Article

Lichens from the Roosevelt River area in the Brazilian Amazon

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Abstract: Lichens were investigated in Brazil in a small area along the Roosevelt river in Amazonas; 26 species are first reports for Brazil, and 192 additional species are first records for Amazonas state. As many as 24 species are described as new to science: *Allographa lineatipruinosa, Allographa variopruinata, Arthonia xanthopycnidiata, Astrothelium aurantioseptemseptatum, Astrothelium bulbosum, Astrothelium coloratum, Astrothelium inspersonovemseptatum, Astrothelium insulare, Astrothelium laureroides, Astrothelium marjoleinae, Astrothelium meandratum, Astrothelium multireflexum, Astrothelium myopicum, Astrothelium parabathelium, Astrothelium stellare* (also known from Mato Grosso state), *Astrothelium suprainspersum, Astrothelium xanthocavatum, Ocellularia fuscolichexanthonica, Ocellularia lichexanthocavata, Pertusaria amazonica, Phaeographis xantholirellinata, Porina ramiisidiata, Pseudopyrenula connexa,* and *Sprucidea squamulosa*.

Keywords: *Allographa; Astrothelium; Ocellularia; Pertusaria; Phaeographis; Porina; Pseudopyrenula; Sprucidea*

1. Introduction

The study of lichens in the Amazon started only seriously recently, with the systematic exploration of all Amazonian states by the author and colleagues. In the last century and before, no papers were published citing more or less complete lists of species from a certain locality. The only paper citing more than 100 lichens from the Amazon [1] cited foliicolous species.

Somewhat surprisingly, apparently no lichenologist ever did some comprehensive collecting in an Amazon area, or even one single tree, before we started this work (or at least the results were never published). This can be seen from the monographs from the last century. For instance, only 35 species of Trypetheliaceae [2] were known from the whole of Amazonian Brazil (an area of around 5 million square kilometers), based on all records available since the end of the 18th century. Here, I report as many as 83 species of this family in just one small locality of around 10 square kilometers (less than a thousandth percent). Similarly, the monograph of *Laurera* Reichenb. (now partly included in *Astrothelium* Eschw. and partly in *Bathelium* Ach.) from 1957 [3] treats 23 species for all of the earth (150 million square kilometers), a number that is almost exactly equaled here on 10 square kilometers.

One of the main research questions of our work is how diverse the lichens are in the Amazon. Even after 11 years of intense fieldwork this is still difficult to assess. The Amazon is known to be a biodiversity hot spot for many groups of organisms, e. g. trees and butterflies, or probably even plants and insects. For other organism groups, like bryophytes, it is reported to be much less diverse than e. g. the Andes. In the past ten years, I visited and published lichen records and species from the Amazonian states of Rondônia [4-9], Amazonas [10], Amapá [11-12], Acre [13], Pará [14], Mato Grosso [15], and Tocantins [14]. Not every specimen could be identified or described so far, but the majority of the material has been published, although over 50 new Graphidaceae from the Amazon are still waiting to be published.

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2. Materials and Methods

Specimens were observed with an Olympus SZX7 and pictures taken with Nikon Coolpix 995. Hand-made sections of ascomata and thallus were studied in water, 5% KOH (K) and/or Lugol's reagent (1% I_2) after pre-treatment with KOH (IKI). Microscopic photographs were prepared using an Olympus BX50 with Nomarski interference contrast and Nikon Coolpix 995. Chemical spot reactions are abbreviated as K (5% KOH), C (commercial bleach), KC (K followed by C), P (paraphenylenediamine), and UV refers to fluorescence at 366 nm. Thin-layer chromatography [16] has been undertaken by the author in solvent A.

3. Results

3.1. Diversity

In five days of intensive field work, lichens were collected on all trees (bark and living leaves) along the c. 12 km of trails through primary forest, and on trees, shrubs and rock along the river and waterfalls. In total, 1067 specimens were collected; most were separatedly collected per species in the field, but the leaves with foliicolous lichens were pooled and the separate species were dissected from them in the lab. In total, about 475 species were found, 406 of which could be identified, 26 of which are new reports for Brazil, and 192 are first reports for Amazonas state (Tab. 1). A further 24 more are described as new to science below. So, more than half of the species found were either new to science, Brazil or Amazonas, highlighting the poor state of knowledge of the Amazon lichens.

One of the problems of collecting lichens in rain forest is that the canopies of the trees are generally out of reach; especially the thicker branches in the lower canopy can be full of species. The twigs usually yield the same small set of pioneer species that is widely wind-dispersed, while the zone of the branches is generally wind still, and species cannot disperse well, leading to local endemism. I of course examined every fallen twig, branche and tree I saw, but I was lucky to find one recently fallen *Enterolobium* tree, which I sampled exhaustively. I collected 136 lichen specimens from it, in which I found 98 different species (Tab. 2), 84 of which could be identified and seven of which are described below (only one of which was found elsewhere too). Among the unidentified species, there are three additional undescribed *Astrothelium* species which are however overmature.

An indication of the incompleteness of any field trip is that in the present Roosevelt location, as many as 48 species were only found on one recently fallen *Enterolobium* tree (including seven new species to science). If I had not found this tree, the list would be considerably shorter; if I had been able to examine more complete trees, who knows how many more species I would have found

Some additional observations can be made, based on the c. 15,000 collections collected in the past ten years in Amazonian Brazil: The borders of the Amazon region in the North (Amapá), West (Acre) and East (Tocantins & Pará) are relatively poor in species. The central region (Manaus) is richer, but the richest areas are in the South borders (Rondônia, Mato Grosso and the Roosevelt locality in Amazonas reported upon here). We have no offhand explanation for this; there is no correlation with the supposed relict areas where rain forest remained in drier geological times, as compared to other Amazon areas that became savannahs. Cristalino in Mato Grosso and the Roosevelt locality in Amazonas share the abundance of exposed rock which contributes to the diversity, but not by so many species.

One analysis I made was if I ever approached the saturation point while collecting, i.e. whether I know how many species occur in a visited area. i found that for the two places where I spent several field days (Parque Natural, Porto Velho, Rondônia and Reserva Florestal Adolphe Ducke, Manaus, Amazonas), the number of new species found every day after the third day was not yet falling.

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3.2. New species

Allographa lineatipruinosa Aptroot, sp. nov. **Fig. 1**

MycoBank MB 848702

Diagnosis: Corticolous *Allographa* with white pruina on the labia (*farinulenta*-morph), hamathecium not inspersed and ascospores at least 4/ascus, muriform, 68–72 × 13–16 µm.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86544 (holotype: CGMS; isotype: ABL).

Description: Thallus crustose, continuous, corticate, glossy, pale mineral grey, under 0.1 mm thick, not surrounded by a prothallus. Photobiont trentepohlioid. Ascomata sessile, solitary, linear, wavy, unbranched, 0.3–0.4 mm wide, up to 3 mm long, c. 0.2 mm high, excipulum completely carbonized, not striate, not covered by thallus, disc closed, with white pruina on the labia (*farinulenta*-morph fide Lücking et al. 2009). Hamathecium not inspersed. Ascospores at least 4/ascus, hyaline, muriform, 68–72 × 13–16 µm, without gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, K–, KC–, P–. TLC: nil.

Etymology: Named after the elongated line of pruina.

Ecology and distribution: On tree bark in primary rain forest; only known from Brazil.

Discussion: This species would key out in the world key to *Graphis* [17] in Group 9 at couplet 26: Labia with line of white pruina.

Additional specimens examined: BRAZIL. Same details as the type, 86584 & 86595 (all CGMS, ABL).

Figure 1. *Allographa lineatipruinosa.*

Allographa variopruinata Aptroot, sp. nov. **Fig. 2**

MycoBank MB 848704

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Diagnosis: Corticolous *Allographa* with often white pruina on the labia (*farinulenta*-morph), hamathecium inspersed and ascospores 8/ascus, 7-septate, 22–24 × 5.5–6.5 µm.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86436 (holotype: CGMS; isotype: ABL).

Description: Thallus crustose, continuous, corticate, dull, whitish grey, up to 0.1 mm thick, not surrounded by a prothallus. Photobiont trentepohlioid. Ascomata erumpent, solitary, linear, wavy, unbranched or sparingly branched, 0.3–0.4 mm wide, up to 4 mm long, c. 0.2 mm high, excipulum completely carbonized, not striate, laterally covered by thallus, disc closed, with white pruina on some labia (similar to *farinulenta*-morph fide Lücking et al. 2009). Hamathecium inspersed. Ascospores 8/ascus, hyaline, 7-septate, 22–24 × 5.5–6.5 µm, without gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, K+ yellow, KC–, P+ orange. TLC: Stictic acid.

