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Morden-Smithsonian Expedition to Dominica: The Lichens (Parmeliaceae)

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ABSTRACT

Hale, Mason E., Jr. Morden-Smithsonian Expedition to Dominica: The Lichens (Parmeliaceae). *Smithsonian Contributions to Botany,* number 4, 25 pages, 1971.—A revision is made of the lichen family Parmeliaceae in Dominica, based on previous published records by Elliott and on collections by the author. Twenty-two species are now known for *Parmelia,* the only genus in this family on the island. A new species, *Parmelia mordenii,* is described from rock habitats in the dry scrub woodland.

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Mason E. Hale, Jr.

Morden-Smithsonian Expedition to Dominica: The Lichens (Parmeliaceae)

Introduction

Dominica lies in the Windward Lesser Antilles, approximately midway between Trinidad to the south and Antigua to the north. It is the most mountainous island in this chain and has been subject to the least disturbance by man. There are extensive areas of virgin forest, and although commercial logging has begun in earnest in the past five years, it will hopefully remain limited in scope because of the rugged terrain.

The first lichen collector on Dominica was W. R. Elliott. He made remarkably complete collections in 1891–1892 and 1896 on behalf of the West India Natural History Exploration Committee. The specimens were sent to the Finnish lichenologist E. A. Vainio, the authority on tropical lichens at that time. Vainio's first report (1896) covered Elliott's collections numbered below 1,000 from Dominica and his equally large collections from nearby St. Vincent. A second report (1915) dealt mainly with specimens collected by Duss from Guadeloupe and Martinique and by Raunkiaer and Boergesen from the Virgin Islands but included the later series (1896) by Elliott from Dominica numbered between 1,000 and 1,500. Vainio retained duplicates of the first series and returned the originals to the British Museum, but he kept most of the second series from 1896. Thus all of these historically important collections are available either in London (BM) or Turku (TUR).

Alexander Evans made a few collections in the Roseau Botanical Garden during a 1926 cruise, and his specimens are now preserved in the Smithsonian Institution (US). The only other lichenologist to visit the island, as far as I can determine, is Henry Imshaug, who spent about a month there in 1963. His specimens, which I have seen, are preserved at Michigan State University (MSC) and will form part of the materials for his proposed lichen flora of the West Indies. They are not included in this report except for *P. fungicola,* the only species I did not collect.

In January 1969, I had an unparalleled opportunity to study and collect the lichens of this unusual island under the sponsorship of the Morden-Smithsonian Expedition. The immediate goals of this work were to study changes in the lichen flora—especially any attributable to increasing destruction of the native vegetation—to revise Vainio's now outdated lists, and to compile from these and my own collections a modern lichen flora of Dominica. Families will be published separately as completed. This first part on the Parmeliaceae will be followed by the Physciaceae and the Thelotremataceae. A complete set of specimens is deposited in the Smithsonian Institution with duplicates as available going to the British Museum.

Sincere thanks are due Mrs. William J. Morden, sponsor of the Morden-Smithsonian Expedition, who in addition arranged for curating and transportation facilities in Dominica. Under this program I was also able to visit herbaria in Europe for a special study of the historical Dominican and West Indian lichen collections. In this connection I want to give special thanks to Dr. Reino Alava (TUR), Mr. Peter James (BM), and Mr. S. Christiansen (C) for providing space for study and permitting extensive loans.

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Physiography and Climate of Dominica

Dominica is approximately 50 km long and 25 km wide with a maximum elevation of 1,420 m (Morne Diablotin). There is a fairly extensive system of roads and trails that greatly simplify field work. The island is entirely of volcanic origin with active fumaroles and a boiling lake in the interior southeast of Roseau. The climate and vegetation zones have been summarized in detail by Hodges (1954). Briefly, the annual temperature variation is small, as one would expect for a tropical island lying near 15°N latitude. The west coast, facing the Caribbean, has a pronounced dry season from about February to June. The vegetation is xerophytic and in places savanna-like (Figure 1). The east coast is wetter, with dense low forest buffeted by the strong trade winds off the Atlantic Ocean. The bulk of the island above about 300 meters elevation is covered with primary and secondary rain forest (Figure 2). Rainfall here is heavy (in the range of 3,000 mm) and distributed more or less thoughout the year. Actual logging in this zone is going ahead at Pont Cassé (Figure 3) and at the D'leau Gommier

