849 (VEN holotype, B).

Diagnosis: Thallus muscicola vel corticola, epiphloeodes, 10 cm diametro vulgo superans, pallide viridocinereus, laevis vel rugulosus, opacus, continuus, acidos lichenicos sticticum et consticticum continens. Apothecia valde emergentia, subcylindrica, frequentia, c. 0.4 mm diametro, margine non carbonaceo, apice plano vel radiatim furcato, periphysis proviso, columella absenti, poro c. 0.1 mm lato paulo impresso; hymenium 160-170 µm altum, hyalinum; sporae cinereae, muriformes, c. 11 x 2-septatae, quaternae ad octonae, I-negativae, c. 30-60 x 12-14 µm.

Thallus muscicolous or corticolous, up to at least 10 cm diam., pale greenish grey, smooth or rugulose, dull, continuous, without vegetative propagules, c. 80 µm thick; cortical layer composed of strongly agglutinated hyphae, c. 10 µm thick; TLC: stictic and constictic acids; algal cells subglobose, c. 8 µm diam.; medulla in part between the bryophyte leaves, filled with minute crystals. Apothecia strongly emergent, subcylindrical, basally slightly constricted, plentiful, single, uncarbonized, without columella, round, c. 0.4 mm diam., on top rather flat and often radiately grooved; pore c. 0.1 mm wide, slightly impressed; excipulum pale brown, c. 25 µm thick both laterally and below the hymenium, with c. 8 µm long periphyses, laterally not separating from the thalline margin; hymenium 160-170 µm high, clear; paraphyses not thickened at apex, not exserted above the hymenial gelatin; spores grey, muriform, c. 11 x 2-septate, 4-8 per ascus, I-negative, 30-60 x 12-14 µm.

The new species resembles *T. lepadinum* (Ach.) Ach. by its apothecium anatomy, but is rather different by its spores, chemistry and apothecium shape. It is perhaps closest to *T. monosporum* Nyl., which differs by larger spores, thallus anatomy, apothecium shape and chemistry (cf. Hale 1981: 260). In muscicolous apothecia the margin contains remains of bryophyte leaves, showing that the apothecia develop immersed in the substrate, as usual in the family.

Distribution and ecology: Known from two collections on the humid sandstone tableland of Cerro Guaiquinima, Guyana highlands, Venezuela, where it was found on soft, moss-covered rotten logs in low forest in a sheltered valley at

1100-1200 m alt.

Additional material: Camp 2: 26904.

In addition, 34 unidentified specimens of *Myriotrema*, 22 of *Ocellularia* and 38 of *Thelotrema*.

GYALECTALES

Gyalectaceae

Coenogonium leprieurii (Mont.) Nyl. - Epiphyte in c. 15 m tall forest, c. 320 m. Camp 7: 26432.

Coenogonium linkii Ehrenb. - Epiphyte in c. 15 m tall forest, c. 320 m. Camp 7: 26447.

Dimerella epiphylla (Müll. Arg.) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27304.

Dimerella hypophylla Vezda - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27302.

In addition, 4 unidentified specimens of *Coenogonium* and *Dimerella*.

LECANORALES

Acarosporaceae

Biatorella conspersa (Fée) Vainio - Epiphyte in stunted mossy forest on rocky slope, c. 1000 m. Camp 4: 26591.

Biatorella wrightii (Tuck.) A. Zahlbr. - Epiphyte in stunted mossy forest on rocky slope, c. 950 m. Camp 4: 26641, 26647.

Bacidiaceae

Bacidia brasiliensis (Müll. Arg.) Vainio - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27303.

Bacidia psychotriae (Müll. Arg.) A. Zahlbr. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27286.

Bacidina apiahica (Müll. Arg.) Vezda - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27284.

Biatora pyrrhomelaena Tuck. - Trunk epiphyte in c. 15 m tall forest, rarely in stunted forest, c. 320-1500 m. Camp 2: 26880; camp 5: 27178; camp 7: 26351, 26431.

Crocynia gossypina (Sw.) Mass. - Trunk epiphyte in c. 15 tall forest, c. 320 m. Camp 7: 26469, 26481.

Crocynia pyxinoides Nyl. - Epiphyte, mostly on canopy branches, in c. 15 tall forest and in stunted forest, c. 320-1000 m. Camp 3: 26966; camp 4: 26562; camp 7: 26387, 26400 (c. apoth.).

Eschatogonia prolifera (Mont.) R. Sant. - Trunk epiphyte in c. 15 m tall forest, c. 350 m. Camp 7: 26337.

"*Lecidea*" *leucophyllina* Nyl. - Epiphyte on branches in stunted forest, c. 950-1100 m. Camp 2: 26888; camp 4: 26613.

Phyllopsora buettneri (Müll. Arg.) A. Zahlbr. var. *glauca* (Bouly de Lesd.) Brako - Epiphyte in more or less mossy forest, c. 350-1100 m. Camp 2: 26894, 26907; camp 4: 26642, 26662; camp 7: 26365.

Phyllopsora corallina (Eschw.) Müll. Arg. - Epiphyte in stunted forest on tableland, 800-1000 m. Camp 3: 26967; camp 4: 26636, 26699.

Phyllopsora parvifolia (Pers.) Müll. Arg. var. *breviuscula* (Nyl.) Brako - Epiphyte in scrub on tableland, c. 1000 m. Camp 4: 26694.

Physcidia squamulosa Tuck. - Epiphyte in scrub and stunted forest, c. 800-1000 m. Camp 3: 26963; camp 4: 26561, 26592, 26672.

Physcidia wrightii Tuck. - Epiphyte in understorey of tall forest and in stunted forest, c. 320-1250 m. Camp 2: 26797, 26876; camp 4: 26664; camp 7: 26402, 26410.

Tephromela atra (Huds.) Haf. - Epiphyte in low forest and scrub, c. 950-1500 m. Camp 2: 26816, 26930; camp 4: 26632; camp 5: 27241.

Cladoniaceae

Cladia aggregata (Sw.) Nyl. - On soil in rocky slope with exposed rock flats and scrub, c. 800 m. Camp 3: 27070.

Cladina argentea Ahti - Terrestrial on shallow soil on sandstone rock flats in clearings, or in low scrub on blanket bog, c. 1000-1500 m. Camp 2: 26712; camp 4: 26509; camp 5: 27125, 27125a. TLC: atranorin, fumarprotocetraric acid (nr. 26509, 27125a).

Cladina confusa (Sant.) Follm. & Ahti - Terrestrial on shallow soil on sandstone rock flats in clearings, or in low scrub on blanket bog, c. 800-1500 m. Camp 2: 26719; camp 3: 27000, 27063; camp 4: 26492, 26515; camp

5: 27140. TLC: usnic, perlatolic acids; nrs. 26492, 26515 lack usnic acid.

Cladina dendroides (des Abb.) Ahti - Terrestrial on shallow soil on sandstone rock flats in clearings or in low scrub on blanket bog, c. 800-1500 m. Camp 2: 26721; camp 3: 26991; camp 4: 26502, 26510, 26573; camp 5: 27123, 27138. TLC: atranorin, fumarprotocetraric acids; nr. 26510 appeared to have a trace of usnic acid.

Cladina densissima Ahti - Terrestrial in low scrub on blanket bog, or on shallow sandy soil on rock flats in clearings in scrub, c. 1200-1500 m. Camp 2: 26718; camp 5: 27116, 27128, 27131. TLC: usnic, fumarprotocetraric acids

Cladina sprucei (Ahti) Ahti - Terrestrial on shallow soil on sandstone rock flats in clearings, or in low scrub on blanket bog, c. 650-1500 m. Camp 2: 26712a; camp 3: 26992; camp 4: 26491, 26517a, 26584, 26671; camp 5: 27126, 27139; camp 8: 27257, 27268. TLC: atranorin, fumarprotocetraric acid (nr. 26584, 26671)

Cladonia carassensis Vainio - Terrestrial in blanket bog with low scrub and rock outcrops, c. 1500 m. Camp 5: 27101. TLC: thamnolic acid

Cladonia ceratophylla (Sw.) Spreng. - Terrestrial in mossy forest in narrow valley, c. 1100 m. Camp 2: 26919.

Cladonia corallifera (Kunze) Nyl. - On thin, usually humous soil on sandstone plates in clearings, sometimes in low scrub on blanket bog, c. 650-1500 m. Camp 2: 26707; camp 4: 26489a, 26552; camp 5: 27133a; camp 8: 27259.

Cladonia crispatula (Nyl.) Ahti - On thin soil on sandstone plates in clearings, c. 650-1250 m. Camp 2: 26769; camp 8: 27268a.

Cladonia didyma (Fée) Vainio - Terrestrial on thin soil on sandstone flats in clearings, or in low scrub on blanket bog, c. 1000-1500 m. Camp 4: 26489; camp 5: 27106, 27132.

Cladonia furfuracea Vainio - Terrestrial on litter on sandstone rock plate on clearing, c. 800 m. Camp 3: 27079.

Cladonia guianensis Stenr. - Terrestrial on litter on sandstone plates in clearings or in bog, c. 800-1500 m. Camp 2: 26758; camp 3: 27053; camp 4: 26503, 26700; camp 5: 27100, 27114, 27133, 27247.