Etymology: Named after the variable pruina.

Ecology and distribution: On tree bark in primary rain forest; only known from Brazil.

Discussion: This species would key out in the world key to *Graphis* [17] in Group 10 at couplet 3: Labia often with white pruina.

Figure 2. *Allographa variopruinata.*

Arthonia xanthopycnidiata Aptroot, sp. nov. **Fig. 3**

MYCOBANK MB 848705

Diagnosis: Corticolous *Arthonia* with pale brown apothecia, ascospores 8/ascus, hyaline, 1-septate, clavate, 9–10.5 × 2.5–3.5 µm, and pycnidia which are UV+ yellow.

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TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on wood in primary rain forest, 16–20 May 2022, A. Aptroot 86467 (holotype: CGMS; isotype: ABL).

Description: Thallus crustose, continuous, not corticate, dull, pale whitish grey, under 0.1 mm thick, mostly immersed in the wood, not surrounded by a prothallus. Photobiont trentepohlioid. Ascomata sessile, solitary or in fused rows, superficial on the substratum, round to ellipsoid in outline, 0.2–0.3 mm wide, up to 1,5 mm long, c. 0.1 mm high, disc very pale brown. Epihymenium almost hyaline. Hamathecium not inspersed. Ascospores 8/ascus, hyaline, 1-septate, clavate, 9–10.5 × 2.5–3.5 µm, without gelatinous sheath. Pycnidia superficial on the thallus, whitish, hemispherical, c. 0.1 mm diam. Conidia not observed.

Chemistry: Thallus UV–, C–, K–, KC–, P–; pycnidia UV+ yellow. TLC: Lichexanthone.

Etymology: Named after the yellow UV-reaction of only the pycnidia.

Ecology and distribution: On wood in primary rain forest; only known from Brazil.

Discussion: This species is most similar to common pantropical *Arthonia antillarum* Fée, but differs by the lichexanthone being only present on the pycnidia in stead of the thallus.

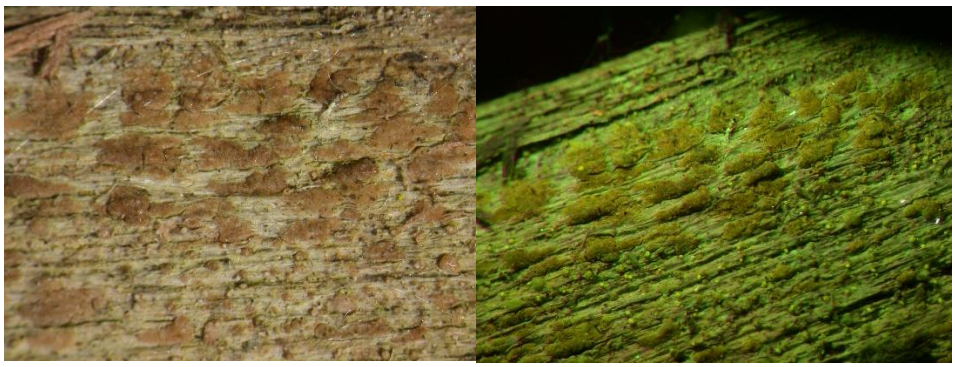

Figure 3. *Arthonia xanthopycnidiata.* Left, daylight; right, under UV-light.

Astrothelium aurantioseptemseptatum Aptroot, sp. nov. **Fig. 4**

MYCOBANK MB 848706

Diagnosis: Corticolous *Astrothelium* with thallus orange-green, UV+ orange, ascomata fused, immersed in thallus-covered hemispherical pseudostromata, hamathecium inspersed, and ascospores 7-septate, 40–47 × 14–16 µm.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 87330 (holotype: CGMS; isotype: ABL).

Description: Thallus dull to shiny, orange-green, surrounded by a 0.2 mm wide black prothallus line. Ascomata pyriform, 0.3–0.5 mm diam., fully immersed in thallus-covered hemispherical pseudostromata. Ostioles skewed, fused, black, 1 or 2 per pseudostroma. Hamathecium inspersed with hyaline oil globules. Ascospores 8/ascus, hyaline, 7-septate, 40–47 × 14–16 µm, long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

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Chemistry: Thallus UV+ orange, C–, P–, K+ red. TLC: An anthraquinone.

Etymology: Named for the orange thallus and the 7-septate ascospores.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key J, couplet 40: Thallus with superficial orange pigment.

Figure 4. *Astrothelium aurantioseptemseptatum.* Left, daylight; right, under UV-light.

Astrothelium bulbosum Aptroot, sp. nov. **Fig. 5**

MycoBank MB 848707

Diagnosis: Corticolous *Astrothelium* with thallus pale metallic green, UV–, pseudostromata mottled whitish and pale brownish, UV+ yellow, ascomata in groups of 10–40 in pseudostromata, ostioles apical, hamathecium not inspersed, and ascospores muriform, 42–47 × 15–16.5 µm.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on *Enterolobium* tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86111 (holotype: CGMS; isotype: ABL).

Description: Thallus glossy, pale metallic green, not surrounded by a prothallus. Ascomata globose, 0.2–0.4 mm diam., immersed in groups of 10–40 in pseudostromata. Pseudostromata raised, mottled whitish and pale brownish, irregular to somewhat linear or almost reticulate, 1–2 mm wide, up to 6 mm long. Ostioles apical, single, pale brown. Hamathecium not inspersed. Ascospores generally 4/ascus, hyaline, muriform, 42–47 × 15–16.5 µm, long-ellipsoid, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

Figure 5. *Astrothelium bulbosum.* Left, daylight; right, under UV-light.

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Chemistry: Thallus UV–, C–, P–, K–; pseudostromata UV+ orange, C–, P–, K+ red. TLC: An anthraquinone.

Etymology: Named for the bulbose pseudostromata.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key L, couplet 16: Pseudostromata with pigment which is not very pronounced but causes a UV+ orange reaction.

Astrothelium coloratum Aptroot, sp. nov. **Fig. 6**

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Diagnosis: Corticolous *Astrothelium* with thallus pale metallic green, UV+ yellow, ascomata in groups of 2–30 in UV+ yellow and orange pseudostromata with both lichexanthone and anthraquinone, ostioles apical, hamathecium not inspersed, and ascospores muriform, 100–117 × 18–21 µm.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86586 (holotype: CGMS; isotype: ABL).

Description: Thallus glossy, pale metallic green, surrounded by a c. 0.1 mm wide black prothallus line. Ascomata globose, 0.2–0.4 mm diam., immersed in groups of 2–30 in pseudostromata. Pseudostromata raised, yellow, irregular to somewhat linear or almost reticulate, 1–2 mm wide, up to 4 mm long. Ostioles apical, single, black, surrounded by a c. 0.2 mm wide whitish area. Hamathecium not inspersed. Ascospores generally 4/ascus, hyaline, muriform, 100–117 × 18–21 µm, long-ellipsoid, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia present in young pseudostromata. Conidia not observed.

Chemistry: Thallus UV+ yellow, C–, P–, K—; pseudostromata UV+ yellow and orange (both anthraquinone and lichexanthone present on the pseudostromata) , C–, P–, K+ red. TLC: An anthraquinone and lichexanthone.

Etymology: Named for the various colours, both in daylight and under UV.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key L, couplet 4: Lichexanthone present on thallus and pseudostromata.

Figure 6. *Astrothelium coloratum.* Left, daylight; right, under UV-light.

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Astrothelium inspersonovemseptatum Aptroot, sp. nov. **Fig. 7**

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Diagnosis: Corticolous *Astrothelium* with thallus pale olivaceous green, UV–, ascomata immersed in whitish erumpent pseudostromata, ostioles fused, hamathecium inspersed, and ascospores 9-septate, 60–64 × 12–14 µm.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 85920 (holotype: CGMS; isotype: ABL).

Description: Thallus shiny, pale olivaceous green, not surrounded by prothallus. Ascomata pyriform, 0.3–0.5 mm diam., fully immersed in mostly thallus-covered erumpent pseudostromata. Pseudostromata whitish. Ostioles skewed, fused, black, 1 to 4 per pseudostroma. Hamathecium inspersed with hyaline oil globules. Ascospores 8/ascus, hyaline, 9-septate, 60–64 × 12–14 µm, long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, P–, K–. TLC: nil.

Etymology: Named for the inspersed hamathecium and the 9-septate ascospores.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key K, couplet 23: Ascospores 9-septate, ostioles fused, pseudostromata whitish, with 1–4 groups of fused ascomata, sideways covered by thallus.