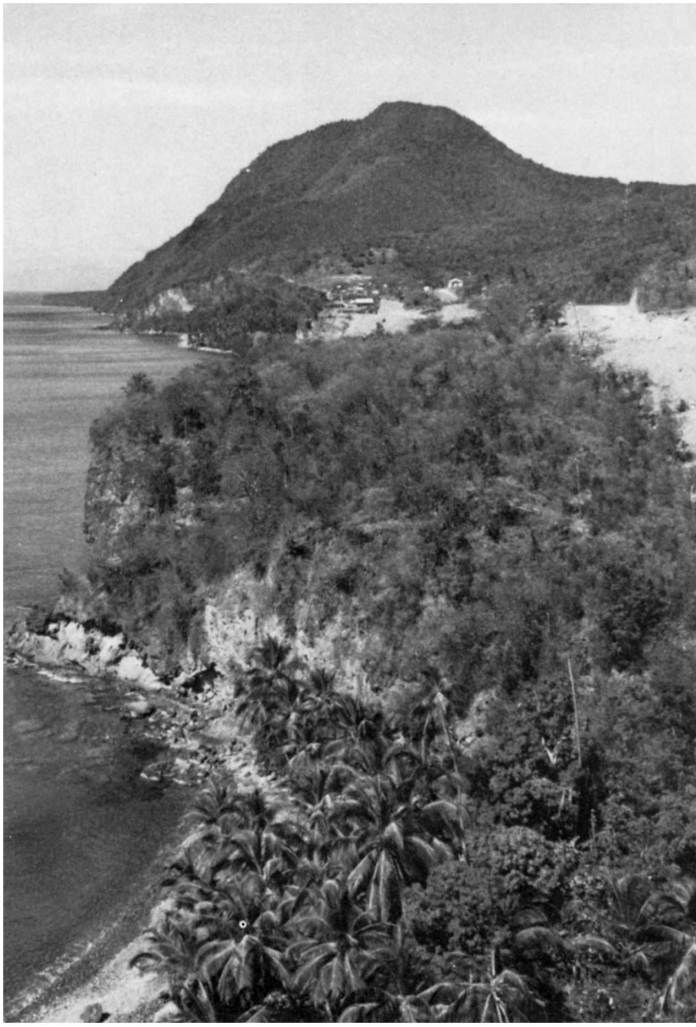

FIGURE 1.—Aspect of the dry scrub woodland (Barber's Block in background) along the west coast of Dominica.

FIGURE 2.—Rain forest in the center of the island (taken from near Springfield with Morne Diablotin in the background).