Cladonia peltastica (Nyl.) Müll. Arg. - On thin soil layers on sandstone plates in clearings, or on blanket bog, c. 650-1500 m. Camp 2: 26732; camp 3: 26993, 26999, 27001, 27002, 27003, 27066; camp 4: 26488, 26490, 26536, 26680; camp 5: 27096, 27127; camp 8: 27255, 27262, 27263, 27267. TLC (8 strains found): (1)thamnolic acid, unknown spot resembling merochlorophaeic acid (26732, 26999, 26488, 26536, 26680, 27096); (2) thamnolic acid only (26490, 27127); (3) thamnolic, homosekikaic acids (27066, 27267); (4) usnic, homosekikaic, thamnolic acids (26993, 27003); (5) usnic, squamatic, ?barbatic acids (27001); (6) usnic, squamatic acids (27002, 27255, 27263); (7) usnic, fumarprotocetraric acids (27262). The chemical variation does not seem to be correlated with morphology or ecology.

Cladonia pityrophylla Nyl. - On thin soil on sandstone plates in clearings, c. 650-800 m. Camp 3: 27080; camp 8: 27268c. TLC: fumarprotocetraric acid

Cladonia pulviniformis Ahti - Terrestrial on thin, sandy soil on sandstone plates in clearings or in low scrub on blanket bog, c. 800-1500 m. Camp 2: 26717, 26737; camp 3: 26995; camp 4: 26495, 26519; camp 5: 27124, 27142.

Cladonia secundana Nyl. - Terrestrial on thin, usually humous, soil on sandstone plates in clearings, also found in low scrub in bog and on decaying tree trunk in forest, c. 320-1500 m. Camp 2: 26706, 26780; camp 3: 26990; camp 5: 27107, 27217; camp 7: 26421; camp 8: 27260.

Cladonia signata Vainio - Terrestrial on thin, sandy soil on sandstone plates in clearings or in low scrub on blanket bog, c. 800-1500 m. Camp 3: 26994, 27068; camp 4: 26506; camp 5: 27117. TLC: homosekikaic, fumarprotocetraric acids; nr. 26994 without homosekikaic acid.

Cladonia sphacelata Vainio - Terrestrial in stunted forest on rocky places, c. 650-1500 m. Camp 2: 26890; camp 3: 27065; camp 4: 26487; camp 5: 27102; camp 8: 27256.

Cladonia spinea Ahti - Terrestrial on thin soil on sandstone plates in clearings, c. 650-1000

m. Camp 3: 26998, 26999a, 27062; camp 4: 26517, 26521; camp 8: 27261. TLC (3 strains): (1) usnic, squamatic acids (26998, 26999a, 26517, 27261); (2) usnic, barbatic acids (26521); (3) usnic, thamnolic acids (27062).

Cladonia steyermarkii Ahti - On thin soil cover on sandstone plates in clearings. Camp 2: 26722, 26735, 26806. Camp 4: 26511, 26512, 26518, 26580. TLC (3 strains): (1) usnic, squamatic acids (26722); (2) usnic acid (26511, 26512, 26518, 26580, 26735); (3) usnic, thamnolic acids (26806). Four specimens of strain 2 (26511, 26512, 26518, 26580) gave an unidentified weak additional spot.

Cladonia subradiata (Vainio) Scriba - Terrestrial on litter on sandstone plate in half-shade , c. 800 m. Camp 3: 27081.

Cladonia sufflata Ahti - Terrestrial in low scrub on bog, c. 1000-1500 m. Camp 4: 26516; camp 5: 27120, 27121, 27136, 27141. TLC: usnic, thamnolic acids; nr. 27120 and 27136 without usnic acid.

Cladonia vareschii Ahti - Terrestrial on thin soil on sandstone plates in clearings, or in low scrub on blanket bog, c. 800-1500 m. Camp 2: 26714, 26716, 26773a; camp 3: 27061; camp 4: 26516a, 26582; camp 5: 27108, 27110, 27112, 27129, 27135, 27137. TLC (2 strains): (1) usnic, trace of barbatic, thamnolic acids (26714, 26516a, 27129, 27135); (2) usnic, thamnolic acids (26716, 26773a, 27061, 26582, 27108, 27110, 27112, 27137). Specimen 27129 has a larger amount of barbatic acid; specimen 27061 shows a trace of thamnolic acid only.

Cladonia variegata Ahti - Terrestrial on thin soil on sandstone plates in clearings or in low scrub on bog, c. 650-1500 m. Camp 2: 26726; camp 4: 26496, 26520, 26522a, 26691; camp 5: 27118, 27130, 27134; camp 8: 27268b.

In addition, 10 unidentified specimens belonging to a *Cladia* species under study by Ahti (pers. comm.), 5 of *Cladina* and 12 of *Cladonia*.

Coccocarpiaceae

Coccocarpia domingensis Vainio - Epiphyte on twigs or branches in stunted, often mossy forest, c. 800-1500 m. Camp 2: 26842; camp 3: 27078a; camp 4: 26590, 26667; camp 5: 27163, 27244.

Coccocarpia erythrocardia (Müll. Arg.) Arvids. - Epiphyte on branches in stunted forest, c. 950-1250 m. Camp 2: 26804; camp 4: 26629a, 26646, 26648.

Coccocarpia erythroxyli (Spreng.) Swinsc. & Krog - Epiphyte on branches in forest canopy or in stunted forest, c. 320-800 m. Camp 3: 26941; camp 7: 26295.

Coccocarpia imbricascens Nyl. - Epiphyte on branches in stunted, usually mossy, forest, c. 800-1100 m. Camp 2: 26861; camp 3: 26949, 27004; camp 4: 26599, 26665.

Coccocarpia palmicola (Spreng.) Arvids. & Gallow. - Epiphyte on canopy branches in forest or in stunted, often mossy, forest, c. 320-1500 m. Camp 3: 26979, 27014; camp 5: 27164; camp 7: 26291, 26327; camp 8: 27269.

Coccocarpia pellita (Ach.) Müll. Arg. - Epiphyte on branches in stunted forest, c. 1000-1500 m. Camp 4: 26698; camp 5: 27191.

In addition, 14 unidentified specimens of *Coccocarpia*.

Collemataceae

Leptogium burgessii (L.) Mont. - Epiphyte on branches in stunted, mossy forest, c. 950 m. Camp 4: 26589.

Lecanoraceae

Pyrrhospora russula (Ach.) Hafellner - Epiphytic or epilithic in scrub, c. 800-1250 m. Camp 2: 26703, 26810, 26742; camp 3: 27073. TLC: fumarprotocetraric acid and lichexanthone, (26810, 26703). Basionym: *Lecidea russula* Ach., Methodus Lichenum, p. 61, Stockholm 1803. The inclusion of this species in *Pyrrhospora* is a logical consequence of the extension of the genus by Rambold (1989) to include *P. sanguinolenta* (Kremp.) Rambold & Haf. Saxicolous (nr. 26703 tested) and corticolous (nr. 26810 tested) plants appear to agree in chemistry, indicating that they belong to a single species.

"Lecideaceae" (in the old sense; new position

to be determined)

"*Lecidea*" *granifera* (Ach.) Vainio - Epiphyte in understorey of c. 15 m tall forest, c. 320-350 m. Camp 7: 26340, 26346, 26406, 27250.

Lobariaceae

Sticta fuliginosa (Dicks.) Ach. - Epiphyte in low, mossy forest on rocky slope, c. 950 m. Camp 4: 26612.

Sticta weigelii (Isert) Ach. - Epiphyte in low or stunted, more or less mossy forest, c. 800-1100 m. Camp 2: 26917; camp 3: 27041; camp 4: 26615.

In addition, 5 unidentified specimens, belonging to the genera *Dendriscocaulon*, *Lobaria* and *Sticta*.

Megalosporaceae

Megalospora tuberculosa (Fée) Sipman - Epiphyte of canopy branches in c. 15 m tall forest, and of stunted forest, c. 320-1500 m. Camp 2: 26771, 26771a; Camp 3: 26944, 27008 (with apothecium primordia only); camp 4: 26549, 26555, 26616; camp 5: 27234; camp 7: 26297. Specimens 26771 and 26771a deviate by the presence of isidia. Since they differ in no other way and grow under similar conditions as non-isidiate specimens, the presence of isidia does not seem to indicate a different species in this case. Isidia were not known before from this species, but have been encountered in e.g. *M. sulphurata* Meyen as inconstant feature (Sipman 1983).

Pannariaceae

Erioderma sorediatum Gallow. & Jörg. - On branchlets in canopy of stunted mossy forest, c. 1500 m. Camp 5: 27173.

Erioderma verruculosum Vainio - Epiphyte in shrub on exposed ridge and on twigs at margin of stunted mossy forest, c. 1250-1500 m. Camp 2: 26798; camp 5: 27237a.

Erioderma wrightii Tuck. - Epiphyte in scrub on exposed ridge, c. 1250 m. Camp 2: 26796.

In addition, 2 specimens belonging in the genus *Leioderma*, but too scrappy for identification.

Parmeliaceae

Bulbothrix apophysata (Hale & Kurok.) Hale - On scattered shrubs on sandstone plateau and on twigs at margin of mossy forest, c. 800-1500 m. Camp 3: 27036a; camp 4: 26563; camp 5: 27245g. TLC: atranorin, lobaric acid.