Figure 7. *Astrothelium inspersoseptatum.*

Astrothelium insulare Aptroot, sp. nov. **Fig. 8**

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Diagnosis: Corticolous *Astrothelium* with thallus pale metallic green, UV–, ascomata 3 to 10 per pseudostroma, which are whitish and almost flush with the thallus, ostioles skewed, hamathecium inspersed, and ascospores 13–16-septate, 50–56 × 14–16.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86484 (holotype: CGMS; isotype: ABL).

Description: Thallus shiny, pale metallic green, not surrounded by prothallus. Ascomata pyriform, 0.5–0.8 mm diam., fully immersed inside the bark below the thallus. Pseudostromata almost flush with the thallus, irregularly shaped, whitish, c. 1–2 mm diam. Ostioles skewed, single, pale brown, concave, 3 to 10 per pseudostroma. Hamathecium inspersed with hyaline oil globules. Ascospores 8/ascus, hyaline, 13–16-septate, 50–56 × 14–16 µm, long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, P–, K–. TLC: nil.

Etymology: Named for the island-shaped pattern formed by the pseudostromata.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key K, couplet 23: Ascospores 13–16-septate, ostioles single, pseudostromata whitish, almost flush with the thallus.

Figure 8. *Astrothelium insulare.*

Astrothelium laureroides Aptroot, sp. nov. **Fig. 9**

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Diagnosis: Corticolous *Astrothelium* with thallus pale olivaceous green, UV–, ascomata in groups of 10–40 in raised brownish, UV+ orange pseudostromata, ostioles apical, hamathecium not inspersed, and ascospores muriform, 75–80 × 15–17 µm.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on *Enterolobium* tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86116 (holotype: CGMS; isotype: ABL).

Description: Thallus glossy, pale olivaceous green, not surrounded by prothallus. Ascomata globose, 0.2–0.4 mm diam., immersed in groups of 10–40 in pseudostromata. Pseudostromata raised, brownish, irregular to somewhat linear or almost reticulate, 1–2 mm wide, up to 4 mm long. Ostioles apical, single, black, surrounded by a c. 0.2 mm wide whitish area. Hamathecium not inspersed. Ascospores generally 4/ascus, hyaline, muriform, 75–80 × 15–17 µm, long-ellipsoid, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, P–, K–; pseudostromata UV+ orange, C–, P–, K+ red. TLC: An anthraquinone.

Etymology: Named for the similarity to the former genus *Laurera*.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key L, couplet 20: Pseudostromata raised, brownish, but UV+ orange.

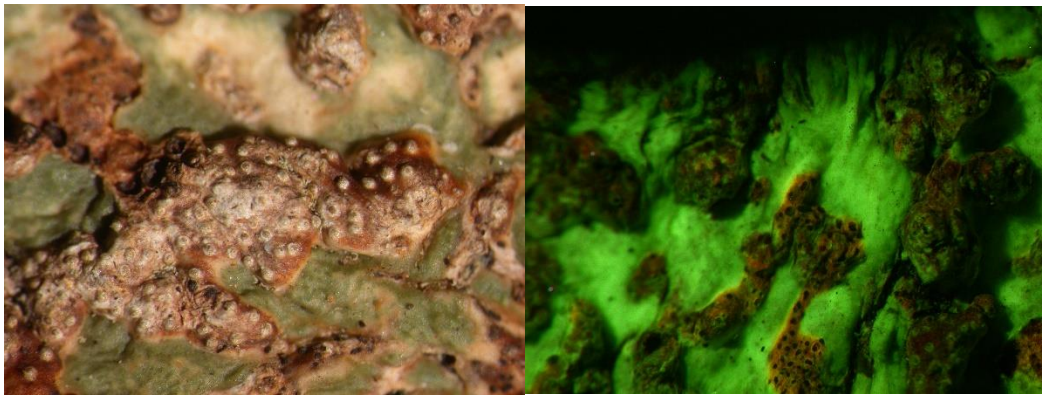

Figure 9. *Astrothelium laurerioides.* Left, daylight; right, under UV-light.

Astrothelium marjoleinae Aptroot, sp. nov. **Fig. 10**

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Diagnosis: Corticolous *Astrothelium* with thallus orange-green, UV+ orange, ascomata immersed in thallus-covered hemispherical, UV+ orange pseudostromata, ostioles fused, hamathecium inspersed, and ascospores 7–9-septate, 62–67 × 11–13 µm.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86378 (holotype: CGMS; isotype: ABL).

Description: Thallus dull to shiny, orange-green, not surrounded by prothallus. Ascomata pyriform, 0.3–0.5 mm diam., fully immersed in thallus-covered hemispherical pseudostromata. Ostioles skewed, fused, black, surrounded by a 0.2 mm wide whitish area, 1–

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3 groups per pseudostroma. Hamathecium inspersed with hyaline oil globules. Ascospores 8/ascus, hyaline, 7–9-septate, 62–67 × 11–13 µm, long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV+ orange, C–, P–, K+ red; pseudostromata UV+ orange, C–, P–, K+ red. TLC: An anthraquinone.

Etymology: Named for the my wife, whom I married in the week that I described this species.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key J, couplet 40: Thallus and pseudostromata orange-green, ascospores 7–9-septate, 62–67 × 11–13 µm.

Additional material examined. Same details as the type, Aptroot 86389, 86411, & 86418 (all CGMS, ABL).

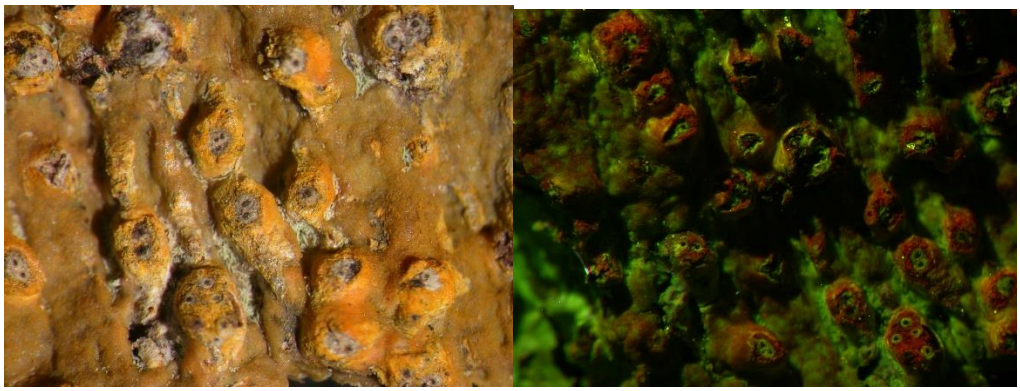

Figure 10. *Astrothelium marjoleinae.* Left, daylight; right, under UV-light.

Astrothelium meandratum Aptroot, sp. nov. **Fig. 11**

MycoBank MB 848713

Diagnosis: Corticolous *Astrothelium* with thallus pale olivaceous green, UV–, ascomata immersed inside the bark below whitish pseudostromata which are flush with the bark, ostioles fused, hamathecium not inspersed, and ascospores 1/ascus, muriform, 270–305 × 42–46 µm, fusiform, median septum strongly thickened.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on *Enterolobium* tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86094 (holotype: CGMS; isotype: ABL).

Description: Thallus shiny, olivaceous green, not surrounded by prothallus. Ascomata pyriform, 0.5–0.8 mm diam., fully immersed inside the bark below the pseudostromata. Pseudostromata almost flush with the thallus, round to lobate following the contours of the ascomata, whitish, c. 1–4 mm diam. Ostioles lateral, 3–10 fused, pale brown, convex, 1 fused group per pseudostroma. Hamathecium not inspersed. Ascospores 1/ascus, hyaline, muriform, 270–305 × 42–46 µm, fusiform, median septum strongly thickened, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, P–, K–. TLC: nil.

Etymology: Named for the meandering outline of the pseudostromata.

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Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key O, couplet 18: Ascospores 270–305 × 42–46 µm.

Figure 11. *Astrothelium meandratum.*

Astrothelium multireflexum Aptroot, sp. nov. **Fig. 12**

MycoBank MB 848715

Diagnosis: Corticolous *Astrothelium* with thallus pale metallic green, UV–, ascomata in groups of 5–30 in raised, yellow, UV+ orange pseudostromata, ostioles apical, UV+ yellow, hamathecium not inspersed, and ascospores muriform, 65–77 × 12–14 µm.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on *Enterolobium* tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86112 (holotype: CGMS; isotype: ABL).