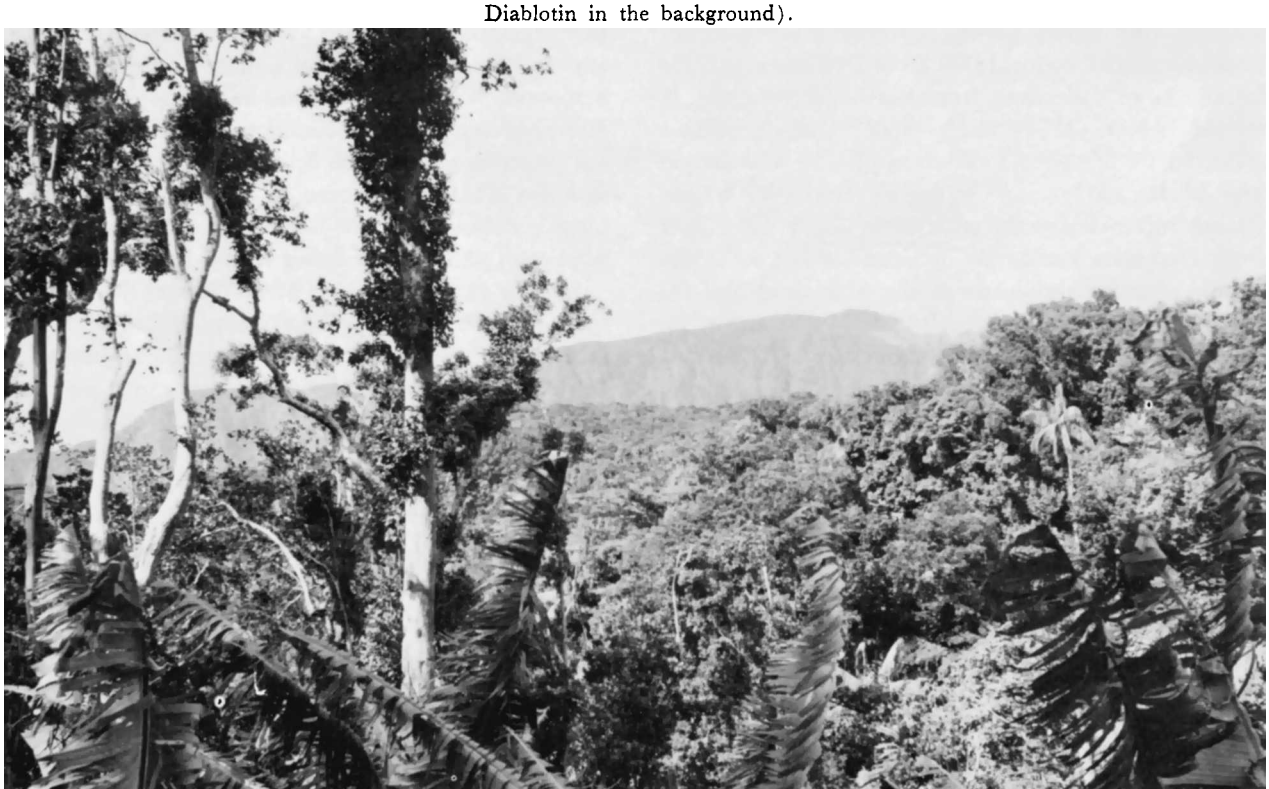

FIGURE 3.—Logging road in primary rain forest about 1 km southeast of Pont Cassé.

Forest Reserve. Above about 1,000 m elevation is a transition to mossy forest where the stunted trees are draped with mosses. On higher exposed ridge tops above 1,300 m to the highest mountain tops (Figure 4) one finds a peculiar elfin forest or thicket dominated by *Clusia*.

Parmelia Vegetation

The most interesting area on Dominica is the dry scrub woodland along the west coast, characterized by scattered deciduous trees and lava outcrops. Indicator species are *P. dominicana, P. cristifera,* and *P. martinicana* on the trees, and *P. mordenii* and *P. subramigera* on the rocks. Coconut palms in this belt, as well as along shorelines elsewhere on most of the island, are usually covered with *P. endosulphurea* (Figure 5), the most conspicuous lichen on the island, *P. cristifera, P. praesorediosa, P. dominicana,* and *P. laevigatula. Parmelia subcrinita* is common on rocks at Rodneys Rock.

The lower rain forest zone between about 300 and 600 m is the richest area for lichens. This is also the location of the numerous planted citrus groves (Figure 6). The commonest species here, both on virgin trees and citrus, are *P. antillensis, P. dissecta,* and *P. laevigata;* more rarely one will collect *P. costaricensis* or *P. microblasta.* The undisturbed rain forest zone above 700 m, extending upward to near 1,000 m, is exceedingly poor in *Parmelia* species, and only *P. subfatiscens* grew here at all commonly and could be found only on the canopy branches of felled trees. *Parmelia peralbida,* a Caribbean endemic, was the only species collected in the mossy forest zone, and no species were found in the elfin *Clusia* forests.

These distinctive lichen communities depend on the maintenance of the native forests or a similar environment for their continued existence. Lichens are among the first plants to succumb to pollution and habitat disturbances, no doubt because of their unusual nature, that of a composite plant association of fungus and alga. The delicate symbiotic balance between the two components is easily upset. Lichens have, therefore, considerable value as bio-indicators of the environment. Generally speaking, we can view a depauperate lichen flora, that is, the present flora compared with the original one reconstructed from historical records, as a reflection of this phenomenon. From the evidence of the past hundred years, it is obvious that urbanization and intensive farming have so altered the biosphere that only a few of the original plants and animals are able to survive in many temperate areas.