Bulbothrix atrichella (Nyl.) Hale - In stunted, interrupted forest on rocky slope, c. 800 m. Camp 3: 27035. TLC: atranorin, gyrophoric acid.

Bulbothrix laevigatula (Nyl.) Hale - In forest along streamlet, c. 1500 m. Camp 5: 27162. TLC: atranorin, lecanoric acid.

Canoparmelia cinerascens (Lynge) Elix & Hale - On scattered shrubs on dry sandstone plateau, c. 650 m. Camp 8: 27255a. TLC: atranorin, norstictic, connorstictic acids.

Canoparmelia cryptochlorophaea (Hale) Elix & Hale - Sandstone plateau with *Stegolepis* bog and scattered shrubs, c. 1000 m. Camp 4: 26690. TLC: atranorin, cryptochlorophaeic acid, unkn.

Hypotrachyna adaffinis Sipman, *sp. nov.*
Fig. 9.

Type: Venezuela, Estado Bolivar, Cerro Guaiquinima, surroundings of camp 2, near NE edge of upper plateau, coord. c. 5°54' N, 63°27' W, alt. c. 1250 m, rocky area with scrub on exposed ridge, 8 February 1990, H. Sipman 26792b (VEN holotype, B)

Diagnosis: Thallus foliaceus, corticola, adnatus, c. 2-3 cm latus, pallide flavocinereus, laciniatus; laciniae sublineares, dichotomoramosae, c. 0.4-0.6 mm latae, internodiis c. 0.4-0.8 mm longae, latere superiori planae vel leviter convexae, emaculatae, soraliis capitatis superficialibus vel in apicibus lobulis abbreviatis, latere inferiori rhizinis vulgo singulariter furcatae; substantias chimicas lichexanthonum et acidum echinocarpicum continens.

Thallus closely adnate on bark, c. 2-3 cm wide, pale yellowish grey; lobes sublinear, dichotomously branched, c. 0.4-0.6 mm wide, with c. 0.4-0.8 mm long internodes; upper surface plane or slightly convex, emaculate, continuous, in older parts slightly rugulose and cracked, sorediate; soralia capitate and much swollen, to 2

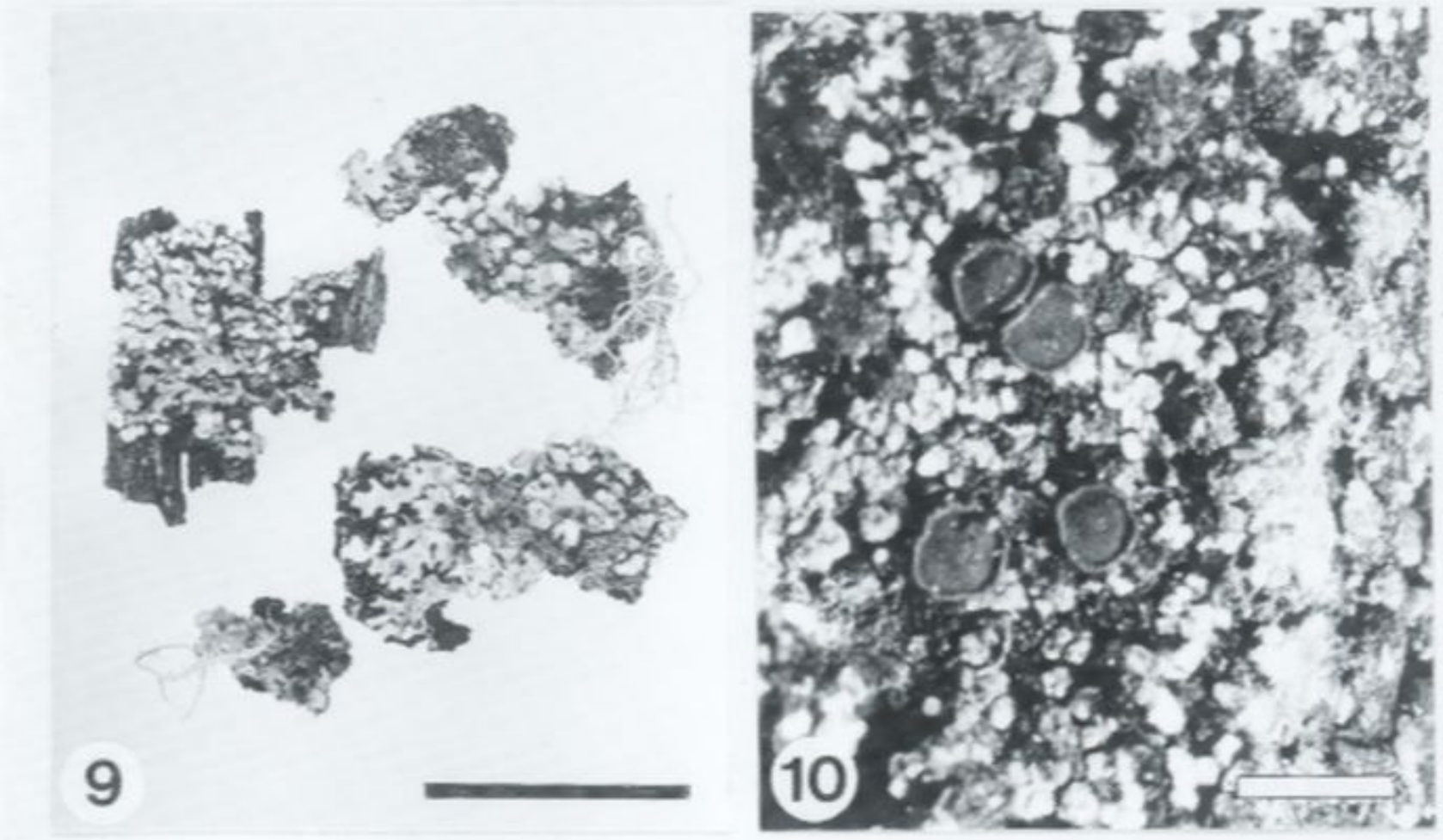

Fig. 9-10. New lichen taxa. 9. *Hypotrachyna adaffinis*, habitus of type. 10. *Buellia bellardii*, habitus of type. Scale = 1 mm.

mm wide, superficial and subterminal on short branchlets, with farinose soredia; lower side moderately rhizinate, the rhizines mostly only once branched, often projecting along the margins. Apothecia evidently uncommon, not investigated. TLC: lichexanthone (in the cortex) and echinocarpic acid.

The species shows a close similarity with *H. subaffinis* (Zahlbr.) Hale by its small size, its capitate soralia, and the presence of echinocarpic acid (Hale 1975). The principal, conspicuous difference is in the cortical substance, lichexanthone in *H. adaffinis*, usnic acid in *H. subaffinis*. Very similar plants have been found in the Dominican Republic, which differ by the presence of barbatic acid or other, not identified substances instead of echinocarpic acid.

Distribution and ecology: Known so far from single specimens from the Guayana Highland in Venezuela and from the Dominican Republic. It was found on bark in light forest at c. 1100-1250 m alt.

Additional material: DOMINICAN REPUBLIC, Prov. Independencia, Sierra de Boaruco, c. 9.5 km S of Puerto Esconcito, 1085 m, 24 January 1987, R. C. Harris 20389 (NY).

Hypotrachyna consimilis (Vainio) Hale - Scrub on exposed ridge, c. 1250 m. Camp 2: 26790b. TLC: atranorin, protocetraric acid.

Hypotrachyna costaricensis (Nyl.) Hale - Epiphyte on branches of isolated shrubs on sandstone plateau or in stunted forest along stream. Camp 4: 26689; camp 5: 27183. TLC: atranorin, protolichesterinic? acid

Hypotrachyna dactylifera (Vainio) Hale - Epiphyte in stunted forest, c. 950-1250 m. Camp 2: 26792a; camp 4: 26594. TLC: atranorin, several unidentified spots.

Hypotrachyna degelii (Hale) Hale - Epiphyte in stunted forest in clefts between sandstone rocks, c. 800 m. Camp 3: 26984, 27050. TLC: atranorin, alectoronic, a-collatolic acid.

Hypotrachyna flavida (Zahlbr.) Hale - On sandstone outcrops among scrub, c. 1250 m. Camp 2: 26770, 26789.

Hypotrachyna imbricatula (Zahlbr.) Hale - Epiphyte on canopy branches in 15 m tall forest and in stunted forest and scrub, c. 320-1500 m. Camp 2: 26713, 26790; camp 3: 27077; camp 4: 26576; camp 5: 27245h; camp 7: 26290.

Hypotrachyna microblasta (Vainio) Hale - Epiphyte on branches of stunted forest and scrub, c. 800-1500 m. Camp 2: 26791, 26805; camp 3: 27039; camp 4: 26609, 26643; camp 5: 27184, 27190. TLC: usnic, norstictic, galbinic, salazinic acids.

Hypotrachyna osseoalba (Vainio) Park & Hale - Epiphyte in scrub on sandstone plateaus, in mossy forest on branchlets at the margin, c. 1000-1500 m. Camp 4: 26542, 26566; camp 5: 27245j. TLC (nr. 26542, 26566): lichexanthone, several unidentified spots, probably including lividic and lobaric acids.