Description: Thallus glossy, pale metallic green, not surrounded by prothallus. Ascomata globose, 0.2–0.4 mm diam., immersed in groups of 5–30 in pseudostromata. Pseudostromata raised, yellow, round to irregular in outline, 1–2 mm wide, up to 4 mm long. Ostioles apical, single, c. 0.2 mm wide, whitish to brown. Hamathecium not inspersed. Ascospores generally 4/ascus, hyaline, muriform, 65–77 × 12–14 µm, long-ellipsoid, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, P–, K–; pseudostromata UV+ orange, C–, P–, K+ red; ostioles UV+ yellow. TLC: An anthraquinone and lichexanthone.

Etymology: Named for the various UV-reactions of the different thallus parts.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

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Discussion: This species would key out as follows in the world key [18]: key L, couplet 4: Lichexanthone only on the ostioles; pseudostromata yelllow.

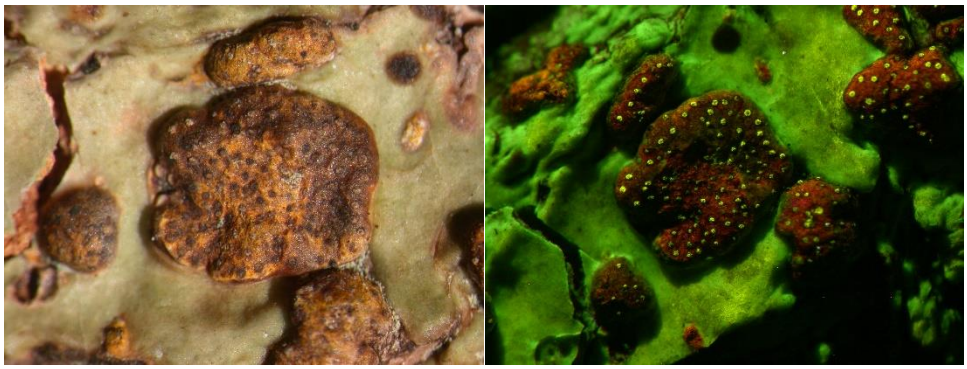

Figure 12. *Astrothelium multireflexum.* Left, daylight; right, under UV-light

Astrothelium myopicum Aptroot, sp. nov. **Fig. 13**

MycoBank MB 848716

Diagnosis: Corticolous *Astrothelium* with thallus orange-green, UV+ orange, ascomata in laterally thallus-covered hemispherical, UV+ orange pseudostromata which are at the tops flat, brown, and not thallus-covered, ostioles fused, hamathecium inspersed, and ascospores 7–9-septate, 35–45 × 9–10 µm.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on *Enterolobium* tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86109 (holotype: CGMS; isotype: ABL).

Description: Thallus dull to shiny, orange-green, not surrounded by prothallus. Ascomata pyriform, 0.3–0.5 mm diam., fully immersed in laterally thallus-covered hemispherical pseudostromata. Pseudostromata at the tops flat, brown, and not thallus-covered. Ostioles skewed, fused, brown, surrounded by a 0.2 mm wide whitish area, 1–3 groups per pseudostroma. Hamathecium inspersed with hyaline oil globules. Ascospores 8/ascus, hyaline, 7–9-septate, 35–45 × 9–10 µm, long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV+ orange, C–, P–, K+ red; pseudostromata UV+ orange, C–, P–, K+ red. TLC: An anthraquinone.

Etymology: Named for the ostioles that give the impression of myopic eyes.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key J, couplet 40: Thallus and pseudostromata orange-green, ascospores 7–9-septate, 35–45 × 9–10 µm.

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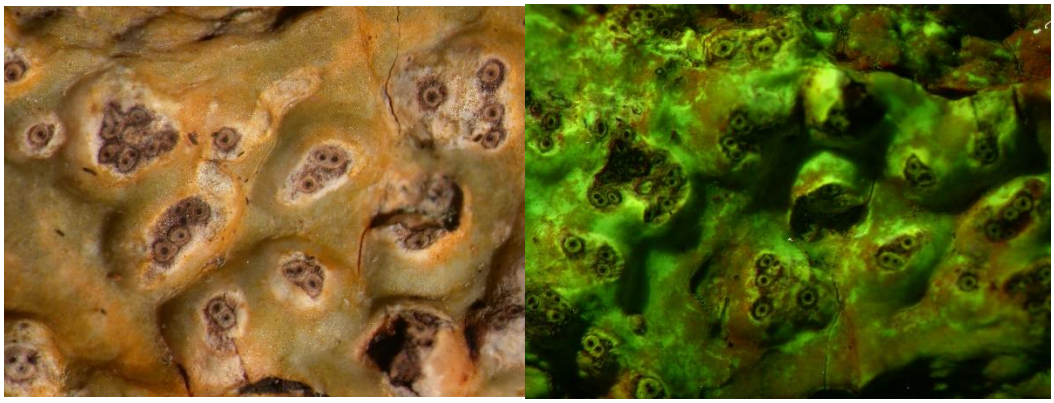

Figure 13. *Astrothelium myopicum.* Left, daylight; right, under UV-light.

Astrothelium parabathelium Aptroot, sp. nov. **Fig. 14**

MycoBank MB 848717

Diagnosis: Corticolous *Astrothelium* with thallus olivaceous green, UV+ yellow, ascomata in groups of c. 3–40 in brownish, UV– pseudostromata, ostioles apical, UV+ yellow, hamathecium not inspersed, and ascospores muriform, 115–130 × 18–21 µm.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86535 (holotype: CGMS; isotype: ABL).

Description: Thallus glossy, olivaceous green, not surrounded by prothallus. Ascomata globose, 0.2–0.4 mm diam., immersed in groups of c. 3–40 in pseudostromata. Pseudostromata raised, brownish, irregular to somewhat linear or almost reticulate, 1–2 mm wide, up to 4 mm long. Ostioles apical, whitish to pale or dark brown to black, convex, c. 0.1 mm wide. Hamathecium not inspersed. Ascospores generally 4/ascus, hyaline, muriform, 115–130 × 18–21 µm, long-ellipsoid, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV+ yellow, C–, P–, K–; pseudostromata UV–, C–, P–, K–; ostioles UV+ yellow. TLC: Lichexanthone.

Etymology: Named for the similarity to *Bathelium*.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

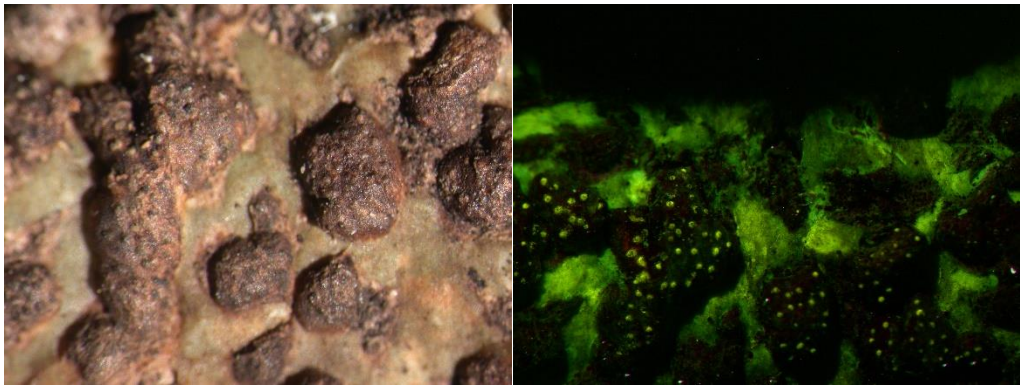

Figure 14. *Astrothelium parabathelium.* Left, daylight; right, under UV-light.

 doi:10.20944/preprints202305.1161.v1

Discussion: This species would key out as follows in the world key [18]: key L, couplet 13: Pseudostromata brown, superficial; thallus and ostioles UV+ yellow.

Astrothelium stellare Aptroot, sp. nov. **Fig. 15**

MycoBank MB 848718

Diagnosis: Corticolous *Astrothelium* with thallus olivaceous greeen, UV–, ascomata in groups of c. 3–40 in raised, brown to whitish, UV– pseudostromata, ostioles apical, UV+ yellow, hamathecium not inspersed, and ascospores muriform, 120–140 × 23–27 µm.

Type: BRAZIL. Amazonas: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on *Enterolobium* tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86110 (holotype: CGMS; isotype: ABL).

