

## Article

# Lichens from the Roosevelt River Area in the Brazilian Amazon

André Aptroot 

Instituto de Biosciências, Universidade Federal de Mato Grosso do Sul, Avenida Costa e Silva, s/n Bairro Universitário, Campo Grande 79070-900, Brazil; andreaptroot@gmail.com

**Abstract:** Lichens were investigated in Brazil in a small area along the Roosevelt River in Amazonas; 25 species are first reports for Brazil, and 190 additional species are first records for Amazonas state. As many as 24 species are described that are new to science: *Allographa lineatipruinosa*, *Allographa variopruinata*, *Arthonia xanthopycnidiata*, *Astrothelium aurantioseptemseptatum*, *Astrothelium bulbosum*, *Astrothelium coloratum*, *Astrothelium inspersonovemseptatum*, *Astrothelium insulare*, *Astrothelium laurerooides*, *Astrothelium marjoleinae*, *Astrothelium meandratum*, *Astrothelium multireflexum*, *Astrothelium myopicum*, *Astrothelium parabathelium*, *Astrothelium stellare* (also known from Mato Grosso state), *Astrothelium suprainpersum*, *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



**Citation:** Aptroot, A. Lichens from the Roosevelt River Area in the Brazilian Amazon. *Microbiol. Res.* **2023**, *14*, 755–786. <https://doi.org/10.3390/microbiolres14020054>

Academic Editor: Valery M. Dembitsky

Received: 9 May 2023

Revised: 4 June 2023

Accepted: 7 June 2023

Published: 8 June 2023



**Copyright:** © 2023 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

The serious study of lichens in the Amazon started only 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 has ever carried out comprehensive collection 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 km<sup>2</sup>), 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 km<sup>2</sup> (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 the whole earth (150 million km<sup>2</sup>), a number that is almost exactly equaled here on 10 km<sup>2</sup>.

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 hotspot for many groups of organisms, e.g., trees and butterflies, or probably even plants and insects. For other organism groups, such as 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 yet, but the majority of the material has been published, although over 50 new Graphidaceae from the Amazon are still waiting to be published.

The Roosevelt river area is located in Amazonas state, at the southern border of the Amazone forest region. The visited area consists largely of mature undisturbed tropical

rainforest along a river with many rapids and some exposed siliceous rock with shrubs and small trees. Not far (around 30 km) to the west, there are areas with exposed rocks with drier forest; in all other directions, there are hundreds of kilometers of virtually undisturbed rainforest. No logging has ever taken place in the area or near it.

The area is adjacent to an Amerindian Reserve but privately owned. Occupation started 30 years ago, but little effect of this is visible; there are only a few mango trees aged 30. All there is are a small airstrip and several cabins and a restaurant. It is mostly frequented by fishermen, but there are trails for naturalists. The river is navigable, but there are major rapids just upstream and a bit downstream of the locality, which prevents traffic by boats other than those owned by the owner.

The climate is hot tropical; it is never below 20 degrees Celsius, and the average temperature approaches 30 degrees Celsius. Rainfall is abundant but somewhat seasonal: from October till April, it rains every day; from May till September, it rains intermittently, but still almost every day. There is no weather station nearby, so the average total amount of rainfall is unknown.

## 2. Materials and Methods

Specimens were observed with an Olympus SZX7 (Olympus, Nieuwegein, Netherlands), and pictures were taken with Nikon Coolpix 995 (Nikon, Breda, Netherlands). Hand-made sections of ascomata and thallus were studied in water, 5% KOH (K), and/or Lugol's reagent (1% I<sub>2</sub>) after pre-treatment with KOH (IKI). Microscopic photographs were prepared using an Olympus BX50 (Olympus, Nieuwegein, Netherlands) with Nomarski interference contrast and Nikon Coolpix 995 (Nikon, Breda, Netherlands). Chemical spot reactions are abbreviated as K (5% KOH), C (commercial bleach), KC (K followed by C), and s\P (paraphenylenediamine), and UV refers to fluorescence at 366 nm. Thin-layer chromatography [16] has been undertaken by the author in solvent A. All pictures are 7 × 5 mm.

## 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 the primary forest, and on trees, shrubs, and rock along the river and waterfalls. In total, 1067 specimens were collected; most were separately collected per species in the field, but 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, 25 of which are new reports for Brazil, and 190 of which are first reports for Amazonas state (Table 1). A further 24 more are described as new to science below. Therefore, 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.

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

Species	New	#	Substratum
<i>Acanthothesia peplophora</i>	BR	87,255	bark
<i>Allographa angustata</i>	AM	86,357	bark
<i>Allographa balbisii</i>	AM	86,462	siliceous rock
<i>Allographa flavens</i>	BR	86,359	twig
<i>Allographa longula</i>	AM	85,997	bark of fallen Enterolobium tree
<i>Allographa rufopallida</i>	AM	86,404	bark
<i>Anomomorpha sordida</i>	AM	87,231	bark
<i>Anthracothecium prasinum</i>	AM	86,298	bark

Table 1. Cont.

Species	New	#	Substratum
<i>Architrypethelium grande</i>	AM	85,967	bark
<i>Arthonia parantillarum</i>	AM	86,549	bark
<i>Astrochapsa astroidea</i>	AM	85,969	bark
<i>Astrochapsa calathiformis</i>	BR	86,197	bark
<i>Astrothelium astrolucidum</i>	AM	87,353	bark
<i>Astrothelium aureomaculatum</i>	AM	86,036	bark of fallen Enterolobium tree
<i>Astrothelium chapadense</i>	AM	86,011	bark of fallen Enterolobium tree
<i>Astrothelium eustomum</i>	AM	86,047	bark of fallen Enterolobium tree
<i>Astrothelium floridanum</i>	AM	85,917	bark
<i>Astrothelium globosum</i>	AM	86,062	bark of fallen Enterolobium tree
<i>Astrothelium inspersotuberculosum</i>	AM	86,114	bark of fallen Enterolobium tree
<i>Astrothelium introflavidum</i>	AM	86,017	bark of fallen Enterolobium tree
<i>Astrothelium leucosessile</i>	AM	86,053	bark of fallen Enterolobium tree
<i>Arthonia mediella</i>	BR	86,365	pebbles
<i>Astrothelium megaeneum</i>	AM	85,908	bark
<i>Astrothelium mesoduplex</i>	AM	86,103	bark of fallen Enterolobium tree
<i>Astrothelium neogalbineum</i>	AM	86,035	bark of fallen Enterolobium tree
<i>Astrothelium neovariolosum</i>	AM	86,379	bark
<i>Astrothelium nicaraguense</i>	BR	86,498	bark
<i>Astrothelium novemseptatum</i>	AM	85,916	bark
<i>Astrothelium ochroleuroides</i>	AM	86,033	bark of fallen Enterolobium tree
<i>Astrothelium pallidoflavum</i>	BR	86,009	bark of fallen Enterolobium tree
<i>Astrothelium pyrenastrosulphureum</i>	AM	86,568	bark
<i>Astrothelium scoria</i>	AM	85,992	bark
<i>Astrothelium sepultum</i>	AM	86,227	bark
<i>Astrothelium sphaerioides</i>	AM	86,107	bark of fallen Enterolobium tree
<i>Astrothelium subfuscum</i>	AM	85,958	bark
<i>Astrothelium trypethelioides</i>	BR	85,988	bark
<i>Bacidina neotropica</i>	AM	85,892	bark
<i>Bacidina pseudoisidiata</i>	BR	86,241	bark
<i>Bapalmuia lineata</i>	AM	86,637	living leaves
<i>Bapalmuia pallescens</i>	AM	86,695	living leaves
<i>Bathelium madreporiforme</i>	AM	86,004	bark of fallen Enterolobium tree
<i>Bathelium mastoideum</i>	AM	86,088	bark of fallen Enterolobium tree
<i>Bogoriella megaspora</i>	AM	85,961	bark
<i>Bogoriella oleosa</i>	AM	86,087	bark of fallen Enterolobium tree
<i>Buellia subtabacina</i>	AM	86,511	siliceous rock
<i>Bulbothrix fungicola</i>	AM	86,580	bark
<i>Byssolecania hymenocarpa</i>	AM	86,718	living leaves
<i>Byssoloma chlorinum</i>	AM	87,181	living leaves
<i>Byssoloma subdiscordans</i>	AM	86,698	living leaves

Table 1. Cont.