Hypotrachyna pseudosinuosa (Asah.) Hale - Epiphyte on branches of stunted forest, in mossy forest on twigs, c. 1250-1500 m. Camp 2: 26792; camp 5: 27245.

Parmelinopsis horrescens (Tayl.) Elix & Hale - Epiphyte in stunted forest, c. 800-1500 m. Camp 2: 26790a; camp 3: 27051; camp 5: 27169.

Parmotrema aurantiacoparvum Sipman - Epiphyte in stunted, mossy forest on rocky slope, c. 950 m. Camp 4: 26651a.

Parmotrema conformatum (Vainio) Hale - Epiphyte in stunted forest, c. 1250-1500 m. Camp 2: 26754; camp 5: 27189, 27223.

Parmotrema cristiferum (Tayl.) Hale - Epiphyte in canopy of c. 15 m tall forest and in stunted forest, sometimes epilithic on sandstone outcrop, c. 320-1000 m. Camp 3: 27019, 27026; camp 4: 26583; camp 7: 26294.

Parmotrema dilatatum (Vainio) Hale - Epiphyte in scrub, sometimes on soil at tree base or on mossy rock, c. 650-1250 m. Camp 2: 26807; camp 3: 26977, 26985; camp 4: 26604; camp 8: 27266.

Parmotrema guyanum Hale - Epiphyte in scrub, c. 1000 m. Camp 4: 26554.

Parmotrema madagascariaceum (Hue) Hale - Epiphyte in scrub on exposed ridge, c. 1250 m. Camp 2: 26761.

Parmotrema mellisii (Dodge) Hale - Epiphyte in stunted forest, c. 1000-1500 m. Camp 2: 26781, 26785; camp 4: 26572; camp 5: 27174.

Parmotrema peralbidum (Hale) Hale - In stunted forest along streamlet, c. 1500 m. Camp 5: 27165.

Parmotrema sulphuratum (Nees) Hale - Epiphyte in low, mossy forest on rocky slope, c. 950 m. Camp 4: 26611.

Parmotrema verrucisetosum Sipman - Epiphyte in low, mossy forest on rocky slope, c. 950 m. Camp 4: 26595.

Pseudoparmelia sphaerospora (Nyl.) Hale - Epiphyte in stunted forest, c. 600-1500 m. Camp 2: 26753, 26786, 26851; camp 5: 27230; camp 8: 27271.

Relicina abstrusa (Vainio) Hale - Epiphyte in low forest and scrub, c. 800-1200 m. Camp 2: 26723; camp 3: 27034a; camp 4: 26632a, 26640.

Usnea aspera (Eschw.) Vainio - On exposed sandstone rock outcrop in open spot in rock savannah, c. 1200 m. Camp 2: 26710, 26765. TLC: usnic, norstictic, with or without protocetraric acids.

Usnea baileyi (Stirt.) A. Zahlbr. - Epiphyte on isolated shrubs on sandstone plateaus, c. 650-1500 m. Camp 2: 26760, 26768c; camp 5: 27109b; camp 8: 27258c.

Xanthoparmelia neopropaguloides Hale - On quartzite outcrop in scrub, c. 1000 m. Camp 4: 26498.

In addition, 27 unidentified specimens, half of which belong to the genus *Usnea*.

Physciaceae

Buellia aptrootii Sipman - On rock outcrop and on twigs in scrub on sandstone plateau, c. 1200 m. Camp 2: 26734, 26936.

Buellia bellardii Sipman, *sp. nov.*
Fig. 10.

Type: Venezuela, Estado Bolivar, Cerro Guaiquinima, near West end of upper plateau (near camp 5), coord. c. 5°48' N, 63°40' W, alt. c. 1500 m, blanket bog with *Stegolepis* on gentle slopes, with scattered rock outcrops and mossy dwarf forest, on twigs at forest margin, 15 February 1990, H. Sipman 27243 (VEN holotype, B).

Diagnosis: Thallus corticola, c. 1-2 cm diametro, pallide cinereus, areolatus, hypothallo nigro, areolis dispersis vel centralibus contiguis, 0.2-0.5 mm latis, c. 80 µm crassis, rotundis vel maioribus crenulatis, superficie leviter convexis vel undulatis, nitidis, acidum lobaricum continentia, hinc inde agglomerationibus substantiae rubrae (an acidum chiodectonicum?) in medulla. Apothecia sessilia, basi constricta, c. 0.3-0.6(-0.9) mm diametro, disco nigro, opaco, vulgo plano vel concavo, margine tenui, nigro, prominente, flexuoso; raro apotheciis paulo albopruinosis; epithecium fuscum; hymenium 40-70 µm crassum vulgo hyalinum; hypothecium excipulumque atrofuscum, nonnumquam substantia rubra in parte medullare excipuli; sporae fuscae, octonae, uniseptatae, 10-11 x 5 µm.

Thallus epiphytic, c. 1-2 cm diam., pale grey, areolate, with black hypothallus; areoles c. 0.2-0.5 mm wide, round, the larger ones crenulate, sessile to almost peltate, in the centre of the thallus more or less contiguous to coalescing, near the margin more dispersed, with smooth, slightly glossy, slightly convex or undulate upper surface, c. 80 µm thick; medulla to c. 30 µm thick, whitish, or thicker and bright red through masses of a K+ purplish pigment (anthraquinone?). Chemistry: lobaric acid (TLC), anthraquinone? Apothecia sessile, with strongly constricted base, c. 0.3-0.6(-0.9) mm diam., with black, sometimes slightly white-pruinose, dull, mostly flat or slightly concave disc, and rather thin, prominent, black, glossy, sometimes slightly white-pruinose, often flexuous margin; epithecium brown; hymenium 40-70 µm thick, clear, sometimes inspersed; hypothecium and excipulum dark brown, sometimes with large masses of red substance in the medullary exciple; these masses K+ purplish, dissolving in thin KOH-solution, probably the same anthraquinone as in the thallus. Ascospores dark brown, ellipsoid, rather wide at the poles, uniseptate, thinwalled, 8/ascus, 10-11 x 5 µm. Pycnidia not observed.

This species is conspicuous by its well-delimited, almost peltate areoles and the presence of a red pigment in parts of the thallus and sometimes also in the apothecial margin. The pigment has the same colour as that in *B. aptrootii* Sipman and *B. coccinea* (Fée) Aptroot, which is supposed to be chiodectonic acid (Aptroot 1988: 11). The former species differs in its thallus shape and the presence of a xanthone in the medulla instead of lobaric acid. The second differs by its granular thallus and the absence of lobaric acid.

It is unclear what defines the spots where the red pigment is accumulated in the medulla. Sometimes such spots are recognizable as swellings. The fact that the red pigment is sometimes found in the excipulum, suggests that the accumulation spots in the medulla may be apothecium initials.

The Colombian specimen is somewhat deviant because of its slightly pruinose apothecia and inspersed hymenium. The Venezuelan samples lack these characters.

The name is given in honour of Dr. Eugenio de Bellard-Pietri, organizer of the expedition to Cerro Guaiquinima, during which the species was detected. His efforts to make the expedition successful are gratefully acknowledged.

Distribution and ecology: Known so far from sandstone tableland in the Amazon basin in Colombia and in the Venezuelan part of the Guayana Highland. It has been found on twigs and branches of isolated trees on strongly leached sandstone tableland at 350-1500 m.

Additional material: camp 2: 26815, 26823. COLOMBIA, Comisaría Amazonas, Araracuara, tableland on S-side of river Caquetá W of Puerto Santander, opposite airstrip of Araracuara, alt. 350 m, 30 October 1988, H. Sipman & J. Duivenvoorden 27855 (ARA, B).

Buellia coccinea (Fée) Aptroot - On scattered shrubs in open, more or less boggy vegetation on sandstone plateau, c. 1000-1200 m. Camp 2: 26935; camp 4: 26541, 26570.

Buellia epimarta Malme - In stunted forest in clefts in rocky slope, c. 800 m. Camp 3: 27073a.

Heterodermia casarettiana (Mass.) Trev. - Scrub on sandstone plateau, c. 800-15000 m. Camp 2: 26729; camp 3: 27036b; camp 4: 26682; camp 5: 27211.

Heterodermia flabellata (Fée) Awas. - Epiphyte in scrub and stunted mossy forest on sandstone plateau, c. 650-950 m. Camp 3: 27071; camp 4: 26603, 26610; camp 8: 27255b, 27264.

Heterodermia galactophylla (Tuck.) Trev. - Epiphyte on branches in stunted forest and on twigs at margin of stunted mossy forest, c. 800-1500 m. Camp 3: 27023a; camp 5: 27245f.

Heterodermia hypoleuca (Ach.) Trev. - Epiphyte in stunted mossy forest, c. 950 m. Camp 4: 26586.

Heterodermia obscurata (Nyl.) Trev. - Stunted forest in clefts among sandstone rocks, c. 800 m. Camp 3: 27036.

Heterodermia speciosa (Wulf.) Trev. - Stunted forest on sandstone flats or in clefts, c. 800-1250 m. Camp 2: 26795; camp 3: 27023, 27076a. TLC: atranorin, zeorin.

Heterodermia squamulosa (Degel.) Culb. - Scrub and mossy stunted forest on rocky soil, c. 1000-1100 m. Camp 2: 26905; camp 4: 26692.