When we compare the lichen flora of Dominica of 80 years ago, as evidenced by Elliott's collections, with our results, we find that all the species have been recollected, sometimes at the very same locality. Surely this may be interpreted as a good sign that the pristine environment of Dominica has undergone little if any change. There is no general or localized air pollution such as now poses a serious threat to industrialized nations. The people here continue to live in a relatively undeveloped agricultural society, and even when rain forest is cleared for citrus, planted trees soon become colonized with native lichens that apparently invade from nearby undisturbed areas.

The only significant ecological difference following invasion is that the rain forest lichens, such as *P. antillensis,* which normally inhabit the canopy of virgin

FIGURE 4.—Elfin forest with *Clusia* on the summit of Morne Diablotin.

trees, now grow on the lower branches and trunks of cultivated trees. In other words, the microenvironment of the canopy has now been shifted downward, but the persistence of lichens in this new habitat and in adjacent secondary forest is a favorable indication that the ecological changes are not catastrophic.

The present commercial logging operations, however, can potentially inflict large-scale harm on the lichens, much more so than the effects of small-scale clearing practiced by the Dominicans. The difference is that loggers clear-cut over large areas, depriving the lichens of an immediate source of propagules and bringing on abrupt ecological changes. The first *Parmelia* to be affected is the West Indies-South Africa *P. subfatiscens,* a lichen confined to virgin forest canopy and not able to invade secondary forest.

In another vegetation zone, the scrub woodland, local cutting is decimating habitats for the Caribbean endemic *P. martinicana,* which does not easily invade palm or other cultivated trees. This lichen, too, could disappear from the flora.

In these two examples I am not implying that loss of the lichen flora would have even the remotest effect on the economy of Dominica, but land-use patterns that enable lichens to survive would reflect a more balanced management of the forest resources. In this case lichens would behave as indicators of undesirable ecological change. One cannot escape the conclusion that logging, for example, must be done selectively over smaller areas and that replanting programs be carried out vigorously if irreparable damage is not to be done to the watershed and soil.

The *Parmelia* Flora

Vainio (1896, 1915) reported 11 species of *Parmelia* from Elliott's collections. A summary of these with my revisions is given below:

FIGURE 5.—Coco palm at the mouth of the Layou River, covered with *Parmelia endosulphurea* and *P. dominicana.*

P. blastica Vainio=*P. antillensis* Nylander
P. cryptochlora Vainio=correct determination
P. dissecta Nylander=correct determination
P. dominicana Vainio=correct determination (in part; see discussion under *P. mordenii)*
P. laevigata (Smith) Acharius= correct determination
P. latissima var. *cristifera* (Taylor) Hue=*P. cristifera* Taylor
P. martinicana Nylander=correct determination
P. minarum Vainio=*P. dissecta* Nylander
P. perlata var. *flavogranulosa* Vainio=*P. dominicana* Vainio
P. peruviana Nylander=*P. laevigata* (Smith) Acharius
P. tropica Vainio=*P. costaricensis* Nylander

The revised total is 8 species that were collected by Elliott. I was able to re-collect all of these and an additional 13 species. Adding the record of *P. fungicola* by Imshaug, we now have a total of 22 species of *Parmelia* known in Dominica. Missing from the flora are such conspicuous pantropical weeds as *P. crinita* Acharius, *P. latissima* Fée, *P. reticulata* Taylor, and *P. tinctorum* Nylander. If these actually do occur on Dominica, they must be very rare.

We know more of the lichens in the West Indies than in any other tropical region (see Imshaug's catalogue, 1957). Nearly 100 species of *Parmelia* are represented, with the greatest number on Jamaica and Hispaniola. The *Parmelia* flora of Dominica and the Lesser Antilles in general, however, is not as well developed, partly because these islands are geologically younger and less elevated, remote from the main routes of plant migration, and partly because of a climate hardly ideal for lichen growth, the lower elevations being very dry, even desertlike, and the higher elevations having excessive rainfall. Furthermore, the highest elevation in Dominica (1,420 m) is still well below the zone (1,600–2,000 m) where one can expect to find the highly developed montane oak forest so rich in *Parmelia* or the high elevation pine forests such as those in Hispaniola.