Species	New	#	Substratum
<i>Calopadia subcoerulescens</i>	AM	86,474	siliceous rock
<i>Caloplaca baueri</i>	AM	86,439	siliceous rock
<i>Caloplaca lecapustulata</i>	AM	85,900	siliceous rock
<i>Canoparmelia caroliniana</i>	AM	86,413	bark
<i>Carbacanthographis latispora</i>	BR	87,351	bark
<i>Carbacanthographis subchionophora</i>	BR	86,601	bark
<i>Chapsa chionostoma</i>	AM	87,302	bark
<i>Chapsa defectosorediata</i>	AM	86,237	bark
<i>Chapsa leprocarpa</i>	AM	85,938	twig
<i>Chapsa phlyctidioides</i>	AM	86,165	bark
<i>Chiodecton malmei</i>	AM	87,277	bark
<i>Clandestinotrema leucomelaenum</i>	AM	87,246	bark
<i>Coenogonium subdentatum</i>	AM	86,265	bark
<i>Crustospathula amazonica</i>	AM	86,200	bark
<i>Crustospathula humboldtii</i>	AM	85,891	bark
<i>Crypthonia corticorygmoides</i>	AM	86,229	bark
<i>Cryptoschizotrema cryptotrema</i>	AM	87,325	bark
<i>Cryptothecia aleurocarpa</i>	AM	86,277	bark
<i>Cryptothecia effusa</i>	AM	86,721	living leaves
<i>Cryptothecia inexpectata</i>	AM	87,176	living leaves
<i>Cryptothecia macrocephala</i>	AM	86,489	bark
<i>Cryptothecia striata</i>	AM	85,939	bark
<i>Dichoporis phaea</i>	AM	86,140	bark
<i>Dictyomeridium proponens</i>	AM	86,119	bark of fallen Enterolobium tree
<i>Dictyonema phyllophilum</i>	AM	87,177	living leaves
<i>Diploschistes actinostomus</i>	AM	86,516	siliceous rock
<i>Dirinaria picta</i>	AM	86,427	bark
<i>Enterographa subserialis</i>	AM	85,987	bark
<i>Ephebe brasiliensis</i>	AM	86,442	siliceous rock
<i>Eschatogonia minuta</i>	AM	86,207	bark
<i>Fellhanera badimiodes</i>	BR	86,636	living leaves
<i>Fellhanera bouteillei</i>	AM	86,307	root under overhang
<i>Fellhanera fuscata</i>	AM	86,716	living leaves
<i>Fellhanera muhleii</i>	AM	86,731	living leaves
<i>Fellhanera rubida</i>	AM	86,226	termitarium on bark
<i>Fissurina dumastii</i>	AM	85,932	bark
<i>Fissurina incondita</i>	AM	86,469	siliceous rock
<i>Fissurina pseudostromatica</i>	AM	86,316	bark
<i>Fissurina scolecitis</i>	AM	86,069	bark of fallen Enterolobium tree
<i>Flavobathelium epiphyllum</i>	AM	86,711	living leaves
<i>Graphis lineola</i>	AM	86,477	twig

Table 1. Cont.

Species	New	#	Substratum
<i>Graphis pinicola</i>	AM	86,477a	bark
<i>Graphis subhiascens</i>	AM	87,326	bark
<i>Graphis subtecta</i>	AM	86,001	bark of fallen Enterolobium tree
<i>Graphis syzygii</i>	BR	86,128	bark of fallen Enterolobium tree
<i>Herpothallon adnatum</i>	AM	86,629	bark
<i>Herpothallon minimum</i>	AM	86,147	siliceous rock
<i>Herpothallon nigroisidiatum</i>	AM	85,968	bark
<i>Hypotrachyna minarum</i>	AM	86,381	bark
<i>Lecanora brasiliana</i>	AM	86,449	siliceous rock
<i>Lepra tropica</i>	AM	86,025	bark of fallen Enterolobium tree
<i>Leptogium coralloideum</i>	AM	86,628	bark
<i>Leptogium cyanescens</i>	AM	85,901	siliceous rock
<i>Leptogium moluccanum</i>	AM	85,927	bark
<i>Leucodecton compunctum</i>	BR	87,346	siliceous rock
<i>Leucodecton expallescens</i>	AM	86,396	bark
<i>Lithothelium immersum</i>	AM	86,291	bark
<i>Lithothelium obtectum</i>	AM	86,145	bark
<i>Lyromma confusum</i>	AM	86,699	living leaves
<i>Malmidea bakeri</i>	AM	85,911	bark
<i>Malmidea nigra</i>	AM	86,501	bark
<i>Malmidea piperis</i>	AM	86,141	bark
<i>Malmidea tratiana</i>	AM	86,076	bark of fallen Enterolobium tree
<i>Malmidea vinosa</i>	AM	86,503	bark
<i>Mazosia carnea</i>	AM	86,393	bark
<i>Megalospora tuberculosa</i>	AM	87,269	bark
<i>Micarea lithinella</i>	BR	85,888	siliceous rock
<i>Multisporidea conidiophora</i>	AM	85,913	bark
<i>Mycoporum lacteum</i>	AM	86,624	wood
<i>Myriostigma xanthominiatum</i>	AM	86,149	bark
<i>Myriotrema frondosolucens</i>	AM	86,348	bark
<i>Myriotrema myrioporoides</i>	AM	86,221	bark
<i>Myriotrema subclandestinum</i>	AM	86,194	bark
<i>Myriotrema viride</i>	AM	86,222	bark
<i>Myriotrema viridialbum</i>	AM	85,951	bark
<i>Nadvornikia hawaiiensis</i>	AM	86,627	bark
<i>Ocellularia ascidioidea</i>	AM	86,218	bark
<i>Ocellularia aurulenta</i>	AM	86,312	bark
<i>Ocellularia barroensis</i>	AM	87,341	siliceous rock
<i>Ocellularia buckii</i>	AM	86,564	bark
<i>Ocellularia cicra</i>	BR	86,275	bark
<i>Ocellularia dolichotata</i>	AM	86,195	bark

Table 1. Cont.