Pyxine obscurascens Malme - On sandstone outcrops in open spots, 600- 1250 m. Camp 2: 26762; camp 8: 27254a. TLC: atranorin, terpenoid.

Pilocarpaceae

Badimia dimidiata (Bab.) Vezda - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27288.

Byssoloma aeruginascens Vezda - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27289.

Byssoloma amazonicum Kalb & Vezda - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27292.

Byssoloma leucoblepharum (Nyl.) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27290.

Byssoloma subdiscordans (Nyl.) P. James - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27291.

Fellhanera rhapidophylli (Rehm) Vezda - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27306.

Placynthiaceae

Polychidium dendriscum (Nyl.) Henssen - Twig epiphyte at margin of mossy forest, c. 1500 m. Camp 5: 27245i.

Ramalinaceae

Ramalina bistorta Nyl. - On twigs in scrub on top of exposed ridge, c. 1250 m. Camp 2: 26788.

Ramalina camptospora Nyl. - On twigs in scrub on exposed ridge and at margin of mossy forest, c. 1250-1500 m. Camp 2: 26767; camp 5: 27246c.

In addition, 56 unidentified specimens of Lecanorales, most of them falling within the old concepts of the families Lecanoraceae and Lecideaceae.

MELANOMMATALES

Aspidotheliaceae

Aspidothelium fugiens (Müll. Arg.) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27281.

Pyrenulaceae

Pyrenula anomala (Ach.) Vainio - Epiphyte in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 26388, 26430.

Pyrenula marginata Hook. in Kunth - Epiphyte in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 26394.

Pyrgillus americanus Nyl. - Epiphyte in forest and scrub, c. 600-1250 m. Camp 2: 26744, 26850; camp 8: 27269b.

In addition, 12 unidentified specimens of *Pyrenula*.

Trypetheliaceae

Astrothelium cinnamomeum (Eschw.) Müll. Arg. - In scattered scrub on sandstone plateau and in stunted, mossy forest on rocky slope, c. 950-1000 m. Camp 4: 26539, 26548, 26633a, 26658.

Astrothelium gigasporum Harris - Trunk epiphyte in c. 15 m tall forest, c. 320-350 m. Camp 7: 26338, 26438, 26442.

Astrothelium ochrothelium (Nyl.) Müll. Arg. - On scattered shrubs in *Stegolepis* bog on sandstone plateau, c. 1000 m. Camp 4: 26522, 26526, 26535.

Astrothelium scorioides Nyl. - In stunted, interrupted forest on rocky slope, c. c. 800 m. Camp 3: 26986, 27005, 27007, 27011, 27016.

Astrothelium subfuscum Kremp. - In stunted, mossy, more or less interrupted forest on rocky slope, c. 800-950 m. Camp 3: 26950, 26952, 26972.

Astrothelium versicolor Müll. Arg. - In stunted, mossy, more or less interrupted forest on rocky slope, c. 800-950 m. Camp 3: 26947; camp 4: 26656.

Laurera subdisjuncta (Müll. Arg.) Harris - Epiphyte in low forest in clefts of rocky slope, c. 800 m. Camp 3: 27006.

Trypethelium aeneum (Eschw.) A. Zahlbr. - Epiphyte in canopy of c. 15 m tall forest and in low forest and scrub, c. 320-1200 m. Camp 2: 26934; camp 3: 26983, 27076; camp 4: 26525, 26533; camp 7: 26329.

Trypethelium nitidiusculum (Nyl.) Harris - Epiphyte in canopy of c. 15 m tall forest, in understorey of low mossy forest and in scrub, c. 320-1100 m. Camp 2: 26826, 26883, 26886, 26897; camp 3: 27017, 27018, 27022, 27048; camp 4: 26523, 26650, 26659, 26686; camp 7: 26301.

Trypethelium ochroleucum (Eschw.) Nyl. - Epiphyte in low forest and scrub, c. 800-1200 m. Camp 2: 26845; camp 3: 26940, 26943, 26959, 26960, 26965, 26971, 26981, 27009, 27015; camp 4: 26529, 26553, 26629, 26657, 26673.

Trypethelium tuberculosum (Vainio) Harris - Epiphyte in low forest, c. 1200 m. Camp 2: 26841.

In addition, 26 unidentified specimens, mainly belonging in *Astrothelium*, *Polymeridium* and *Trypethelium*, and 2 representing *Pseudopyrenula*.

VERRUCARIALES

Verrucariaceae

Normandina pulchella (Borr.) Nyl. - Epiphyte in scrub on sandstone plateau, c. 1200 m. Camp 2: 26811.

ORDER UNCERTAIN

Gomphillaceae

Actinoplaca strigulacea Müll. Arg. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27277.

Aulaxina minuta R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27282.

Aulaxina opegraphina Fée - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27283a.

Aulaxina quadrangula (Stirt.) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27283.

Calenia conspersa (Stirt.) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27294, 27295.

Calenia submaculans R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27296.

Caleniopsis laevigata (Müll. Arg.) Vezda & Poelt - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27297.

Echinoplaca affinis Kalb & Vezda - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27303.

Echinoplaca heterella (Stirt.) R. Sant. - Foliicolous in undergrowth of forest, c. 320 m. Camp 7: 27305.

Gyalectidium filicinum Müll. Arg. - Foliicolous in undergrowth of forest, c. 320 m.Camp 7: 27308.

Gyalideopsis robusta Kalb & Vezda - On thin litter layer on sandstone plate in half-shade, c. 800 m. Camp 3: 27080a.

Tricharia hyalina Kalb & Vezda - Foliicolous in undergrowth of c. 15 m tall forest, c. 320 m. Camp 7: 27329.

Strigulaceae

Raciborskiella janeirensis (Müll. Arg.) R. Sant.

- Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27326.

Strigula melanobapha (Kremp.) R. Sant. - Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27328.

Strigula nemathora Mont. - Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27327.

Trichotheliaceae

Porina epiphylla (Fée) Fée - Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27321.

Porina exasperatula Vainio - Epiphyte on treetrunk in c. 15 m tall forest along river, c. 320 m. Camp 7: 26478

Porina fusca Lücking - Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27325.

Porina imitatrix Müll. Arg. - Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27322.

Porina mastoidea (Ach.) Müll. Arg. - Epiphyte on treetrunk in c. 15 m tall forest and on branchlets in undergrowth of mossy forest in narrow valley, also on sandstone boulder on bank of river, c. 320-1100 m. Camp 2: 26914; Camp 7: 26396, 26412. Nr. 26412 and 26914 are deviating by their large spores. Further investigations might reveal that they belong to different species.

Porina rubentior (Stirt.) Müll. Arg. - Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27323.

Porina rufula (Kremp.) Vainio - Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27324.

Porina tetracerae (Afz. in Ach.) Müll. Arg. - Epiphyte on shrubs, palms, trunks, in undergrowth of c. 15 m tall forest, c. 320 m. Camp 7: 26437, 26454, 26471, 27249.

Porina tetralocularis Aptroot, ined. - Trunk epiphyte in mossy forest in narrow valley, c. 1100 m. Camp 2: 26924. To be published by Aptroot & Sipman (1992, in prep.).

Trichothelium annulatum (Karst.) R. Sant. - Foliicolous in undergrowth of c. 15 m tall forest, c. 320 m. Camp 7: 27330.

In addition, 3 unidentified specimens of *Porina*.

BASIDIOMYCETES

Corticiaceae

Corella zahlbruckneri Schiffn. - On mossy, horizontal treetrunk in mossy forest along streamlet, c. 1500 m. Camp 5: 27192.

Dictyonema glabratum (Spreng.) Hawksw. - Epiphyte on branches in stunted forest, c. 950-1500 m. Camp 2: 26777; camp 4: 26627; camp 5: 27186, 27187.

Dictyonema sericeum (Sw.) Berk. - In stunted forest, c. 650-1500 m. Camp 2: 26793; camp 3: 27037; camp 4: 26587, 26626; camp 8: 27265.

INCERTAE SEDIS

Phyllophiale alba R. Sant. - Foliicolous in understorey of c. 15 m tall forest, c. 320 m. Camp 7: 27320.

Siphula carassensis Müll. Arg. - On sandstone plates along periodically dry streamlets, 1000-1500 m. Camp 2: 26704, 26730; camp 4: 26486; camp 5: 27099 (cf.), 27156. Nr. 27099 differs by its taller, more slender stature, and its organic substrate. TLC: siphulin, thamnolic acid (nr. 27156 without thamnolic acid).

Siphula decumbens Nyl. - On thinner or thicker layer of organic, decaying material on sandstone rock, long moist after rain, in open places, and on decaying bark of sheltered treetrunks, c. 800-1500 m. Camp 2: 26708, 26748; camp 3: 27078; camp 5: 27226. TLC: thamnolic acid, with or without traces of siphulin.

Bryophyta

HEPATICAE

Trichocoleaceae

Trichocolea flaccida (Spruce) Jack & Steph. - On soil in stunted, mossy forest on rocky slope, c. 950 m. Camp 4: 26608. Dupl. in U det. by S. R. Gradstein, 1991.

Lepidoziaceae

Bazzania cf. *roraimensis* (Steph.) Fulf. - In scrub on exposed sandstone ridge, c. 1250 m. Camp 2: 26766. Dupl. in U det. by S. R.