Description: Thallus glossy, olivaceous green, not surrounded by prothallus. Ascomata globose, 0.2–0.4 mm diam., immersed in groups of c. 3–40 in pseudostromata. Pseudostromata raised, brown to whitish, often mottled, occasionally with patches of thallus cover, round to lobate to irregular to somewhat linear or almost reticulate, 1–2 mm wide, up to 4 mm long. Ostioles apical, single, whitish to pale or dark brown, convex, c. 0.1 mm wide. Hamathecium not inspersed. Ascospores generally 4/ascus, hyaline, muriform, 120–140 × 23–27 µm, long-ellipsoid, IKI+ blue, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus and pseudostromata UV–, C–, P–, K–; ostioles UV+ yellow, C–, P–, K–. TLC: Lichexanthone.

Etymology: Named for the brilliantly UV+ yellow ostioles that remind a starry night.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key L, couplet 13: Pseudostromata brown, superficial; only ostioles UV+ yellow.

Additional material examined. Same as the type, Aptroot 86113, 86129, 86338, & 86343; Mato Grosso: Reserva Cristalino, alt. 250–350 m, on tree bark in primary rain forest, 22–29 Apr. 2021, Aptroot 84061, 84065 (all CGMS, ABL).

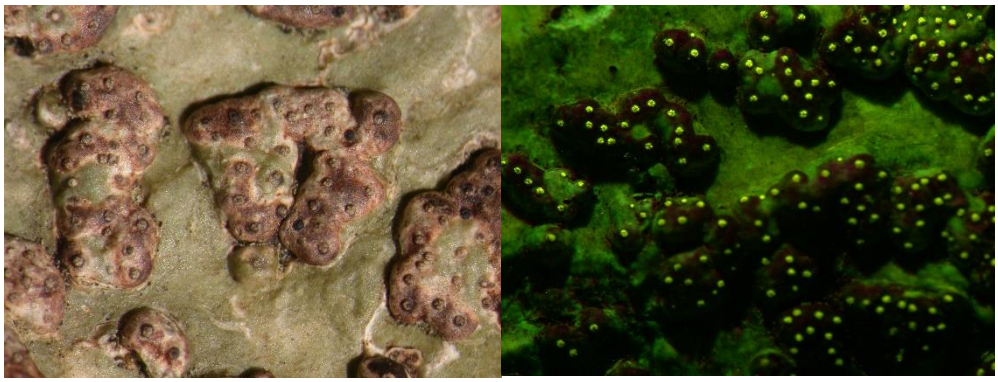

Figure 15. *Astrothelium stellare.* Left, daylight; right, under UV-light

Astrothelium suprainspersum Aptroot, sp. nov. **Fig. 16**

MycoBank MB 848719

 doi:10.20944/preprints202305.1161.v1

Diagnosis: Corticolous *Astrothelium* with thallus pale olivaceous green, UV+ yellow, ascomata in groups of c. 3–20 in raised, dark brown to to black, UV+ yellow pseudostromata with thin to thick whitish, often mottled, pruina, ostioles apical, hamathecium inspersed, and ascospores 3-septate, 18–21 × 6–7.5 µm.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86416 (holotype: CGMS; isotype: ABL).

Description: Thallus glossy, pale olivaceous green, with thin to thick whitish, often mottled, pruina, not surrounded by prothallus. Ascomata globose, 0.2–0.4 mm diam., immersed in groups of c. 3–20 in pseudostromata. Pseudostromata raised, dark brown to to black but with thin to thick whitish, often mottled, pruina, round to lobate to irregular to somewhat linear or almost reticulate, 0.7–1.3 mm wide, up to 3 mm long. Ostioles apical, single, brown, concave, c. 0.1 mm wide. Hamathecium inspersed with hyaline oil droplets, but only in the upper half. Ascospores 8/ascus, hyaline, 3-septate, 18–21 × 6–7.5 µm, long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV+ yellow, C–, P–, K–; pseudostromata UV+ yellow, C–, P–, K–. TLC: Lichexanthone.

Etymology: Named for the inspersion in the upper half of the hamathecium.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key H, couplet 7: Hamathecium inspersed with hyaline oil droplets, but only in the upper half, ascospores 18–21 × 6–7.5 µm.

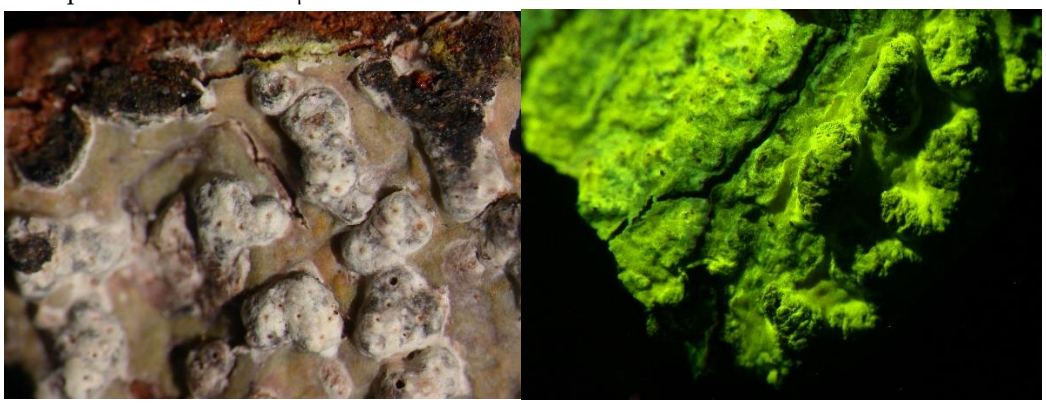

Figure 16. *Astrothelium suprainspersum.* Left, daylight; right, under UV-light.

Astrothelium xanthocavatum Aptroot, sp. nov. **Fig. 17**

MYCOBANK MB 848720

Diagnosis: Corticolous *Astrothelium* with thallus pale olivaceous brown, UV–, ascomata in groups of 1–10 in whitish, partly UV+ yellow pseudostramata which are almost flush with the thallus, ostioles apical, hamathecium not inspersed, and ascospores 1/ascus, hyaline, muriform, 140–175 × 21–24 µm.

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TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86551 (holotype: CGMS; isotype: ABL).

Description: Thallus shiny, pale olivaceous brown, not surrounded by prothallus. Ascomata pyriform, 0.4–0.8 mm diam., mostly immersed inside the bark below the thallus, but usually some black parts exposed. Pseudostromata almost flush with the thallus, round to lobate to somewhat irregularly linear, whitish, c. 1–2 mm wide, up to 3 mm long, containing 1–10 ascomata. Ostioles apical, black, c. 0.1 mm diam. Hamathecium not inspersed. Ascospores 1/ascus, hyaline, muriform, 140–175 × 21–24 µm, long ellipsoid, without thickened median septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, P–, K–; pseudostromata partly UV+ yellow, C–, P–, K–. TLC: Lichexanthone.

Etymology: Named for the yellow UV reaction and the cavate ascomata.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key L, couplet 13: Pseudostromata almost flush with the thallus, whitish, with UV+ yellow patches, ascospores 140–175 × 21–24 µm.

Figure 17. *Astrothelium xanthocavatum.*

Ocellularia fuscolichexanthonica Aptroot, sp. nov. **Fig. 18**

MYCOBANK MB 848721

Diagnosis: Corticolous *Ocellularia* with thallus medulla UV+ white, cortex UV+ yellow, columella isodiametric, c. 0.1 mm wide, surface white, internally brown, excipulum

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with brown ring-shaped tips, hamathecium not inspersed, ascospores brown, 3-septate, ellipsoid, 18–21 × 7.5–8.5 µm

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86492 (holotype: CGMS; isotype: ABL).

Description: Thallus crustose, continuous, corticate, somewhat shiny, pale whitish grey, up to 0.3 mm thick, not surrounded by a prothallus. Photobiont trentepohlioid. Ascomata immersed in the thallus, solitary, round, 0.3–0.4 mm diam., disc brown-black, white pruinose, columella isodiametric, c. 0.1 mm wide, surface white, internally brown. Excipulum with brown ring-shaped tips. Hamathecium not inspersed. Ascospores 8/ascus, brown, 3-septate, ellipsoid, 18–21 × 7.5–8.5 µm, without gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus medulla UV+ white, C–, K–, KC–, P–; thallus cortex UV+ yellow, C–, K–, KC–, P–. TLC: Lichexanthone and hypothamnolic acid.

Etymology: Named after the brown ascospores and the thallus with lichexanthone.

Ecology and distribution: On tree bark in primary rain forest; only known from Brazil.

Discussion: This species differs from all known species in the genus (and in the family) by the combination of 3-septate brown ascospores, lichexanthone in the thallus and the presence of a columella that is brown inside.