Species	New	#	Substratum
<i>Ocellularia excavata</i>	BR	86,249	bark
<i>Ocellularia inspersula</i>	AM	86,166	bark
<i>Ocellularia laeviusculoides</i>	AM	86,068	bark of fallen Enterolobium tree
<i>Ocellularia landronii</i>	AM	86,534	bark
<i>Ocellularia marmorata</i>	AM	86,337	bark
<i>Ocellularia percolumellata</i>	AM	85,984	bark
<i>Ocellularia pulverulenta</i>	AM	86,159	bark
<i>Ocellularia rondoniana</i>	AM	86,168	bark
<i>Ocellularia rugosothallina</i>	AM	86,282	bark
<i>Ocellularia nataishae</i>	BR	86,246	bark
<i>Ocellularia usnicolor</i>	AM	86,490a	bark
<i>Opegrapha contracta</i>	AM	86,435	bark
<i>Opegrapha ramisorediata</i>	AM	86,172	bark
<i>Opegrapha vegae</i>	AM	86,737	living leaves
<i>Pallidogramme chapadana</i>	AM	86,106	bark of fallen Enterolobium tree
<i>Pallidogramme chlorocarpoides</i>	AM	87,264	bark
<i>Parallopsora leucophyllina</i>	AM	86,174	bark
<i>Parmeliella nigrata</i>	AM	86,390	bark
<i>Parmotrema gardneri</i>	AM	87,290	bark
<i>Parmotrema progenes</i>	AM	86,493	bark
<i>Parmotrema rubifaciens</i>	AM	87,284	bark
<i>Parmotrema tinctorum</i>	AM	87,340	bark
<i>Peltula brasiliensis</i>	AM	85,879	wet siliceous rock
<i>Peltula lingulata</i>	AM	86,517	wet siliceous rock
<i>Phaeographis brasiliensis</i>	AM	86,146	bark
<i>Phaeographis dendritica</i>	AM	87,322	bark
<i>Phaeographis haematites</i>	AM	85,923	bark
<i>Phaeographis tortuosa</i>	AM	86,423	bark
<i>Phyllicium vermiformis</i>	AM	86,527	wet siliceous rock
<i>Phyllopsora buettneri</i>	AM	87,312	bark
<i>Phyllopsora ochroxantha</i>	AM	86,575	siliceous rock
<i>Phyllopsora parvifolia</i>	AM	86,133	bark
<i>Phyllopsora soralifera</i>	AM	85,912	bark
<i>Platythecium colliculosum</i>	AM	87,243	bark
<i>Platythecium grammites</i>	AM	86,196	bark
<i>Polymeridium albidovarians</i>	AM	86,352	bark
<i>Porina applanata</i>	BR	86,672	living leaves
<i>Porina atriceps</i>	AM	87,190	living leaves
<i>Porina chlorotica</i>	AM	85,893	siliceous rock
<i>Porina conspersa</i>	AM	86,438	siliceous rock
<i>Porina distans</i>	AM	86,086	bark of fallen Enterolobium tree

Table 1. Cont.

Species	New	#	Substratum
<i>Porina epiphyllodes</i>	AM	86,671	living leaves
<i>Porina interjungens</i>	BR	86,451	siliceous rock
<i>Porina internigrans</i>	AM	86,264	bark
<i>Porina melanops</i>	AM	85,902	siliceous rock
<i>Porina nucula</i>	AM	87,252	bark
<i>Porina ocellata</i>	AM	86,440	siliceous rock
<i>Porina cubana</i>	AM	87,204	living leaves
<i>Porina sorediata</i>	AM	86,398	bark
<i>Pseudobogoriella exigua</i>	AM	87,236	bark
<i>Pseudopyrenula subgregaria</i>	AM	85,903	bark
<i>Pterygiopsis densisidiata</i>	AM	86,514	siliceous rock
<i>Pterygiopsis guyanensis</i>	AM	86,528	wet siliceous rock
<i>Pyrenopsis carassensis</i>	AM	86,523	wet siliceous rock
<i>Pyrenopsis cylindrophora</i>	AM	86,519	wet siliceous rock
<i>Pyrenopsis olivacea</i>	AM	86,515	wet siliceous rock
<i>Pyrenula acutispora</i>	AM	86,267	bark
<i>Pyrenula aggregataspistea</i>	AM	85,999	bark of fallen Enterolobium tree
<i>Pyrenula minor</i>	AM	85,928	bark
<i>Pyrenula minutispora</i>	AM	86,325	bark
<i>Pyrenula monospora</i>	AM	87,274	bark
<i>Pyrenula obvolvata</i>	BR	85,949	twig
<i>Pyrgillus javanicus</i>	AM	87,295	bark
<i>Pyxine coralligera</i>	AM	86,626	siliceous rock
<i>Ramboldia badia</i>	AM	87,267	bark
<i>Redingeria glyphica</i>	AM	87,240	bark
<i>Relicina subabstrusa</i>	AM	87,304	bark
<i>Rhabdodiscus isidiiferus</i>	BR	87,237	bark
<i>Schizotrema zebrinum</i>	BR	86,096	bark of fallen Enterolobium tree
<i>Sclerophyton elegans</i>	AM	87,229	bark
<i>Sclerophyton fluorescens</i>	AM	86,557	bark
<i>Sprucidea granulosa</i>	AM	86,504	bark
<i>Sprucidea penicillata</i>	AM	86,085	bark of fallen Enterolobium tree
<i>Stegobolus radians</i>	AM	86,244	bark
<i>Stirtonia nivea</i>	AM	86,089	bark of fallen Enterolobium tree
<i>Synarthonia inconspicua</i>	AM	86,424a	bark
<i>Synarthothelium cerebriforme</i>	AM	86,219	bark
<i>Thalloloma anguiniforme</i>	AM	87,306	wood
<i>Thalloloma hypoleptum</i>	AM	86,578	bark
<i>Thelotrema adjectum</i>	BR	87,352	bark
<i>Thelotrema suecicum</i>	BR	86,606	bark
<i>Trichothelium horridulum</i>	AM	86,619	bark

**Table 1.** *Cont.*

Species	New	#	Substratum
<i>Trichothelium mirum</i>	AM	86,691	living leaves
<i>Trypetheliopsis kalbii</i>	AM	87,191	living leaves

One of the problems with collecting lichens in rainforests is that the canopies of the trees are generally out of reach, and the thicker branches in the lower canopy can be especially 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 still, and species cannot disperse well, leading to local endemism. I of course examined every fallen twig, branch, and tree I saw, but I was lucky to find one recently fallen *Enterolobium* tree (common names: conacaste, guanacaste, caro caro, devil's ear tree, monkey-ear tree, or elephant-ear tree; Fabaceae family), which I sampled exhaustively. I collected 136 lichen specimens from it, in which I found 98 different species (Table 2), 84 of which could be identified and 7 of which are described below (only one of which was also found elsewhere). Among the unidentified species, there are three additional undescribed *Astrothelium* species which are, however, overmature.

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

Species	#
<i>Aggregatorygma triseptatum</i>	86,000
<i>Allographa longula</i>	85,997
<i>Allographa striatula</i>	86,124
<i>Ampliotrema amplius</i>	86,010
<i>Astrothelium aeneoides</i>	86,003
<i>Astrothelium aeneum</i>	86,022
<i>Astrothelium aureomaculatum</i>	86,036
<i>Astrothelium bulbosum</i>	86,111
<i>Astrothelium chapadense</i>	86,011
<i>Astrothelium cinnamomeum</i>	86,034
<i>Astrothelium crassum</i>	86,055
<i>Astrothelium croceum</i>	86,039
<i>Astrothelium cryptolucens</i>	86,098
<i>Astrothelium disjunctum</i>	86,101
<i>Astrothelium eustomum</i>	86,047
<i>Astrothelium flavoduplex</i>	86,115
<i>Astrothelium globosum</i>	86,062
<i>Astrothelium inpersotuberculosum</i>	86,114
<i>Astrothelium introflavidum</i>	86,017
<i>Astrothelium kunzei</i>	86,056
<i>Astrothelium laureroides</i>	86,116
<i>Astrothelium leucosessile</i>	86,053
<i>Astrothelium meandratum</i>	86,094
<i>Astrothelium mesoduplex</i>	86,103
<i>Astrothelium multireflexum</i>	86,112



Table 2. Cont.