Gradstein, 1991.

Micropterygium bolivarense Fulf. - In scrub on exposed ridge and in stunted forest in rock cleft, c. 800-1250 m. Camp 2: 26745, 26746; camp 3: 27042. Dupl. in U det. by S. R. Gradstein, 1991.

Micropterygium cf. *tatei* Reimers - In stunted mossy forest along streamlet, c. 1500 m. Camp 5: 27219. Dupl. in U det. by S. R. Gradstein, 1991.

Micropterygium trachyphyllum Reimers - In mossy forest in narrow valley, c. 1100 m. Camp 2: 26893. Dupl. in NY det. by W. R. Buck, 1991.

Mytilopsis albifrons Spruce - In mossy stunted forest, c. 800-1500 m. Camp 3: 27020; camp 4: 26619; camp 5: 27092, 27207, 27228. Nr. 27092 det. by M. Menzel, 1990.

Calypogeiaceae

Calypogeia venezuelana Fulf. - In stunted mossy forest along streamlet, c. 1500 m. Camp 5: 27147, 27166. Dupl. in U det. by S. R. Gradstein, 1991.

Cephaloziaceae

Anomoclada portoricensis (Hampe & Gott.) Vana - In open scrub with boggy places on sandstone flats, c. 1000 m. Camp 4: 26557. Dupl. in U det. by S. R. Gradstein, 1991.

Jamesoniella rubricaulis (Nees) Grolle - In blanket bog with rock outcrops and along streamlet, c. 1500 m. Camp 5: 27085, 27177. Dupl. in U det. by S. R. Gradstein, 1991.

Scapaniaceae

Scapania portoricensis Hampe & Gott. - In mossy forest along stream, c. 1500 m. Camp 5: 27149.

Geocalycaceae

Leptoscyphus ovatus (Spruce) Grolle - On sandy bank of stream in stunted mossy forest, c. 1500 m. Camp 5: 27155. Dupl. in U det. by S. R. Gradstein, 1991.

Lejeuneaceae

Blepharolejeunea saccata (Steph.) v. Slag. & Kruijt - Along streamlet in stunted mossy forest, c. 1500 m. Camp 5: 27171. Dupl. in U det. by S. R. Gradstein, 1991.

Ceratolejeunea grandiloba Jack & Steph. - Along streamlet in stunted mossy forest, c. 1500 m. Camp 5: 27154, 27205. Dupl. in U det. by S. R. Gradstein, 1991.

Cheilolejeunea fragrantissima (Spruce) Schust. - In mossy forest in narrow valley and in scrub on exposed ridge, c. 1100-1250 m. Camp 2: 26763, 26913. Dupl. in U det. by S. R. Gradstein, 1991.

Pycnolejeunea cf. *macroloba* (Nees & Mont.) Steph. - Blanket bog with scattered shrubs and rock outcrops, c. 1500 m. Camp 5: 27090. Dupl. in U det. S. R. Gradstein, 1991.

Thysananthus amazonicus (Spruce) Schiffn. - In stunted, mossy forest on rocky slope, c. 950 m. Camp 4: 26654, 26678. Dupl. in U det. by S. R. Gradstein, 1991.

In addition, unidentified Hepaticae are available from the following families and genera: Herbertaceae (*Herbertus* 6); Lepidoziaceae (*Bazzania* 7, *Lepidozia* 2); Cephaloziaceae (*Cephalozia* 1, *Odontoschisma* 2); Plagiochilaceae (*Plagiochila* 10); Radulaceae (*Radula* 1); Frullaniaceae (*Frullania* 6); Lejeuneaceae (*Cheilolejeunea* (*Strepsilejeunea*) 3, *Cololejeunea* (*Pedinolejeunea*) 1, *Colura* 1, *Lejeunea* 1); Aneuraceae (*Riccardia* 3).

MUSCI

Sphagnaceae

Sphagnum oxyphyllum Warnst. - On bank of streamlet in stunted mossy forest, c. 1500 m. Camp 5: 27227. Dupl. in NY det. by H. Crum, 1991.

Sphagnum sanguinale Warnst. - Terrestrial in *Stegolepis* bog and in mossy forest along streamlet, c. 1500 m. Camp 5: 27086, 27231. Dupl. in NY det. by H. Crum, 1991.

Sphagnum sipmanii Crum, *n. sp.*

Fig. 11a-g.

Type: VENEZUELA, Estado Bolivar, Cerro Guaiquinima, c. 5°40' N, 63°34' W, alt. c. 950 m, on soil in a low, mossy forest, on a rocky slope towards a stream, H. Sipman 26618, February 5,

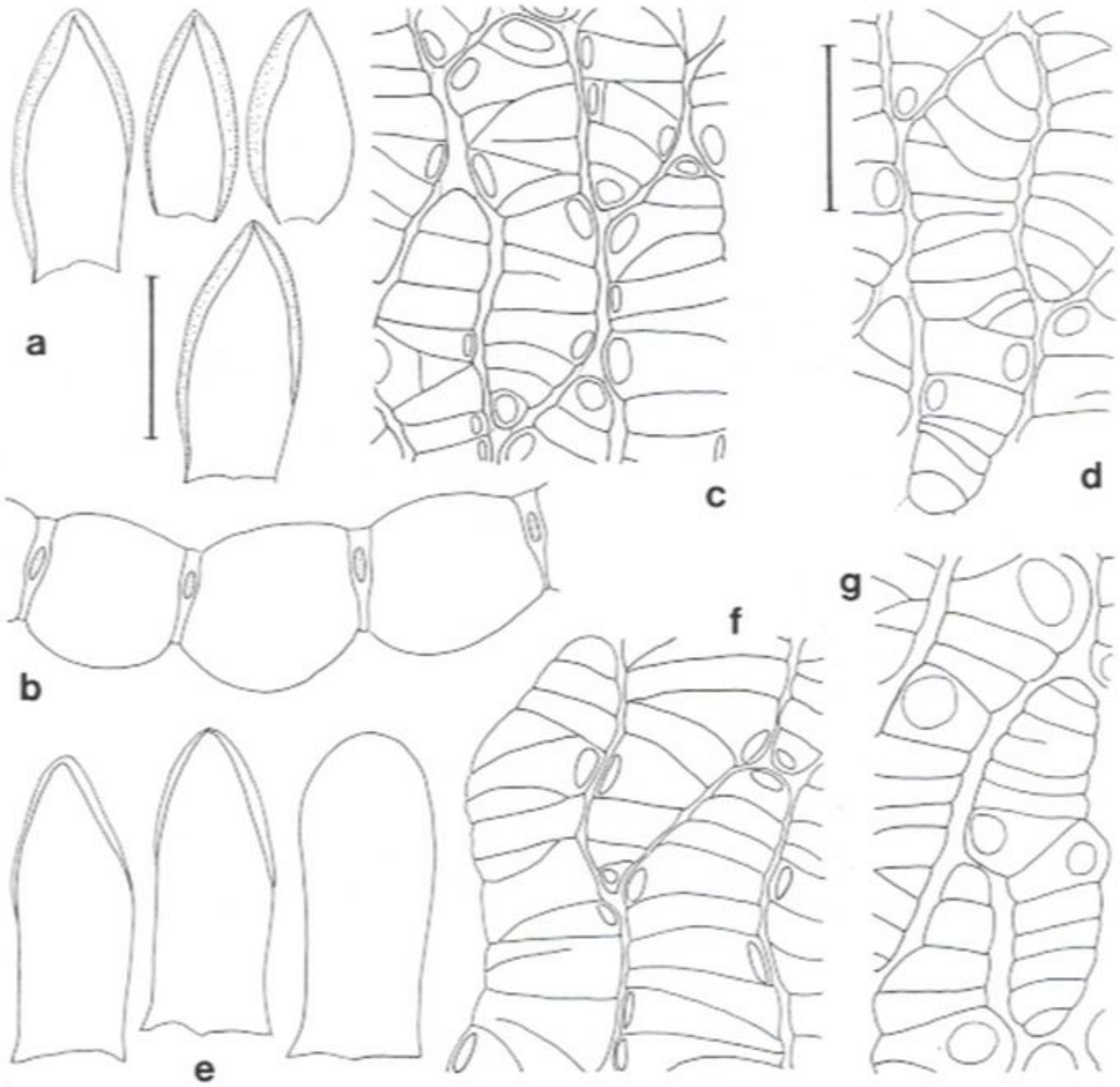

Fig. 11. *Sphagnum sipmanii*. a. Branch leaves; scale = 1 mm. b. Cross-section of branch leaf; scale as d. c. Branch leaf, outer surface; scale as d. d. Branch leaf, inner surface; scale = 50 µm. e. Stem leaves; scale as a. f. Stem leaf, outer surface; scale as d. g. Stem leaf, inner surface; scale as d.

1990 (NY holotype, B, VEN).