Figure 18. *Ocellularia fuscolichexanthonica.*

Ocellularia lichexanthocavata Aptroot, sp. nov. **Fig. 19**

MYCOBANK MB 848722

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Diagnosis: Corticolous *Ocellularia* with thallus UV+ yellow, columella isodiametric, c. 0.1 mm wide, surface and internally black, margin of thallus colour, medulla with copious orange-yellow crystals, excipulum with black ring-shaped tips, hamathecium not inspersed, ascospores hyaline, 5-septate, long ellipsoid, 18–21 × 5.5–6.5 µm.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86424 (holotype: CGMS; isotype: ABL).

Description: Thallus crustose, continuous, slightly verrucose, corticate, somewhat shiny, pale whitish grey, up to 0.1 mm thick, surrounded by a black prothallus line. Photobiont trentepohlioid. Ascomata erumpent from the thallus, solitary, round, 0.3–0.5 mm diam., disc black, not pruinose, columella isodiametric, c. 0.1 mm wide, surface and internally black, margin of thallus colour, medulla with copious orange-yellow crystals. Excipulum with black ring-shaped tips. Hamathecium not inspersed. Ascospores 8/ascus, hyaline, 5-septate, long ellipsoid, 18–21 × 5.5–6.5 µm, without gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV+ yellow, C–, K+ red, KC–, P–. TLC: Lichexanthone and an orange-(Ach.) Müll. Arg.

Etymology: Named after the thallus with lichexanthone and similarity to *O. cavata* (Ach.) Müll. Arg.

Ecology and distribution: On tree bark in primary rain forest; only known from Brazil.

Discussion: This species is very similar to the type of the genus, *O. cavata*, but it has lichexanthone in the thallus.

Figure 19. *Ocellularia lichexanthocavata.*

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Pertusaria amazonica Aptroot, sp. nov. **Fig. 20**

MYCOBANK MB 848723

Diagnosis: Saxicolous *Pertusaria* with thallus medulla UV+ white, cortex UV+ yellow, with isidia of thallus colour but with black tips, sparsely dichotomously branched, c. 0.3 mm wide, up to 1.3 mm long, hamathecium not inspersed, ascomata globose, c. 0.4 mm diam., 2–8 immersed in sessile warts of thallus colour that are constricted at the base, 1–2 mm diam., ascospores 8/ascus but usually 4 ascospores maturating, hyaline, ellipsoid, 75–97 × 32–40 µm, wall c. 8 µm wide, smooth.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on siliceous rock along river in primary rain forest, 16–20 May 2022, A. Aptroot 86458 (holotype: CGMS; isotype: ABL).

Description: Thallus crustose, continuous, corticate, dull, metallic grey, up to 0.3 mm thick, up to 1 meter diam., not surrounded by a c. 2–5 mm wide, zonated prothallus. Isidia sparse or copious, of thallus colour but with black tips, sparsely dichotomously branched, c. 0.3 mm wide, up to 1.3 mm long. Photobiont trebouxioid. Ascomata globose, c. 0.4 mm diam., 2–8 immersed in sessile warts of thallus colour that are constricted at the base, 1–2 mm diam. And c. 1 mm high. Ostioles concave, grey, c. 0.2 mm diam. Hamathecium not inspersed. Ascospores 8/ascus but usually 4 ascospores maturating, hyaline, ellipsoid, 75–97 × 32–40 µm, wall c. 8 µm wide, smooth. Pycnidia not observed.

Chemistry: Thallus medulla UV+ white, C–, K–, KC–, P–; thallus cortex UV+ yellow, C–, K–, KC–, P–. TLC: Lichexanthone and divaricatic acid aggregate.

Etymology: Named after the small muriform ascospores.

Ecology and distribution: On tree bark in primary rain forest; only known from Brazil.

Discussion: This species would key out in the world key [19] in Group 21 at couplet 4: Thallus with isidia, with divaricatic acid. *Pertusaria* species are very scarce in the Amazon, just like *Lecanora* and in general all lichens with trebouxioid algae. This species is locally very abundant, covering many complete rockfaces. The new species is markedly different from any described species, by the presence of isidia and the chemistry of lichexanthone and divaricatic acid. Over 100 species of *Pertusaria* are already described or reported from Brazil, but a preliminary analysis of our recently collected specimens suggests that probably at least 200 species occur there.

Additional specimens examined: Same details as the type, Aptroot 86452, 8457, 86521, 86531, 86441, 86445, 86459, 87342, & 87347 (all CGMS; ABL).

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Figure 20. *Pertusaria amazonica.*

Phaeographis xantholirellinata Aptroot, sp. nov. **Fig. 21**

MYCOBANK MB 848724

Diagnosis: Corticolous *Phaeographis* with thallus UV– and K–, lirellae deeply crenately furrowed, UV+ yellow, hamathecium not inspersed; ascospores brown, 3-septate, clavate, 19–20 × 7–8 µm.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86349 (holotype: CGMS; isotype: ABL).

Description: Thallus crustose, continuous, corticate, glossy, pale greenish grey, up to 0.1 mm thick, not surrounded by a prothallus. Photobiont trentepohlioid. Ascomata erumpent, linear, wavy and branched in outline, 0.25–0.35 mm wide, up to 7 mm long, c. 0.2 mm high, disc grey (pruinose?), margin raised much above the disc, cream white, deeply crenately furrowed, c. 0.1 mm wide. Excipulum and hypothecium not carbonized. Epihymenium pale brown. Hamathecium not inspersed. Ascospores 8/ascus, brown, 3-septate, clavate, 19–20 × 7–8 µm, without gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, K–, KC–, P–; lirellae UV+ yellow, C–, K–, KC–, P–. TLC: Lichexanthone.

Etymology: Named after the lirellae that are UV+ yellow.

Ecology and distribution: On tree bark in primary rain forest; only known from Brazil.

Discussion: This species differs from all known species in the genus (and family) by the yellow reflecting crenate lirellae.

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Figure 21. *Phaeographis xantholirellinata.*

Porina ramiisidiata Aptroot, sp. nov. **Fig. 22**

MYCOBANK MB 848725

Diagnosis: Corticolous *Porina* with thallus ochraceous green, with isidia in irregular groups, cylindrical, irregularly branched, c. 0.1 mm wide and up to 0.8 mm long, often ending in white prothallus filaments.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86322 (holotype: CGMS; isotype: ABL).

Description: Thallus glossy, olivaceous green, up to 7 cm diam., surrounded by a whitish prothallus line. Isidia in irregular groups, cylindrical, irregularly branched, c. 0.1 mm wide and up to 0.8 mm long, often ending in white prothallus filaments. Ascomata and pycnidia not observed.

Chemistry: Thallus UV–, C–, K–, KC–, P–. TLC: nil.

Etymology: Named for the branched isidia.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species was sterile, but sequence data showed that it is (indeed) a *Porina*. It differs from all other isidiate species so far described in the irregularly branched isidia that often end in white prothallus.

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Figure 22. *Porina ramiisidiata.*

Pseudopyrenula connexa Aptroot, sp. nov. **Fig. 23**

MYCOBANK MB 848726

Diagnosis: Corticolous *Pseudopyrenula* with thallus pale ochraceous white, UV–, ascomata 1–8 immersed in carbonized pseudostroma, ostioles fused, hamathecium inspersed, and ascospores 3-septate, 24–25.5 × 6.5–7.5 µm.

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 85964 (holotype: CGMS; isotype: ABL).

Description: Thallus dull, not corticate, pale ochraceous white, not surrounded by a prothallus. Ascomata pyriform, 0.2–0.4 mm diam., 1–8 immersed in carbonized pseudostroma. Ostioles skewed, fused, black. Hamathecium inspersed with hyaline oil globules. Ascospores 8/ascus, hyaline, 3-septate, 24–25.5 × 6.5–7.5 µm, long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

Chemistry: Thallus UV–, C–, K–, KC–, P–. TLC: nil.

Etymology: Named for the connected ostioles.

Ecology and distribution: On tree bark in rain forest; only known from Brazil.

Discussion: This species would key out as follows in the world key [18]: key Y, couplet 18: Ostioles skewed, fused.

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Figure 23. *Pseudopyrenula connexa.*

Sprucidea squamulosa Aptroot, sp. nov. **Fig. 24**

MYCOBANK MB 848728

Diagnosis: Corticolous *Sprucidea* with thallus with norsoloronic acid, microsquamulose on a continuous black hypothallus, consisting of a 0.1–0.4 mm thick layer of squamules, greyish green mottled with brigt brick red patches, surrounded by a black prothallus line, which is a continuation of the hypothallus. Squamules much dissected into lobules of c. 0.03 mm wide, flattened, at the margin often fragmenting into small propagules

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29'S, 60°58'W, on *Enterolobium* tree bark in primary rain forest, 16–20 May 2022, A. Aptroot 86075 (holotype: CGMS; isotype: ABL).