Species	#
<i>Astrothelium myopicum</i>	86,109
<i>Astrothelium neogalbineum</i>	86,035
<i>Astrothelium nitidiusculum</i>	86,100
<i>Astrothelium novemseptatum</i>	86,020
<i>Astrothelium ochroleuroides</i>	86,033
<i>Astrothelium pallidoflavum</i>	86,009
<i>Astrothelium pleiostomum</i>	86,037
<i>Astrothelium sphaerioides</i>	86,107
<i>Astrothelium stellare</i>	86,129
<i>Astrothelium stromatofluorescens</i>	86,028
<i>Astrothelium subinterjectum</i>	86,029
<i>Astrothelium subscoria</i>	86,091
<i>Astrothelium variolosum</i>	86,046
<i>Arthothelium (additional species)</i>	86,042
<i>Arthothelium (additional species)</i>	86,060
<i>Arthothelium (additional species)</i>	86,117
<i>Bacidina</i>	86,070
<i>Bathelium madreporiforme</i>	86,004
<i>Bathelium mastoideum</i>	86,088
<i>Bogoriella megaspora</i>	86,090
<i>Bogoriella oleosa</i>	86,087
<i>Chapsa</i>	86,032
<i>Chapsa thallotrema</i>	86,122
<i>Cryptothecia</i>	86,082
<i>Cryptothecia lichexanthonica</i>	86,043
<i>Dictyomeridium proponens</i>	86,119
<i>Diorygma confluens</i>	86,031
<i>Dyplolabia afzelii</i>	86,002
<i>Enterographa lichexanthonica</i>	86,030
<i>Erythrodecton granulatum</i>	86,057
<i>Eschatogonia prolifera</i>	86,063
<i>Fellhanera</i>	86,071
<i>Fissurina</i>	86,044
<i>Fissurina scolecitis</i>	86,069
<i>Flegographa leprieurii</i>	86,045
<i>Glaucotrema glaucophaenum</i>	86,066
<i>Graphidaceae c sor</i>	86,016
<i>Graphis pitmanii</i>	86,015
<i>Graphis subtecta</i>	86,001
<i>Graphis syzygii</i>	86,128
<i>Herpothallon nigrosidiatum</i>	85,998

Table 2. Cont.

Species	#
<i>Lepra tropica</i>	86,126
<i>Malmidea bakeri</i>	86,078
<i>Malmidea polycampia</i>	86,074
<i>Malmidea tratiana</i>	86,076
<i>Malmographina plicosa</i>	86,008
<i>Melanotrema platystomum</i>	86,024
<i>Micarea corallothallina</i>	86,073
<i>Myriotrema</i>	86,054
<i>Myriotrema viridialbum</i>	86,059
<i>Ocellularia ascidioidea</i>	86,026
<i>Ocellularia cavata</i>	86,125
<i>Ocellularia laeviusculoides</i>	86,068
<i>Ocellularia referta</i>	86,095
<i>Opegrapha</i>	85,995
<i>Pallidogramme chapadana</i>	86,106
<i>Phaeographis nylanderii</i>	86,041
<i>Phyllopsora cinchonarum</i>	86,081
<i>Platygramme caesiopruinosa</i>	85,996
<i>Polymeridium</i>	86,018
<i>Porina</i>	86,072
<i>Porina distans</i>	86,086
<i>Porina isidioambigua</i>	86,104
<i>Pseudopyrenula subnudata</i>	86,058
<i>Pyrenula aggregataspistea</i>	85,999
<i>Pyrenula inframamillana</i>	86,014
<i>Schizotrema zebrinum</i>	86,096
<i>Sprucidea penicillata</i>	86,085
<i>Sprucidea squamulosa</i>	86,079
<i>Stirtonia nivea</i>	86,089
<i>Trypethelium platystomum</i>	86,049
<i>Tylophoron</i>	86,006
<i>Tylophoron moderatum</i>	86,130

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 and Pará) are relatively low 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 supposedly relict areas where rainforest 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 as many species.

One analysis I made was if I ever approached the saturation point while collecting, i.e., whether I knew 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, and Amazonas), the number of new species found every day after the third day was not yet falling.

### 3.2. New Species

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



**Figure 1.** *Allographa lineatipruinosa*.

MYCOBANK MB 848702

*Diagnosis:* Corticolous *Allographa* with white pruina on the labia (*farinulenta*-morph), hamathecium not interspersed and ascospores were at least 4/ascus, muriform,  $68\text{--}72 \times 13\text{--}16 \mu\text{m}$ .

*TYPE:* BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{ S}$ ,  $60^{\circ}58' \text{ W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,544 (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 interspersed. Ascospores at least 4/ascus, hyaline, muriform,  $68\text{--}72 \times 13\text{--}16 \mu\text{m}$ , 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 rainforest; 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 a line of white pruina.

*Additional specimens examined:* BRAZIL. Same details as the types 86,584 and 86,595 (all CGMS, ABL).

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



**Figure 2.** *Allographa variopruinata*.

MYCOBANK MB 848704

*Diagnosis:* Corticolous *Allographa* with often white pruina on the labia (*farinulenta*-morph), hamathecium interspersed and ascospores 8/ascus, 7-septate,  $22\text{--}24 \times 5.5\text{--}6.5 \mu\text{m}$ .

*TYPE:* BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,436 (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 interspersed. Ascospores 8/ascus, hyaline, 7-septate,  $22\text{--}24 \times 5.5\text{--}6.5 \mu\text{m}$ , without gelatinous sheath. Pycnidia not observed.

*Chemistry:* Thallus UV<sup>-</sup>, C<sup>-</sup>, K<sup>+</sup> yellow, KC<sup>-</sup>, P<sup>+</sup> orange. TLC: Stictic acid.

*Etymology:* Named after the variable pruina.

*Ecology and distribution:* On tree bark in primary rainforest; 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.

***Arthonia xanthopycniata*** Aptroot, sp. nov. Figure 3.



**Figure 3.** *Arthonia xanthopycniata*. (left), daylight; (right), under UV light with pycnidia yellow.

MYCOBANK MB 848705

**Diagnosis:** Corticolous *Arthonia* with pale brown apothecia, ascospores 8/ascus, hyaline, 1-septate, clavate,  $9\text{--}10.5 \times 2.5\text{--}3.5 \mu\text{m}$ , and pycnidia that are UV+ yellow.

**TYPE:** BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , on wood in primary rainforest, 16–20 May 2022, A. Aptroot 86,467 (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. Epithemium almost hyaline. Hamathecium not interspersed. Ascospores 8/ascus, hyaline, 1-septate, clavate,  $9\text{--}10.5 \times 2.5\text{--}3.5 \mu\text{m}$ , without gelatinous sheath. Pycnidia superficial on the thallus, whitish, hemispherical, c. 0.1 mm diam. Conidia not observed.

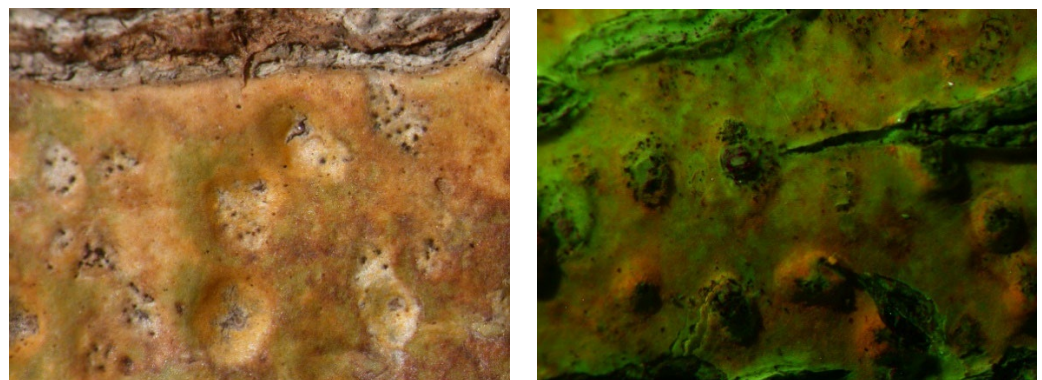
**Chemistry:** Thallus UV–, C–, K–, KC–, P–; pycnidia UV+ yellow. TLC: Lichexanthone.

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

**Ecology and distribution:** On wood in primary rainforest; 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 instead of the thallus.

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



**Figure 4.** *Astrothelium aurantioseptemseptatum*. (left), daylight; (right), under UV-light with thallus orange.

MYCOBANK MB 848706

**Diagnosis:** Corticolous *Astrothelium* with thallus orange-green, UV+ orange, ascomata fused, immersed in thallus-covered hemispherical pseudostromata, hamathecium interspersed, and ascospores 7-septate,  $40\text{--}47 \times 14\text{--}16 \mu\text{m}$ .