The 22 species of *Parmelia* from Dominica may be categorized broadly as follows in the context of their West Indies and world-distribution patterns (species with asterisks are typically montane in the tropics;

FIGURE 6.—Citrus grove at the turnoff to Trafalgar Falls.

those without asterisks are generally lowland weedy species):

Pantropical:
- *P. costaricensis**
- *P. cristifera*
- *P. dissecta**
- *P. dominicana*
- *P. endosulphurea*
- *P. imbricatula**
- *P. microblasta**
- *P. praesorediosa*
- *P. pseudosinuosa**
- *P. rockii**
- *P. subcrinita*
- *P. subramigera*

Tropical North and South America:
- *P. congruens* (with occurrence in Africa)
- *P. fungicola*
- *P. laevigatula*

Endemic to the Caribbean region:
- *P. antillensis**
- *P. martinicana*
- *P. mordenii*
- *P. peralbida**

Caribbean region-South Africa:
- *P. subfatiscens**

Endemic to Dominica:
- *P. cryptochlora**

Temperate North and South America and Europe:
- *P. laevigata**

In the course of this study I had the opportunity to study other records of *Parmelia* from the Lesser Antilles published by Vainio on specimens preserved at TUR. Revisions of these are as follows:

Parmelia addenda Vainio (1915, p. 21)=*P. dissecta* Nylander (*Duss* 1030, Guadeloupe).

Parmelia borrerioides Nylander (1915, p. 20)=*P. cryptochlorophaea* Hale (*Lassen,* Trinidad).

Parmelia coralloidea (Meyen and Flotow) Vainio (1915, p. 16)=*P. tinctorum* Nylander (all reports listed).

Parmelia crinita Acharius (1915, p. 14)=correct determination (*Eggers,* St. Thomas; *Hornbeck,* Virgin Islands).

Parmelia chilena Nylander (1896, p. 34)=*P. scortella* Nylander (*Elliott* 17, St. Andrews). I have been unable to typify *P. chilena* from the materials available in the Nylander herbarium.

Parmelia granatensis Nylander (1915, p. 20)= *P. martinicana* Nylander (*Raunkiaer* 545, St. Croix).

Parmelia lusitana Nylander and *P. lusitana* var. *decipiens* Vainio (1915, p. 24)=*P. subramigera* Gyelnik (all records listed except for *Boergesen* (St. Thomas), which is close to *P. plittii* Gyelnik and contains stictic acid).

Parmelia microblasta Vainio (1915, p. 21)=correct determination (*Duss* 676, Guadeloupe).

Parmelia perlata "Krempelhuber" (1915, p. 13)= *P. dilatata* Vainio (*Lassen,* Trinidad).

Parmelia raunkiaeri Vainio (1915, p. 19)=correct determination (*Raunkiaer* 461 and *Boergesen,* St. Croix).

Parmelia scabrosa Vainio (1896, p. 33)=*P. martinicana* (*Elliott* 249, St. Vincent).

Parmelia scortella Nylander (1915, p. 22)=? (Specimen so named (*Lassen*) not found at TUR or C).

Parmelia sulphurata Nees and Flotow (1915, p. 16)=*P. endosulphurea* (Hillmann) Hale (all records listed).

Parmelia subcrinita Nylander (1915, p. 16)=correct determination (*Boergesen,* St. Thomas).

Finally, I published a record of *P. dilatata* from Dominica (Hale, 1965, p. 247) but on reexamination the specimen cited, *Evans* 57, proved to be *P. dominicana.*

Taxonomic Arrangement

The species are listed alphabetically in the main list. Their phylogenetic arrangement is, according to the classifications proposed by Hale (1965) and Hale and Kurokawa (1964), as follows:

Subgenus *Xanthoparmelia* (Vainio) Hale
- *P. subramigera*

Subgenus *Amphigymnia* (Vainio) Dodge
- Section *Amphigymnia*
  - *P. cristifera*
  - *P. dominicana*
  - *P. endosulphurea*
  - *P. mordenii*
  - *P. peralbida*
  - *P. praesorediosa*
- Section *Perlatae* (Müller-Argau) Jatta[1]
  - *P. subcrinita*

Subgenus *Parmelia*
- Section *Imbricaria* (Schreber) Fries
  - *P. antillensis*
  - *P. cryptochlora*
  - *P. dissecta*
  - *P. subfatiscens*
- Section *Bicornuta* Lynge
  - *P. fungicola*
  - *P. laevigatula*
- Section *Cyclocheila* (Vainio) Räsänen
  - *P. congruens*
  - *P. martinicana*
- Section *Hypotrachyna* Vainio
  - *P. costaricensis*
  - *P. imbricatula*
  - *P. laevigata*