Description: Thallus microsquamulose on a continuous black hypothallus, consisting of a 0.1–0.4 mm thick layer of squamules, greyish green mottled with bright brick red patches, surrounded by a black prothallus line, which is a continuation of the hypothallus. Squamules much dissected into lobules of c. 0.03 mm wide, flattened, at the margin often fragmenting into small propagules. Photobiont trebouxioid. Ascomata and pycnidia not observed.

Chemistry: Thallus UV–, C–, K+ purple, KC–, P–. TLC: Norsoloronic acid.

Etymology: Named after the squamules.

Ecology and distribution: On tree bark in primary rain forest; only known from Brazil.

Discussion: This species would key out in the world key [20] at couplet 2: Thallus microsquamulose.

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Figure 24. *Sprucidea squamulosa.*

Table 1. New records for Brazil (BR) or Amazonas State (AM); only one Aptroot collection number mentioned.

Species	new	#	substratum
Acanthothecis peplophora	BR	87255	bark
Allographa angustata	AM	86357	bark
Allographa balbisii	AM	86462	siliceous rock
Allographa flavens	BR	86359	twig
Allographa longula	AM	85997	bark of fallen Enterolobium tree
Allographa rufopallida	AM	86404	bark
Anomomorpha sordida	AM	87231	bark
Anthracothecium prasinum	AM	86298	bark
Architrypethelium grande	AM	85967	bark
Arthonia parantillarum	AM	86549	bark
Astrochapsa astroidea	AM	85969	bark
Astrochapsa calathiformis	BR	86197	bark
Astrothelium astrolucidum	AM	87353	bark
Astrothelium aureomaculatum	AM	86036	bark of fallen Enterolobium tree
Astrothelium chapadense	AM	86011	bark of fallen Enterolobium tree
Astrothelium eustomum	AM	86047	bark of fallen Enterolobium tree
Astrothelium floridanum	AM	85917	bark
Astrothelium globosum	AM	86062	bark of fallen Enterolobium tree
Astrothelium inspersotuberculosum	AM	86114	bark of fallen Enterolobium tree
Astrothelium introflavidum	AM	86017	bark of fallen Enterolobium tree
Astrothelium leucosessile	AM	86053	bark of fallen Enterolobium tree
Astrothelium megaeneum	AM	85908	bark
Astrothelium mesoduplex	AM	86103	bark of fallen Enterolobium tree
Astrothelium neogalbineum	AM	86035	bark of fallen Enterolobium tree
Astrothelium neovariolosum	AM	86379	bark
Astrothelium nicaraguense	BR	86498	bark
Astrothelium novemseptatum	AM	85916	bark
Astrothelium ochroleucoides	AM	86033	bark of fallen Enterolobium tree
Astrothelium pallidoflavum	BR	86009	bark of fallen Enterolobium tree
Astrothelium pyrenastrosulphureum	AM	86568	bark
Astrothelium scoria	AM	85992	bark
Astrothelium sepultum	AM	86227	bark
Astrothelium sphaerioides	AM	86107	bark of fallen Enterolobium tree

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Astrothelium subfuscum	AM	85958	bark
Astrothelium subfuscum	AM	85994	bark
Astrothelium trypethelioides	BR	85988	bark
Bacidina neotropica	AM	85892	bark
Bacidina pseudoisidiata	BR	86241	bark
Bapalmuia lineata	AM	86637	living leaves
Bapalmuia pallescens	AM	86695	living leaves
Bathelium madreporiforme	AM	86004	bark of fallen Enterolobium tree
Bathelium mastoideum	AM	86088	bark of fallen Enterolobium tree
Bogoriella megaspora	AM	85961	bark
Bogoriella oleosa	AM	86087	bark of fallen Enterolobium tree
Bryostigma mediella	BR	86365	pebbles
Buellia subtabacina	AM	86511	siliceous rock
Bulbothrix fungicola	AM	86580	bark
Byssolecania hymenocarpa	AM	86718	living leaves
Byssoloma chlorinum	AM	87181	living leaves
Byssoloma subdiscordans	AM	86698	living leaves
Calopadia subcoerulescens	AM	86474	siliceous rock
Caloplaca baueri	AM	86439	siliceous rock
Caloplaca lecapustulata	AM	85900	siliceous rock
Canoparmelia caroliniana	AM	86413	bark
Carbacanthographis latispora	BR	87351	bark
Carbacanthographis subchionophora	BR	86601	bark
Chapsa chionostoma	AM	87302	bark
Chapsa defectosorediata	AM	86237	bark
Chapsa leprocarpa	AM	85938	twig
Chapsa phlyctidioides	AM	86165	bark
Chiodecton malmei	AM	87277	bark
Clandestinotrema leucomelaenum	AM	87246	bark
Coenogonium subdentatum	AM	86265	bark
Crustospathula amazonica	AM	86200	bark
Crustospathula humboldtii	AM	85891	bark
Crypthonia corticorygmoides	AM	86229	bark
Cryptoschizotrema cryptotrema	AM	87325	bark
Cryptothecia aleurocarpa	AM	86277	bark
Cryptothecia effusa	AM	86721	living leaves
Cryptothecia inexspectata	AM	87176	living leaves
Cryptothecia macrocephala	AM	86489	bark
Cryptothecia striata	AM	85939	bark
Dichoporis phaea	AM	86140	bark
Dictyomeridium proponens	AM	86119	bark of fallen Enterolobium tree
Dictyonema phyllophilum	AM	87177	living leaves
Diploschistes actinostomus	AM	86516	siliceous rock
Dirinaria picta	AM	86427	bark
Enterographa subserialis	AM	85987	bark
Ephebe brasiliensis	AM	86442	siliceous rock
Eschatogonia minuta	AM	86207	bark
Fellhanera badimioides	BR	86636	living leaves
Fellhanera bouteillei	AM	86307	root under overhang
Fellhanera fuscatula	AM	86716	living leaves
Fellhanera muhlei	AM	86731	living leaves
Fellhanera rubida	AM	86226	termitarium on bark
Fissurina dumastii	AM	85932	bark
Fissurina incondita	AM	86469	siliceous rock
Fissurina pseudostromatica	AM	86316	bark
Fissurina scolecitis	AM	86069	bark of fallen Enterolobium tree
Flavobathelium epiphyllum	AM	86711	living leaves
Graphis lineola	AM	86477	twig
Graphis pinicola	AM	86477a	bark
Graphis pitmanii	BR	86015	bark of fallen Enterolobium tree
Graphis subhiascens	AM	87326	bark
Graphis subtecta	AM	86001	bark of fallen Enterolobium tree
Graphis syzygii	BR	86128	bark of fallen Enterolobium tree
Herpothallon adnatum	AM	86629	bark
Herpothallon minimum	AM	86147	siliceous rock
Herpothallon nigroisidiatum	AM	85968	bark
Hypotrachyna minarum	AM	86381	bark
Lecanora brasiliana	AM	86449	siliceous rock
Lepra tropica	AM	86025	bark of fallen Enterolobium tree
Leptogium coralloideum	AM	86628	bark
Leptogium cyanescens	AM	85901	siliceous rock