**TYPE:** BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 87,330 (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, one or two per pseudostroma. Hamathecium interspersed with hyaline oil globules. Ascospores 8/ascus, hyaline, 7-septate,  $40\text{--}47 \times 14\text{--}16 \mu\text{m}$ , long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

*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 rainforest; 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.

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



**Figure 5.** *Astrothelium bulbosum*. (left), daylight; (right), under UV light with pseudostromata orange.

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 interspersed, and ascospores muriform,  $42\text{--}47 \times 15\text{--}16.5 \mu\text{m}$ .

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , 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 interspersed. Ascospores generally 4/ascus, hyaline, muriform,  $42\text{--}47 \times 15\text{--}16.5 \mu\text{m}$ , 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 bulbose pseudostromata.

*Ecology and distribution:* On tree bark in rainforest; only known from Brazil.

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

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



**Figure 6.** *Astrothelium coloratum*. (left), daylight; (right), under UV-light with thallus yellow and pseudostromata partly yellow, partly orange.

MYCOBANK MB 848708

*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 interspersed, and ascospores muriform,  $100\text{--}117 \times 18\text{--}21 \mu\text{m}$ .

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{ S}$ ,  $60^{\circ}58' \text{ W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,586 (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 interspersed. Ascospores generally 4/ascus, hyaline, muriform,  $100\text{--}117 \times 18\text{--}21 \mu\text{m}$ , 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, both in daylight and under UV.

*Ecology and distribution:* On tree bark in rainforest; 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.

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



**Figure 7.** *Astrothelium inspersoseptatum*.

MYCOBANK MB 848709

*Diagnosis:* Corticolous *Astrothelium* with thallus pale olivaceous green, UV−, ascomata immersed in whitish erumpent pseudostromata, ostioles fused, hamathecium inspersed, and ascospores 9-septate,  $60\text{--}64 \times 12\text{--}14 \mu\text{m}$ .

*TYPE:* BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 85,920 (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, four per pseudostroma. Hamathecium inspersed with hyaline oil globules. Ascospores 8/ascus, hyaline, 9-septate,  $60\text{--}64 \times 12\text{--}14 \mu\text{m}$ , 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 rainforest; 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.

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





**Figure 8.** *Astrothelium insulare*.

MYCOBANK MB 848710

*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,  $50\text{--}56 \times 14\text{--}16$ .

*TYPE:* BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{ S}$ ,  $60^{\circ}58' \text{ W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,484 (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,  $50\text{--}56 \times 14\text{--}16 \mu\text{m}$ , long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

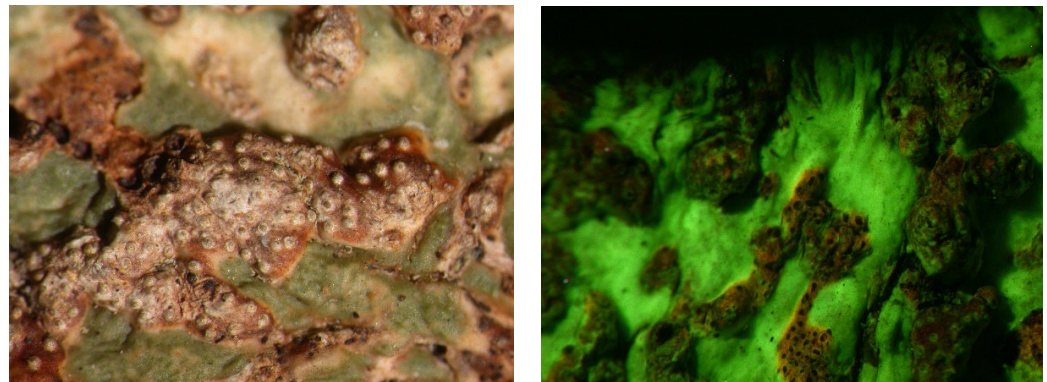
*Chemistry:* Thallus UV−, C−, P−, K−. TLC: nil.

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

*Ecology and distribution:* On tree bark in rainforest; 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.

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



**Figure 9.** *Astrothelium laurerioides*. (left), daylight; (right), under UV-light with pseudostromata orange.

MYCOBANK MB 848711

**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 interspersed, and ascospores muriform,  $75\text{--}80 \times 15\text{--}17 \mu\text{m}$ .

**TYPE:** BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , on *Enterolobium* tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,116 (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 interspersed. Ascospores generally 4/ascus, hyaline, muriform,  $75\text{--}80 \times 15\text{--}17 \mu\text{m}$ , long-ellipsoid, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

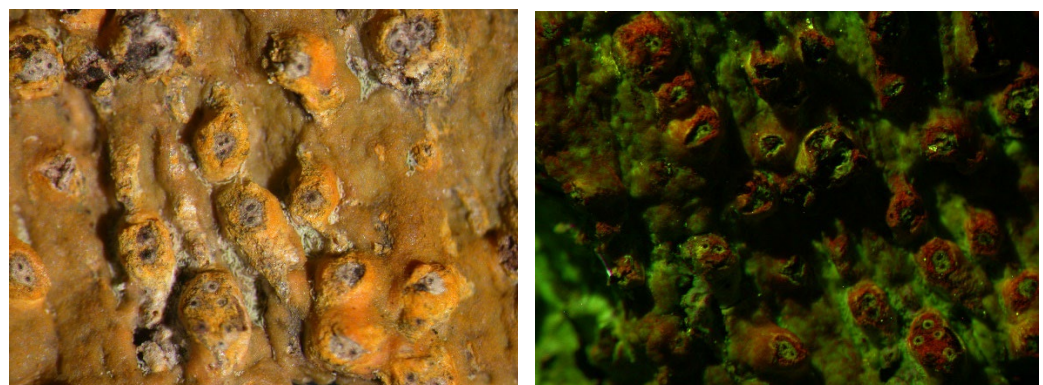
**Chemistry:** Thallus UV−, C−, P−, K−; pseudostromata UV+ orange, C−, P−, K+ red. TLC: An anthraquinone.

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

**Ecology and distribution:** On tree bark in rainforest; 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.

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



**Figure 10.** *Astrothelium marjoleinae*. (left), daylight; (right), under UV light with thallus and pseudostromata orange.

MYCOBANK MB 848712

**Diagnosis:** Corticolous *Astrothelium* with thallus orange-green, UV+ orange, ascomata immersed in thallus-covered hemispherical, UV+ orange pseudostromata, ostioles fused, hamathecium interspersed, and ascospores 7–9-septate,  $62\text{--}67 \times 11\text{--}13 \mu\text{m}$ .

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29' S, 60°58' W, on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,378 (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, 1–3 groups per pseudostroma. Hamathecium interspersed 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 rainforest; 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 86,389, 86,411, & 86,418 (all CGMS, ABL).

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



**Figure 11.** *Astrothelium meandratum*.

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 interspersed, 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 rainforest, 16–20 May 2022, A. Aptroot 86,094 (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,  $270\text{--}305 \times 42\text{--}46 \mu\text{m}$ , fusiform, median septum strongly thickened, not surrounded by a gelatinous sheath. Pycnidia not observed.