Diagnosis: Plantae pallide subfuscae. Epidermis caulina stratis 3, efibrillosa, parietes exteriores cellularum superficialium sine foraminibus, raro uniporosae; cylindrus lignosus obscure fuscus. Folia caulina oblonga, apice rotundata, saepe concavo-obtusa, ad apicem porosa fibrosaque; cellulae hyalinae non septatae, dorso foliorum poris ellipticis ad commissuras, saepe in angulis 2-3, superficie interiore poris rotundis magnis dispergentibus. Rami 2-fasciculati. Folia ramulina concavo-ovata, cucullata; cellulae hyalinae ad basim fibrosa, dorso foliorum poris ellipticis ad commissuras saepe poris annulatis binis ternisque in cellularum angulis coniunctis, interiore foliorum poris magnis rotundis; cellulae chlorophylliferae sectione transversali anguste fusiformes utroque latere foliorum liberae, cum pariete exteriore latiore.

Plants of moderate size, in tawny clumps. Stems brown; cortical cells 3-layered, very delicately fibrillose or, more commonly, efibrillose, without pores at the surface or occasionally uniporose; wood cylinder dark brown. Stem leaves 1.4-1.6 mm long, brown, oblong-lingulate, rounded at the apex but often concave-pointed, bordered by a resorption furrow; hyaline cells not divided, fibrillose in the upper 1/4-1/3, on the outer surface with 2-4 elliptic, ringed pores and pseudopores at corners and commissures, often in 2's and 3's at adjacent angles, near midleaf just below the fibrillose and porose zone with 2-4 large, imperforate, rounded or oblong membrane gaps, on the inner surface with 0-4 large, round, unringed pores (about as wide as the cells). Branches paired (1 spreading); cortical cells efibrillose (or less often very delicately or faintly fibrillose), uniporose at the upper ends. Branch leaves loosely erect, not noticeably 5-ranked, 1.7 mm long, concave, oblong-ovate or ovate, bordered by a resorption furrow and slightly roughened by resorption at the extreme apex; hyaline cells fibrillose throughout, on the outer surface with 1-3 elliptic, ringed pores at corners and commissures, often in groups of 2-3 at adjacent cell angles, on the inner surface with 0-3 rounded or rounded-elliptic, thin-margined pores at or near angles and commissures; hyaline cells in section somewhat convex on the inner surface, more so on the outer, and green cells narrowly lenticular, very narrowly exposed on both surfaces but more broadly so on the inner surface.

This species is more notable for a combination of characters rather than for any striking features. The stem and branch leaves both have a marginal resorption furrow and a similar porosity of hyaline cells. Perhaps the most curious feature of the stem leaves is the narrow zone of efibrillose cells with membrane gaps located next below the fibrillose, porose upper cells. The cortical cells of both stems and branches typically lack fibrils. The green cells of branch leaves are narrowly lenticular in section, with a somewhat broader exposure on the inner surface. (The sectional view of green cells is much like that of *S. perichaetiale* Hampe).

Distribution and ecology: The species is only known from its type, which was collected on the ground in stunted, mossy forest on sandstone, at 950 m elevation on Cerro Guaiquinima, Venezuela.

Sphagnum tenerum Sull. & Lesq. - On bank of streamlet in mossy forest, c. 1500 m. Camp 5: 27224. Dupl. in NY det. by H. Crum, 1991.

Dicranaceae

Bryohumbertia filifolia (Hornsch.) Frahm - In mossy forest in narrow valley, c. 1100 m. Camp 2: 26923. Dupl. in herb. Frahm det. by J.-P. Frahm, 1990.

Campylopus savannarum (C. Müll.) Mitt. - Rocky slope with stunted forest, c. 800 m. Camp 3: 26975. Dupl. in herb. Frahm det. by J.-P. Frahm, 1990.

Campylopus subcuspidatus (Hampe) Jaeg. - On boggy or sandy soil in open low scrub on sandstone tableland, c. 1000-1500 m. Camp 2: 26740; camp 4: 26556; camp 5: 27122. Dupl. in herb. Frahm det. by J.-P. Frahm, 1990.

Leucobryaceae

Leucobryum albidum (Brid.) Lindb. - On soil

along streamlet in mossy stunted forest, c. 1500 m. Camp 7: 27168. Dupl. in NY det. by W. R. Buck, 1991.

Leucobryum crispum C. Müll. - In mossy forest, c. 950-1500 m. Camp 2: 26857, 26912; camp 4: 26596; camp 5: 27144. Dupl. in NY det. by W. R. Buck, 1991.

Leucobryum martianum (Hornsch.) Hampe - On mossy rock in stunted forest in cleft between sandstone rocks, c. 800 m. Camp 3: 27029. Dupl. in NY det. by W. R. Buck, 1991.

Octoblepharum cylindricum Mont. - In stunted forest on exposed ridge, in clefts between sandstone rocks, and along streamlet, c. 800-1500 m. Camp 2: 26750; camp 3: 27047; camp 5: 27167. Dupl. in NY det. by W. R. Buck, 1991.

Calymperaceae

Syrrhopodon elongatus Sull. var. *glaziovii* (Hampe) Reese - In stunted forest on exposed ridge or in clefts between rocks, c. 800-1250 m. Camp 2: 26799; 26803; camp 3: 27034b. Dupl. in NY det. by W. R. Buck, 1991.

Syrrhopodon fimbriatus Mitt. - Epiphyte in stunted mossy forest on rocky slope, c. 950 m. Camp 4: 26622. Dupl. in NY det. by W. R. Buck, 1991.

Syrrhopodon flexifolius Mitt. - On thin, small tree, just above the soil, in stunted forest in cleft between sandstone rocks, c. 800 m. Camp 3: 27072. Dupl. in NY det. by W. R. Buck, 1991.

Syrrhopodon helicophyllus Mitt. - Epiphyte in stunted mossy forest on rocky slope, c. 950 m. Camp 4: 26606, 26653. Dupl. in NY det. by W. R. Buck, 1991.

Syrrhopodon leprieurii Mont. - In mossy stunted forest along streamlet, c. 1500 m. Camp 5: 27153. Dupl. in U det. by S. R. Gradstein, 1991.

Syrrhopodon steyermarkii Robinson - On bank of periodically dry rivulet in mossy forest in narrow valley, c. 1100 m. Camp 2: 26879. Dupl. in NY det. by W. R. Buck, 1991.

Rhizogoniaceae

Pyrrhobryum spiniforme (Hedw.) Mitt. - On bank of periodically dry rivulet in mossy forest in narrow valley, c. 1200 m. Camp 2: 26891. Dupl. in NY det. by W. R. Buck, 1991.

Orthotrichaceae

Macromitrium cf. *portoricense* Williams - In scrub in bog on sandstone tableland, c. 1000 m. Camp 4: 26693. Dupl. in NY det. by W. R. Buck, 1991.

Meteoriaceae

Squamidium leucotrichum (Tayl.) Broth. - In mossy forest in narrow valley, c. 1100 m. Camp 2: 26929. Dupl. in NY det. by W. R. Buck, 1991.

Thuidiaceae

Thuidium tomentosum Schimp. ex Besch. - On soil in mossy forest in narrow valley, c. 1100 m. Camp 2: 26898. Dupl. in NY det. by W. R. Buck, 1991.

Sematophyllaceae

Acroporium pungens (Hedw.) Broth. - In mossy forest, c. 1100-1500 m. Camp 2: 26875; camp 5: 27146. Dupl. in NY det. by W. R. Buck, 1991.

Sematophyllum subsimplex (Hedw.) Mitt. - In mossy stunted forest, c. 1500 m. Camp 5: 27148. Dupl. in NY det. by W. R. Buck, 1991.

Discussion

1. The significance of the presented list as a baseline record of a virgin area

Cerro Guaiquinima bears at present no sign at all of human influence. Such influence is the more unlikely as the area is very infertile and of difficult access. Even for a sporadic hunting party the area seems unsuitable because of the difficulty of bringing prey home. Therefore the list of species can be considered as the record of a virgin situation, which can serve as a baseline for study of future changes when the area becomes more influenced by man. However, it is probably not very representative for virgin neo-

Table 1. Comparison of the lichen flora of Cerro Guaiquinima (C.G., first column) with the N-slope of Mount Roraima and surroundings (M.R., third column, after Sipman & Aptroot 1992). Species numbers are presented for the more important orders and families. The second column gives the species numbers in common between both areas.

	C.G.		M.R.
Arthoniales	16	13	17
Caliciales	3	2	4
Thelotremataceae	35	20	34
Gyalectales	4	3	4
Lecanorales (excl. Cladoniaceae, Parmeliaceae)	52	31	77
Cladoniaceae	25	19	23
Parmeliaceae	31	16	34
Melanommatales	16	12	26
Gomphillaceae	12	7	13
Trichotheliaceae	10	10	15
Basidiolichenes	3	3	4
total number (incl. smaller groups)	216	144	276

tropical areas in general, because the area is uniformly very oligotrophic, and for that reason is likely to have a poor flora.

The value of the species list as a baseline record of a virgin situation depends of course upon its completeness. This is difficult to estimate. On one hand the expedition provided ample time to study the lichen flora on each site. On the other hand the number of visited sites was restricted and, in view of the large size of the mountain and the fact that the investigations were rarely made more than a few hundred meters away from the camps, it is possible that important habitats have remained unobserved. The numbers of unidentified specimens show that about one third of the observed flora remains unnamed because of taxonomical problems. Further incompleteness can be expected because mosses and lichens tend to grow on specialized microhabitats which easily remain unobserved. Foliicolous lichens have been studied in some detail only from one site. Therefore it seems probable that at most half of the real flora is recorded, and only the commoner species seem well represented, whereas the less common elements are probably still very incompletely known. Since more attention was paid to lichens than to bryophytes, the latter are likely to be more incompletely reported.