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Leptogium moluccanum	AM	85927	bark
Leucodecton compunctum	BR	87346	siliceous rock
Leucodecton expallescens	AM	86396	bark
Lithothelium immersum	AM	86291	bark
Lithothelium obtectum	AM	86145	bark
Lyromma confusum	AM	86699	living leaves
Malmidea bakeri	AM	85911	bark
Malmidea nigra	AM	86501	bark
Malmidea piperis	AM	86141	bark
Malmidea tratiana	AM	86076	bark of fallen Enterolobium tree
Malmidea vinosa	AM	86503	bark
Mazosia carnea	AM	86393	bark
Mazosia multipunctata	AM	86732	living leaves
Megalospora tuberculosa	AM	87269	bark
Micarea lithinella	BR	85888	siliceous rock
Multisporidea conidiophora	AM	85913	bark
Mycoporum lacteum	AM	86624	wood
Myriostigma xanthominiatum	AM	86149	bark
Myriotrema frondosolucens	AM	86348	bark
Myriotrema myrioporoides	AM	86221	bark
Myriotrema subclandestinum	AM	86194	bark
Myriotrema viride	AM	86222	bark
Myriotrema viridialbum	AM	85951	bark
Nadvornikia hawaiensis	AM	86627	bark
Ocellularia ascidioidea	AM	86218	bark
Ocellularia aurulenta	AM	86312	bark
Ocellularia barroensis	AM	87341	siliceous rock
Ocellularia buckii	AM	86564	bark
Ocellularia cicra	BR	86275	bark
Ocellularia dolichotata	AM	86195	bark
Ocellularia excavata	BR	86249	bark
Ocellularia inspersula	AM	86166	bark
Ocellularia laeviusculoides	AM	86068	bark of fallen Enterolobium tree
Ocellularia landronii	AM	86534	bark
Ocellularia marmorata	AM	86337	bark
Ocellularia percolumellata	AM	85984	bark
Ocellularia pulverulenta	AM	86159	bark
Ocellularia rondoniana	AM	86168	bark
Ocellularia rugosothallina	AM	86282	bark
Ocellularia tishae	BR	86246	bark
Ocellularia usnicolor	AM	86490a	bark
Opegrapha contracta	AM	86435	bark
Opegrapha ramisorediata	AM	86172	bark
Opegrapha vegae	AM	86737	living leaves
Pallidogramme chapadana	AM	86106	bark of fallen Enterolobium tree
Pallidogramme chlorocarpoides	AM	87264	bark
Parallopsora leucophyllina	AM	86174	bark
Parmeliella nigrata	AM	86390	bark
Parmotrema gardneri	AM	87290	bark
Parmotrema progenes	AM	86493	bark
Parmotrema rubifaciens	AM	87284	bark
Parmotrema tinctorum	AM	87340	bark
Peltula brasiliensis	AM	85879	wet siliceous rock
Peltula lingulata	AM	86517	wet siliceous rock
Phaeographis brasiliensis	AM	86146	bark
Phaeographis dendritica	AM	87322	bark
Phaeographis haematites	AM	85923	bark
Phaeographis tortuosa	AM	86423	bark
Phylliscum vermiformis	AM	86527	wet siliceous rock
Phyllopsora buettneri	AM	87312	bark
Phyllopsora ochroxantha	AM	86575	siliceous rock
Phyllopsora parvifolia	AM	86133	bark
Phyllopsora soralifera	AM	85912	bark
Platythecium colliculosum	AM	87243	bark
Platythecium grammites	AM	86196	bark
Polymeridium albidovarians	AM	86352	bark
Porina applanata	BR	86672	living leaves
Porina atriceps	AM	87190	living leaves
Porina chlorotica	AM	85893	siliceous rock
Porina conspersa	AM	86438	siliceous rock
Porina distans	AM	86086	bark of fallen Enterolobium tree

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Porina epiphylloides	AM	86671	living leaves
Porina interjungens	BR	86451	siliceous rock
Porina internigrans	AM	86264	bark
Porina melanops	AM	85902	siliceous rock
Porina nucula	AM	87252	bark
Porina ocellata	AM	86440	siliceous rock
Porina pilosa	BR	87204	living leaves
Porina sorediata	AM	86398	bark
Pseudobogoriella exigua	AM	87236	bark
Pseudopyrenula subgregaria	AM	85903	bark
Pterygiopsis densisidiata	AM	86514	siliceous rock
Pterygiopsis guyanensis	AM	86528	wet siliceous rock
Pyrenopsis carassensis	AM	86523	wet siliceous rock
Pyrenopsis cylindrophora	AM	86519	wet siliceous rock
Pyrenopsis olivacea	AM	86515	wet siliceous rock
Pyrenula acutispora	AM	86267	bark
Pyrenula aggregataspistea	AM	85999	bark of fallen Enterolobium tree
Pyrenula minor	AM	85928	bark
Pyrenula minutispora	AM	86325	bark
Pyrenula monospora	AM	87274	bark
Pyrenula obvoluta	BR	85949	twig
Pyrgillus javanicus	AM	87295	bark
Pyxine coralligera	AM	86626	siliceous rock
Ramboldia badia	AM	87267	bark
Redingeria glyphica	AM	87240	bark
Relicina subabstrusa	AM	87304	bark
Rhabdodiscus isidiiferus	BR	87237	bark
Schizotrema zebrinum	BR	86096	bark of fallen Enterolobium tree
Sclerophyton elegans	AM	87229	bark
Sclerophyton fluorescens	AM	86557	bark
Sprucidea granulosa	AM	86504	bark
Sprucidea penicillata	AM	86085	bark of fallen Enterolobium tree
Stegobolus radians	AM	86244	bark
Stirtonia nivea	AM	86089	bark of fallen Enterolobium tree
Synarthonia inconspicua	AM	86424a	bark
Synarthothelium cerebriforme	AM	86219	bark
Thalloloma anguiniforme	AM	87306	wood
Thalloloma hypoleptum	AM	86578	bark
Thelotrema adjectum	BR	87352	bark
Thelotrema suecicum	BR	86606	bark
Trichothelium horridulum	AM	86619	bark
Trichothelium mirum	AM	86691	living leaves
Trypetheliopsis kalbii	AM	87191	living leaves

Table 2. Species on the sampled fallen *Enterolobium* tree; only one Aptroot collection number mentioned.

Species	#
Aggregatorygma triseptatum	86000
Allographa longula	85997
Allographa striatula	86124
Ampliotrema amplius	86010
Astrothelium aeneoides	86003
Astrothelium aeneum	86022
Astrothelium aureomaculatum	86036
Astrothelium bulbosum	86111
Astrothelium chapadense	86011
Astrothelium cinnamomeum	86034
Astrothelium crassum	86055
Astrothelium croceum	86039
Astrothelium cryptolucens	86098
Astrothelium disjunctum	86101
Astrothelium eustomum	86047
Astrothelium flavoduplex	86115
Astrothelium globosum	86062
Astrothelium inspersotuberculosum	86114
Astrothelium introflavidum	86017
Astrothelium kunzei	86056
Astrothelium laureroides	86116
Astrothelium leucosessile	86053

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Astrothelium meandratum	86094
Astrothelium mesoduplex	86103
Astrothelium multireflexum	86112
Astrothelium myopicum	86109
Astrothelium neogalbineum	86035
Astrothelium nitidiusculum	86100
Astrothelium novemseptatum	86020
Astrothelium ochroleucoides	86033
Astrothelium pallidoflavum	86009
Astrothelium pleiostomum	86037
Astrothelium sphaerioides	86107
Astrothelium stellare	86129
Astrothelium stromatofluorescens	86028
Astrothelium subinterjectum	86029
Astrothelium subscoria	86091
Astrothelium variolosum	86046
Arthothelium (additional species)	86042
Arthothelium (additional species)	86060
Arthothelium (additional species)	86117
Bacidina	86070
Bathelium madreporiforme	86004
Bathelium mastoideum	86088
Bogoriella megaspora	86090
Bogoriella oleosa	86087
Chapsa	86032
Chapsa thallotrema	86122
Cryptothecia	86082
Cryptothecia lichexanthonica	86043
Dictyomeridium proponens	86119
Diorygma confluens	86031
Dyplolabia afzelii	86002
Enterographa lichexanthonica	86030
Erythrodecton granulatum	86057
Eschatogonia prolifera	86063
Fellhanera	86071
Fissurina	86044
Fissurina scolecitis	86069
Flegographa leprieurii	86045
Glaucotrema glaucophaenum	86066
Graphidaceae c sor	86016
Graphis pitmanii	86015
Graphis subtecta	86001
Graphis syzygii	86128
Herpothallon nigroisidiatum	85998
Lepra tropica	86126
Malmidea bakeri	86078
Malmidea polycampia	86074
Malmidea tratiana	86076
Malmographina plicosa	86008
Melanotrema platystomum	86024
Micarea corallothallina	86073
Myriotrema	86054
Myriotrema viridialbum	86059
Ocellularia ascidioidea	86026
Ocellularia cavata	86125
Ocellularia laeviusculoides	86068
Ocellularia referta	86095
Opegrapha	85995
Pallidogramme chapadana	86106
Phaeographis nylanderi	86041
Phyllopsora cinchonarum	86081
Platygramme caesiopruinosa	85996
Polymeridium	86018
Porina	86072
Porina distans	86086
Porina isidioambigua	86104
Pseudopyrenula subnudata	86058
Pyrenula aggregataspistea	85999
Pyrenula inframamillana	86014
Schizotrema zebrinum	86096
Sprucidea penicillata	86085

Sprucidea squamulosa	86079
Stirtonia nivea	86089
Trypethelium platystomum	86049
Tylophoron	86006
Tylophoron moderatum	86130

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