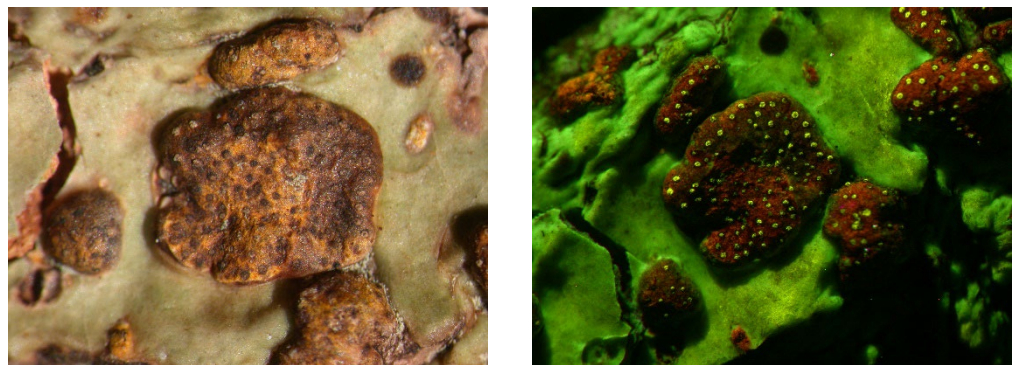
*Chemistry*: Thallus UV<sup>-</sup>, C<sup>-</sup>, P<sup>-</sup>, K<sup>-</sup>. TLC: nil.

*Etymology*: Named for the meandering outline of the pseudostromata.

*Ecology and distribution*: On tree bark in rainforest; only known from Brazil.

*Discussion*: This species would key out as follows in the world key [18]: key O, couplet 18: Ascospores  $270\text{--}305 \times 42\text{--}46 \mu\text{m}$ .

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



**Figure 12.** *Astrothelium multireflexum*. (left), daylight; (right), under UV-light with pseudostromata orange and ostioles yellow.

MYCOBANK MB 848715

*Diagnosis*: Corticolous *Astrothelium* with thallus pale metallic green, UV<sup>-</sup>, ascomata in groups of 5–30 in raised, yellow, UV<sup>+</sup> orange pseudostromata, ostioles apical, UV<sup>+</sup> yellow, hamathecium not inspersed, and ascospores muriform,  $65\text{--}77 \times 12\text{--}14 \mu\text{m}$ .

*TYPE*: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{ S}$ ,  $60^{\circ}58' \text{ W}$ , on *Enterolobium* tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,112 (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,  $65\text{--}77 \times 12\text{--}14 \mu\text{m}$ , long-ellipsoid, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

*Chemistry*: Thallus UV<sup>-</sup>, C<sup>-</sup>, P<sup>-</sup>, K<sup>-</sup>; pseudostromata UV<sup>+</sup> orange, C<sup>-</sup>, P<sup>-</sup>, K<sup>+</sup> red; ostioles UV<sup>+</sup> 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 rainforest; only known from Brazil.

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

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



**Figure 13.** *Astrothelium myopicum*. (left), daylight; (right), under UV light with thallus and pseudostromata orange.

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,  $35\text{--}45 \times 9\text{--}10 \mu\text{m}$ .

**TYPE:** BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{ S}$ ,  $60^{\circ}58' \text{ W}$ , on *Enterolobium* tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,109 (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,  $35\text{--}45 \times 9\text{--}10 \mu\text{m}$ , long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

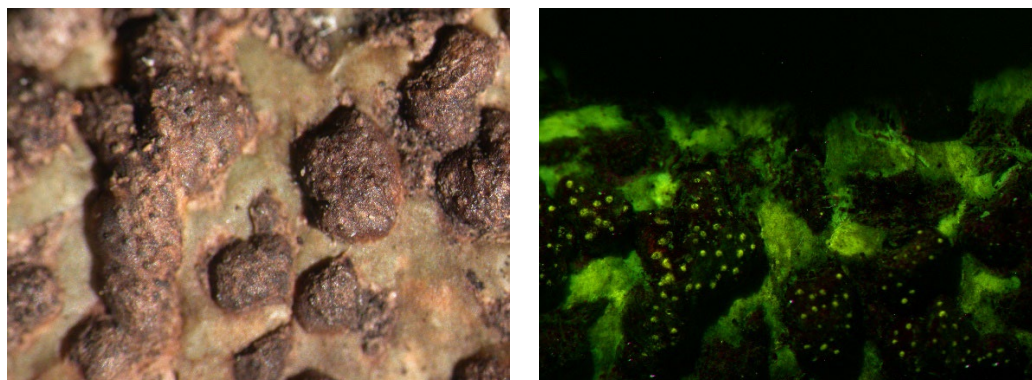
**Chemistry:** Thallus UV+ orange, C–, P–, K+ red; pseudostromata UV+ orange, C–, P–, K+ red. TLC: An anthraquinone.

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

**Ecology and distribution:** On tree bark in rainforest; 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,  $35\text{--}45 \times 9\text{--}10 \mu\text{m}$ .

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



**Figure 14.** *Astrothelium parabathelium*. (left), daylight; (right), under UV light with thallus and ostioles yellow.

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 interspersed, and ascospores muriform,  $115\text{--}130 \times 18\text{--}21 \mu\text{m}$ .

*TYPE:* BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{ S}$ ,  $60^{\circ}58' \text{ W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,535 (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 interspersed. Ascospores generally 4/ascus, hyaline, muriform,  $115\text{--}130 \times 18\text{--}21 \mu\text{m}$ , long-ellipsoid, without thickened central septum, not surrounded by a gelatinous sheath. Pycnidia not observed.

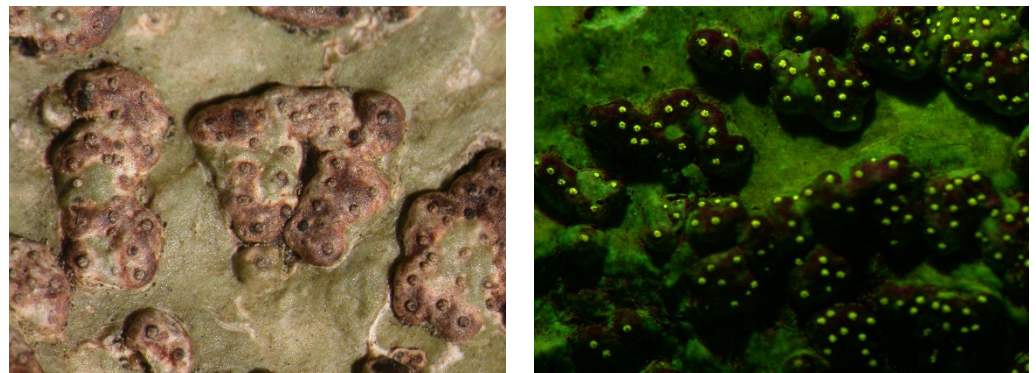
*Chemistry:* Thallus UV+ yellow, C–, P–, K–; pseudostromata UV–, C–, P–, K–; ostioles UV+ yellow. TLC: Lichexanthone.

*Etymology:* Named for the similarity to *Bathelium*.

*Ecology and distribution:* On tree bark in rainforest; only known from Brazil.

*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. Figure 15.



**Figure 15.** *Astrothelium stellare*. (left), daylight; (right), under UV light with ostioles yellow.

MYCOBANK MB 848718

*Diagnosis:* Corticolous *Astrothelium* with thallus olivaceous green, UV–, ascomata in groups of c. 3–40 in raised, brown to whitish, UV– pseudostromata, ostioles apical, UV+ yellow, hamathecium not interspersed, and ascospores muriform,  $120\text{--}140 \times 23\text{--}27 \mu\text{m}$ .

*TYPE:* BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{ S}$ ,  $60^{\circ}58' \text{ W}$ , on *Enterolobium* tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,110 (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 interspersed. Ascospores generally 4/ascus, hyaline, muriform,  $120\text{--}140 \times 23\text{--}27 \mu\text{m}$ , 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.