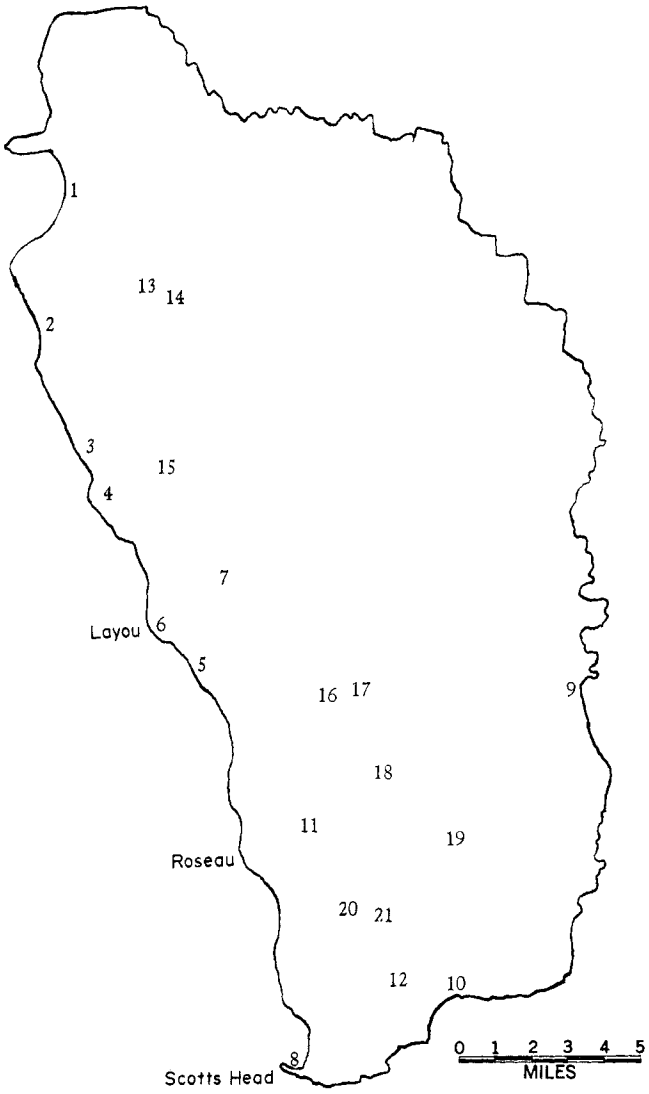

FIGURE 7.—Localities where *Parmelia* specimens were collected by Hale (see text for explanation).

[1] This sectional name antedates section *Subflavescentes* (Vainio) Gyelnik, which I had proposed in a monograph of subgenus *Amphigymnia* (Hale, 1965, p. 269) (see Culberson, 1966, p. 225). Accordingly, series *Emaculatae* Hale would be synonymous with series *Perlatae.*

P. microblasta
P. pseudosinuosa
P. rockii

Collecting Localities

I collected *Parmelia* specimens at 21 of approximately 35 localities visited on the island (see Figure 7). These are coded by the following numbers in the list of specimens examined.

Dry Scrub Woodlands

1. Along road south of Portsmouth (sea level); roadside palms and evergreen trees.
2. Just north of Bioche (60 m); deciduous scrub forest and outcrops.
3. Near Coulibistri (30 m); deciduous scrub forest and outcrops.
4. Grand Savane (30–50 m); deciduous scrub in savanna and on cliffs.
5. Rodneys Rock (sea level); dense evergreen scrub forest and outcrops at shoreline.
6. Flood plain at mouth of Layou River (sea level); coconut palm plantation.
7. Clarke Hall (30 m); palm and cocoa plantations.
8. Scotts Head (sea level); rocks and hardwood trees above shoreline.

Littoral Woodland

9. Rosalie Bay (sea level); palm plantations.
10. Grand Bay (sea level); palm plantations.

Seral Vegetation

11. Road to Laudat at Trafalgar turnoff (200 m); citrus groves.
12. East of Pichelin (200 m); roadside outcrops and trees.