2. Characteristics of the flora

An interpretation of the results is hardly possible because few comparable observations from other tropical areas are available. Literature on tropical lichens and bryophytes usually concerns taxonomically delimited groups, or the flora of a larger area, or incidental observations. The only available comparable reports concern an area which also belongs to the Guayana Highland, the N-slope of Mount Roraima and surroundings (Gradstein & Florschütz-de Waard 1989, Sipman & Aptroot 1992). Since much less

attention was paid to bryophytes on Guaiquinima, a comparison with the above area is restricted to lichens, cf. table 1.

Table 1 shows that the comparison area shares slightly more than half of their species with Guaiquinima. The proportions of the different groups in both areas are rather similar. The total species number from the Roraima area is higher, probably reflecting the larger and more diverse investigated area. Comparison of the species lists shows that an agreement is also found in the poor representation of certain groups which are normally common in the tropics, like *Leptogium*, *Pannaria*, Lobariaceae.

The second column of Table 1 shows that the agreement at species level between Guaiquinima and Roraima is not as high as one would expect in view of the fact that both areas are very similar and that lichen species tend to be widely distributed. A possible explanation is that the exploration of both areas is very incomplete, so that most of the species found in only one area would eventually turn up in the other after more exploration. Alternatively it might indicate that the distribution of many lichens is rather patchy. This hypothesis is supported by the fact that some of the species lacking in one area were observed several times in the other. This concerns the following species, which have been found only in the Roraima area: *Myriotrema hartii*, *M. wrightii*, *Ocellularia subemersa*, "*Catillaria*" *endochroma*, *Squamacidia janeirensis*, *Parmotrema subochraceum*, and those which have been found only on Guaiquinima: *Nadvornikia hawaiensis*, *Ocellularia comparabilis*, *O. glaucoglyphica*, *O. xanthostroma*, *Cladina argentea*, *C. dendroides*, *Cladonia guianensis*, *C. vareschii*, *C. variegata*, *Pyrrhospora russula*, *Bulbothrix apophysata*, *Heterodermia flabellata*. The "patchy" distribution of these species is not correlated with very evident ecological factors, and it would be worth while to investigate whether subtle ecological differences are involved or perhaps dispersal limitations. In this connection the observation by Montfoort and Ek should be mentioned, that lichens occur more dispersed in lowland rainforest than bryophytes (Gradstein 1992: 239).

Some of the species, which are rather frequent in the Roraima area and absent from Guaiquinima, were found mostly but not exclusively in cultivated areas: *Graphis afzelii*, *Bulbothrix goebelii*, *Physcia atrostriata*, *Physcia sorediosa*, *Pseudopyrenula subgregaria*.

Present knowledge is insufficient to decide whether there exist lichen species restricted to the Guayana Highland or Cerro Guaiquinima in other groups than Cladoniaceae (Ahti 1987). A number of new crustose species are being described from the area, both in the present paper and by Sipman & Aptroot (1992), which are known so far only from the Highland. However, the crustose lichen flora of other tropical lowland areas in northern South America is very little known, so that it is uncertain whether the new species are absent from those areas. Future fieldwork is very likely to show that these areas contain many more species than known at present. The same counts for the new bryophyte taxa reported by Gradstein & Florschütz-de Waard (1989). Since small ranges are unusual in lichens and bryophytes, the existence of Guaiquinima endemics is not very likely.

3. Altitudinal zonation

A comparison of the different sampling sites shows, that the altitudinal differences are strongly correlated with differences in vegetation structure: the lowest camp has closed forest, whereas the the higher camps have much open scrub. The floristic differences between the sites appear to reflect principally these differences in vegetation structure. Thus in the lowest camp, nr. 7 at c. 300 m, Cladoniaceae are almost absent, reflecting the absence of clearings in the forest. In the camps on the summit plain at 800-1500 m more Trypetheliaceae were found and less Thelotremataceae, reflecting the more open vegetation.

Characteristic species for the lowest site (camp 7, c. 300 m, some also present in 8, c. 600 m), which have been found only there and seem to be rather frequent since they are represented by more than one collection, include *Myriotrema guianensis*, *Ocellularia auberiana*, *Ocellularia comparabilis*, *Ocellularia glaucoglyphica*, *Ocellularia papillata*, *Ocellularia perforata*, *Ocellularia xanthostroma*, *Thelotrema albomaculatum*, *Crocynia gossypina*, "*Lecidea*"

granifera, *Astrothelium gigasporum*, *Porina tetracerae*. It concerns forest lichens.

The intermediate stations (camp 2, 3, 4, 800-1200 m) appear to have a rather uniform flora, and contain few species restricted to one camp site and observed there more than once. It concerns for camp 2: *Ocellularia tenuis*, *Hypotrachyna flavida*, *Usnea aspera*, *Buellia aptrootii*, *Cheilolejeunea fragrantissima*; for camp 3: *Hypotrachyna degelii*, *Astrothelium scorioides*, *Astrothelium subfuscum*; for camp 4: *Nadvornikia hawaiensis*, *Biatorella wrightii*, *Astrothelium cinnamomeum*, *Astrothelium ochrothelium*, *Thysananthus amazonicus*, *Syrrhopodon helicophyllus*. Unclear is whether their restricted occurrence should be explained by some less obvious ecological differences or by incomplete collecting.

Characteristic species for the highest site, camp 5 at c. 1500 m, which are observed only there and were found more than once, include *Phaeographis exaltata*, *Ocellularia nigropuncta*, *Calypogeia venezuelana*, *Jamesoniella rubricaulis*, and *Sphagnum sanguinale*. It concerns mainly bryophytes, no doubt because of the higher humidity of the site. At least one species can be considered as a montane element, *Jamesoniella rubricaulis*, widespread in high-andean habitats.

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Appendix:

Ocellularia sinuosa Sipman, *sp. nov.*
Fig. 8.

Type: Colombia, Comisaría Amazonas, Comunidad de Villazul, E of Araracuara, N-bank of river Caquetá, opposite E-end of Isla Morrocoy, alt. c. 300 m, coord. 0°36' S, 72°10' W, c. 10 m tall, light savannaforest on podsolized soil with peaty toplayer, on Tertiary sediments, 2 km N of the river, 3 nov. 1988, H. Sipman & J. Duivenvoorden 28497 (ARA holotype, B).

Diagnosis: Thallus corticola, epiphloeodes, 10 cm diametro vulgo superans, cinereus vel pallide viridicinereus, laevis, nitidus, acidum hypoprotocetraricum continens. Apothecia sessilia, rotundata, magna, ad 10 mm lata, margine tenui recurvato non carbonaceo, disco pallide rubro, a columellis linearibus sinuosis partim carbonaceis divisae; hymenium 75 µm altum, hyalinum; sporae hyalinae, transversaliter 9-septatae, I+, c. 24 x 6 µm.

Thallus corticolous, epiphloeodal, often over 10 cm. diam., grey or pale greenish grey, smooth, slightly glossy, without vegetative propagules, 20-40 µm thick; cortex composed of agglutinated hyphae, c. 6 µm thick; TLC: hypoprotocetraric acid with unknown accessory spot; algal cells subglobose, c. 8 µm diam.; medulla without crystals, in part entering the bark cells. Apothecia frequent, rounded with recurved, chroodiscoid margin, measuring up to 10 x 5 mm, flat and appressed on the thallus; disc pink, with numerous parallel, sinuous, partly carbonized columellae; hymenium 75 µm high, clear; spores hyaline, transversely 9-septate, 8 per ascus, I+, c. 24 x 6 µm.

Ocellularia sinuosa is a very conspicuous species because of its large apothecia with pink discs and sinuous linear columellae. The columellae are composed of carbonized tissue which evidently developed along the apothecial margin; with successive enlargement of the apothecia they become detached and situated on the disc, and a repetition of the process produces the numerous parallel columellae. The carbonization shows that the species belongs in *Ocellularia*, and not among the chroodiscoid species in *Thelotrema*, as the recurved margin would suggest. Similar chroodiscoid forms occur in *Ocellularia auberiana* (Mont.) Hale, e.g. the form originally described as *Thelotrema anamorphoides* Nyl.

Older apothecia tend to grow mainly on one side, which causes the apothecia to become more or less semilunar. Most of the apothecia appeared to be without fertile hymenia, and among the available collections spores were found only in nr. 28497.

Distribution and ecology: The available records, from Cerro de la Neblina in Venezuela and Araracuara in Colombia, suggest that the species may be widespread in the eastern part of the Amazon basin. It grows on smooth bark of thin stems in light forest at low elevations (140-300 m). The Colombian finds were from oligotrophic, boggy places.

Additional material: COLOMBIA: Comisaría Amazonas, Comunidad de Villazul, E of Araracuara, N-bank of river Caquetá, opposite Isla Mariñame, 2 nov. 1988, H. Sipman & J. Duivenvoorden 28363 (ARA, B). VENEZUELA: Amazonas, Depto. Río Negro, Cerro de la Neblina, along Río Mawarinuma, just outside Cañon Grande, 21 Febr. 1984, W. R. Buck 11047 (NY). ibidem, 8 Mar. 1984, W. R. Buck 11453 (NY).