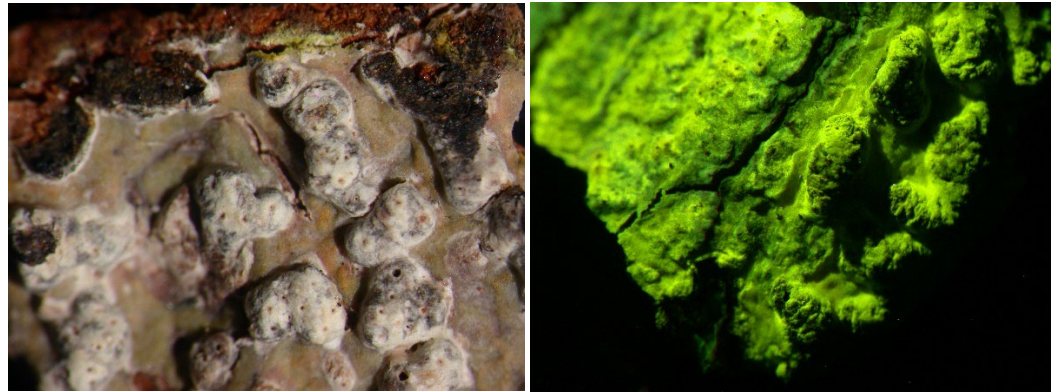
*Etymology:* Named for the brilliantly UV+ yellow ostioles that evoke a starry night.

*Ecology and distribution:* On tree bark in rainforest; 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 86,113, 86,129, 86,338, and 86,343; MATO GROSSO: Reserva Cristalino, alt. 250–350 m, on tree bark in primary rainforest, 22–29 April 2021, Aptroot 84,061, 84,065 (all CGMS, ABL).

***Astrothelium suprainpersum*** Aptroot, sp. nov. Figure 16.



**Figure 16.** *Astrothelium suprainpersum*. (left), daylight; (right), under UV-light with thallus and pseudostromata yellow.

MYCOBANK MB 848719

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

TYPE: BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{ S}$ ,  $60^{\circ}58' \text{ W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,416 (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 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,  $18\text{--}21 \times 6\text{--}7.5 \mu\text{m}$ , 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 inspersed in the upper half of the hamathecium.

*Ecology and distribution:* On tree bark in rainforest; 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  $18\text{--}21 \times 6\text{--}7.5 \mu\text{m}$ .

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



**Figure 17.** *Astrothelium xanthocavatum*.

MYCOBANK MB 848720

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

*TYPE:* BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m, 8°29' S, 60°58' W, on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,551 (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<sup>-</sup>, C<sup>-</sup>, P<sup>-</sup>, K<sup>-</sup>; pseudostramata partly UV<sup>+</sup> yellow, C<sup>-</sup>, P<sup>-</sup>, K<sup>-</sup>. TLC: Lichexanthone.

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

*Ecology and distribution:* On tree bark in rainforest; 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<sup>+</sup> yellow patches, ascospores 140–175 × 21–24 μm.

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





**Figure 18.** *Ocellularia fuscolichexanthonica*.

MYCOBANK MB 848721

**Diagnosis:** *Corticulous Ocellularia* with thallus medulla UV+ white, cortex UV+ yellow, columella isodiametric, c. 0.1 mm wide, surface white, internally brown, excipulum with brown ring-shaped tips, hamathecium not inspersioned, ascospores brown, 3-septate, ellipsoid,  $18\text{--}21 \times 7.5\text{--}8.5 \mu\text{m}$

**TYPE:** BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 86,492 (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 inspersioned. Ascospores 8/ascus, brown, 3-septate, ellipsoid,  $18\text{--}21 \times 7.5\text{--}8.5 \mu\text{m}$ , 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 rainforest; only known from Brazil.

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

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



**Figure 19.** *Ocellularia lichexanthocavata*.

MYCOBANK MB 848722

*Diagnosis:* Corticolous *Ocellularia* with thallus UV+ yellow, columella isodiametric, c. 0.1 mm wide, surface and internally black, margin of thallus color, 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 rainforest, 16–20 May 2022, A. Aptroot 86,424 (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 color, 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 rainforest; 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.

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



**Figure 20.** *Pertusaria amazonica*.

MYCOBANK MB 848723

**Diagnosis:** Saxicolous *Pertusaria* with thallus medulla UV+ white, cortex UV+ yellow, with isidia of thallus color but with black tips, sparsely dichotomously branched, c. 0.3 mm wide, up to 1.3 mm long, hamathecium not interspersed, ascomata globose, c. 0.4 mm diam., 2–8 immersed in sessile warts of thallus color that are constricted at the base, 1–2 mm diam., ascospores 8/ascus but usually four ascospores maturing, hyaline, ellipsoid,  $75\text{--}97 \times 32\text{--}40 \mu\text{m}$ , wall c.  $8 \mu\text{m}$  wide, smooth.

**TYPE:** BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , on siliceous rock along the river in primary rainforest, 16–20 May 2022, A. Aptroot 86,458 (holotype: CGMS; isotype: ABL).

**Description:** Thallus crustose, continuous, corticate, dull, metallic grey, up to 0.3 mm thick, up to 1 m diam., not surrounded by a c. 2–5 mm wide, zoned prothallus. Isidia sparse or copious, of thallus color but with black tips, sparsely dichotomously branched, c. 0.3 mm wide, up to 1.3 mm long. Photobiont trebouxoid. Ascomata globose, c. 0.4 mm diam., 2–8 immersed in sessile warts of thallus color 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 interspersed. Ascospores 8/ascus but usually four ascospores maturing, hyaline, ellipsoid,  $75\text{--}97 \times 32\text{--}40 \mu\text{m}$ , wall c.  $8 \mu\text{m}$  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 rainforest; 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 trebouxoid algae. This species is locally very abundant, covering many complete rockfaces. The new species is markedly different from any described species due to 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 at least 200 species probably occur there.

Additional specimens examined: Same details as the type, Aptroot 86,452, 8457, 86,521, 86,531, 86,441, 86,445, 86,459, 87,342, and 87,347 (all CGMS; ABL).

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



**Figure 21.** *Phaeographis xantholirellinata*.

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 rainforest, 16–20 May 2022, A. Aptroot 86,349 (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 rainforest; only known from Brazil.

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

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



**Figure 22.** *Porina ramiisidiata*.

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 rainforest, 16–20 May 2022, A. Aptroot 86,322 (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 rainforest; 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.

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



**Figure 23.** *Pseudopyrenula connexa*.

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,  $24\text{--}25.5 \times 6.5\text{--}7.5 \mu\text{m}$ .

*TYPE:* BRAZIL. AMAZONAS: Novo Aripuanã, Pousada Rio Roosevelt, alt. 100 m,  $8^{\circ}29' \text{S}$ ,  $60^{\circ}58' \text{W}$ , on tree bark in primary rainforest, 16–20 May 2022, A. Aptroot 85,964 (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,  $24\text{--}25.5 \times 6.5\text{--}7.5 \mu\text{m}$ , long-ellipsoid, lumina diamond-shaped, not surrounded by a gelatinous sheath. Pycnidia not observed.

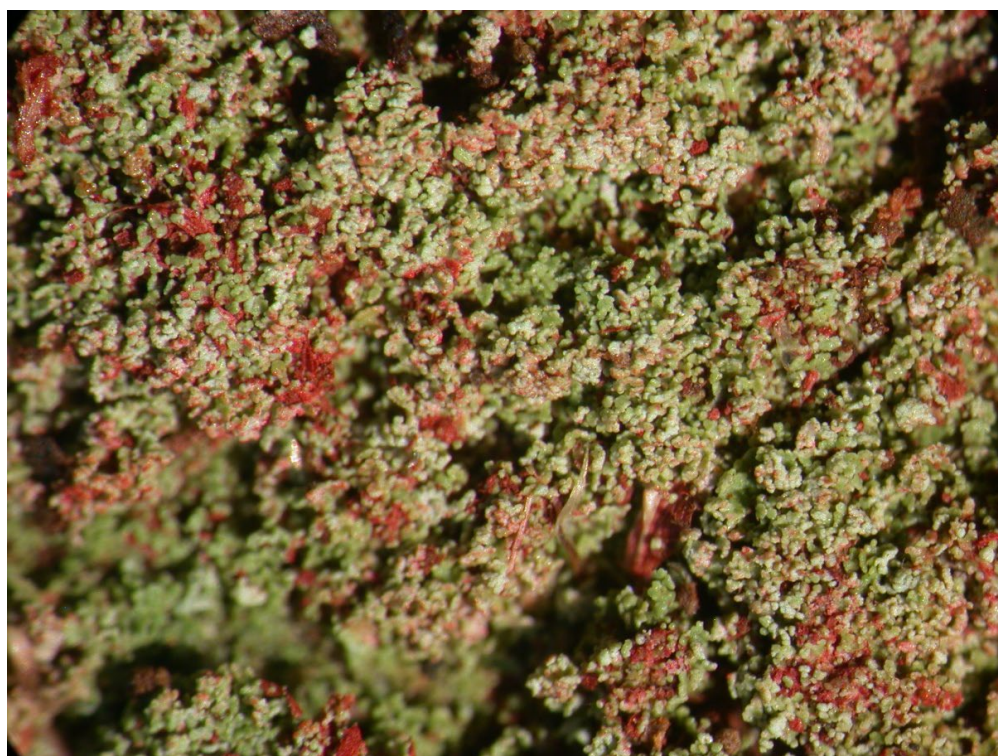
*Chemistry:* Thallus UV−, C−, K−, KC−, P−. TLC: nil.

*Etymology:* Named for the connected ostioles.

*Ecology and distribution:* On tree bark in rainforest; only known from Brazil.

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

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



**Figure 24.** *Spruceidea squamulosa*.

MYCOBANK MB 848728

**Diagnosis:** *Corticolous Spruceidea* 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 bright brick red patches, surrounded by a black prothallus line, which is a continuation of the hypothallus. Squamules greatly 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 rainforest, 16–20 May 2022, A. Aptroot 86,075 (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 greatly dissected into lobules of c. 0.03 mm wide, flattened, at the margin often fragmenting into small propagules. Photobiont trebouxioïd. Ascomata and pycnidia not observed.

**Chemistry:** Thallus UV<sup>-</sup>, C<sup>-</sup>, K<sup>+</sup> purple, KC<sup>-</sup>, P<sup>-</sup>. TLC: Norsoloronic acid.

**Etymology:** Named after the squamules.

**Ecology and distribution:** On tree bark in primary rainforest; only known from Brazil.

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

**Funding:** This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil (CAPES)—Finance Code 001 who provided a visiting professorship to the author. The Stichting Hugo de Vries Fonds kindly gave a generous grant for the fieldwork.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The author declares no conflict of interest.

## References

1. Lücking, R.; Kalb, K. Foliikole Flechten aus Brasilien (vornehmlich Amazonien), inklusive einer Checkliste und Bemerkungen zu *Coenogonium* und *Dimerella* (Gyalectaceae). *Bot. Jahrbücher Für Syst. Pflanzengesch. Pflanzengeogr.* **2000**, *122*, 1–61.
2. Harris, R.C. The family Trypetheliaceae (Loculoascomycetes: Lichenized Melanommatales) in Amazonian Brazil. *Suppl. Acta Amaz.* **1984**, *14*, 55–80. [[CrossRef](#)]
3. Letrouit-Galinou, M.A. Révision monographique du genre *Laurera* (lichens, Trypéthéliacées). *Rev. Bryol. Lichénologique* **1957**, *26*, 207–264.
4. Aptroot, A.; Cáceres, M.E.S. Pyrenocarpous lichens (except Trypetheliaceae) in Rondônia. *Lichenologist* **2013**, *45*, 763–785. [[CrossRef](#)]
5. Aptroot, A.; Cáceres, M.E.S. New lichen species from termite nests in rainforest in Brazilian Rondônia and adjacent Amazonas. *Lichenologist* **2014**, *46*, 365–372. [[CrossRef](#)]
6. Aptroot, A.; Cáceres, M.E.S. A key to the microfoliose, foliose and related crustose lichens from Rondônia, Brazil, with the description of four new species. *Lichenologist* **2014**, *46*, 783–799. [[CrossRef](#)]
7. Aptroot, A.; Cáceres, M.E.S. New Trypetheliaceae from the Amazon basin in Rondônia (Brazil), the centre of diversity of the genus *Astrothelium*. *Lichenologist* **2016**, *48*, 693–712. [[CrossRef](#)]
8. Cáceres, M.E.S.; Ertz, D.; Aptroot, A. New species and interesting records of Arthoniales from the Amazon, Rondônia, Brazil. *Lichenologist* **2014**, *46*, 573–588. [[CrossRef](#)]
9. Cáceres, M.E.S.; Aptroot, A.; Parnmen, S.; Lücking, R. Remarkable diversity of the lichen family Graphidaceae in the Amazon rain forest of Rondônia, Brazil. *Phytotaxa* **2014**, *189*, 87–136. [[CrossRef](#)]
10. Aptroot, A.; Cavalcante, J.G.; dos Santos, L.A.; Oliveira, I., Jr.; Oliveira Lima, D.; Cáceres, M.E.S. Checklist of the lichens of the Reserva Florestal Adolphe Ducke in Manaus (Amazonas, Brazil). *Mycotaxon* **2021**, *136*, 685. [[CrossRef](#)]
11. Cáceres, M.E.S.; Aptroot, A. First inventory of lichens from the Brazilian Amazon in Amapá State. *Bryologist* **2016**, *119*, 250–265. [[CrossRef](#)]
12. Aptroot, A.; Cáceres, M.E.S. New Arthoniales from Amapá (Amazonian North Brazil) show unexpected relationships. *Lichenologist* **2017**, *49*, 607–615. [[CrossRef](#)]
13. Aptroot, A.; dos Santos, L.A.; Cavalcante, J.G.; Oliveira, I., Jr.; Cáceres, M.E.S. Lichens from Brazil: A checklist of lichenized fungi from Acre, in the Amazon. *Mycotaxon* **2021**, *136*, 541. [[CrossRef](#)]
14. Aptroot, A.; Feuerstein, S.C.; Cunha-Dias, I.P.R.; Nunes, A.R.L.; Honorato, M.E.; Cáceres, M.E.S. New lichen species and lichen reports from Amazon forest remnants and Cerrado vegetation in the Tocantina region, northern Brazil. *Bryologist* **2017**, *120*, 320–328. [[CrossRef](#)]
15. Aptroot, A.; Souza, M.F.; dos Santos, L.A.; Oliveira, I., Jr.; Barbosa, B.M.C.; Cáceres, M.E.S. New species of lichenized fungi from Brazil, with a record report of 492 species in a small area of the Amazon Forest. *Bryologist* **2022**, *125*, 433–465. [[CrossRef](#)]
16. Orange, A.; James, P.J.; White, F.J. *Microchemical Methods for the Identification of Lichens*; British Lichen Society: London, UK, 2010.
17. Lücking, R.; Archer, A.W.; Aptroot, A. A world-wide key to the genus *Graphis* (Ostropales: Graphidaceae). *Lichenologist* **2009**, *41*, 363–452. [[CrossRef](#)]
18. Aptroot, A. World key to the species of Pyrenulaceae and Trypetheliaceae. *Arch. Lichenol.* **2022**, *29*, 1–90.
19. Archer, A.W.; Elix, J.A. A Preliminary World-Wide Key to the Lichen Genus *Pertusaria*. 2018. Available online: <https://www.rbgsyd.nsw.gov.au/getmedia/02569f19-bddb-4865-9155-6156d95939f1/Revised-Pertusaria-key-final-August-2018.pdf.aspx> (accessed on 7 May 2023).
20. Cáceres, M.E.S.; Aptroot, A.; Mendonça, C.O.; dos Santos, L.A.; Lücking, R. *Sprucidea*, a further genus of rain forest lichens in the family Malmideaceae (Ascomycota). *Bryologist* **2017**, *120*, 202–211. [[CrossRef](#)]

**Disclaimer/Publisher’s Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.