Rain Forest

13. Felicité (400 m); secondary rain forest along road.
14. Syndicate Estate (600 m); citrus groves and remains of rain forest.
15. Jean (650 m); remnants of rain forest.
16. Dom-Can logging area at Brantridge Estate (550 m); disturbed rain forest, now being selectively logged.
17. Dom-Can logging area just east of Pont Cassé (650 m); virgin rain forest being clear-cut.
18. Laudat (300–450 m); secondary rain forest.
19. Valley of Desolation (800 m); hardwood trees in stabilized area.
20. Giraudel (600–650 m); disturbed secondary rain forest and pasture.

Mossy Forest

21. Trail from Giraudel to Morne Anglais (800–1,000 m); rain forest intergrading into mossy forest.

Surprisingly no *Parmelia* species were found at the D'leau Gommier Forest Reserve (800 m) in the center of the island, now being clear-cut, or at a logging area at about 300 m, Newfoundland, on the east coast. Nor was I able to find any *Parmeliae* in the Freshwater Lake area (beyond Laudat), at Morne Diablotin, or on the summit of Morne Anglais.

Key to Species of *Parmelia*

The following key includes the 22 species so far collected in Dominica, in addition to several others enclosed in brackets that occur on other islands in the Lesser Antilles and might yet be found on Dominica.

1. Thallus large, 6–25 cm in diameter, usually loosely attached to adnate; lobes quite broad, 3–15 mm wide 2
[2. Thallus lacking soredia and isidia ..... ***P. zollingeri*** Hepp]
2. Thallus with soredia or isidia 3
3. Soredia present 4
4. Soredia distinctly yellowish (usnic acid) ..... ***P. dominicana***
4. Soredia white 5
5. Medulla K+ yellow turning red ..... ***P. cristifera***
5. Medulla K— or slowly K+ faint yellow 6
6. Medulla P+ red ..... ***P. dilatata***
6. Medulla P— or P+ faint yellow 7
7. Growing on rocks ..... ***P. mordenii***
7. Growing on trees ..... ***P. praesorediosa***
3. Soredia lacking but upper surface covered with isidia 8
8. Medulla when exposed pale orange yellow ..... ***P. endosulphurea***
8. Medulla white 9
[9. Medulla C+ deep red (see also *P. martinicana*) ..... ***P. tinctorum***]
9. Medulla C— 10
10. Collected on rocks ..... ***P. subcrinita***

Key to Species of *Parmelia*—Continued

10. Collected on trees 11
11. Collected in dry scrub woodland; isidia short, often deformed and irregular ***P. martinicana***
11. Collected in citrus groves, rain forest, or mossy forest; isidia tall, cylindrical 12
12. Medulla K— ..... ***P. peralbida***
12. Medulla K+ yellow turning red ..... ***P. antillensis***

1. Thallus small to medium sized, 2–10 cm broad, usually closely adnate; lobes narrow, 1–4 mm wide 13
13. Thallus lacking isidia and soredia ..... ***P. congruens***
13. Thallus isidiate or sorediate to pustulate 14
14. Thallus isidiate 15
15. Collected on rocks ..... ***P. subramigera***
15. Collected on trees 16
16. Thallus greenish yellow ..... ***P. microblasta***
16. Thallus whitish mineral gray 17
17. Medulla K+ yellow turning red ..... ***P. antillensis***
17. Medulla K— 18
18. Margins of lobes without cilia; rhizines densely dichotomously branched, sometimes projecting outward along the margin 19
19. Medulla KC+ orange ..... ***P. imbricatula***
19. Medulla KC— ..... ***P. costaricensis***
18. Margins of lobes ciliate or bulbate-ciliate 20
20. Margins ciliate, the cilia simple ..... ***P. dissecta***
20. Margins inflated bulbate-ciliate 21
21. Isidia becoming flattened and lobulate ..... ***P. fungicola***
21. Isidia all cylindrical, not lobulate 22
22. Medulla deep C+ red (lecanoric acid); thallus thick, whitish ***P. laevigatula***
[22. Medulla C+ rose (gyrophoric acid); thallus thin, greenish to tan mineral gray ..... ***P. scortella***]

14. Thallus sorediate 23
23. Rhizines richly dichotomously branched, dense 24
24. Medulla C+, KC+ orange ..... ***P. laevigata***
24. Medulla C— or C+, KC+ rose 25
25. Medulla P+ red ..... ***P. pseudosinuosa***
25. Medulla P— ..... ***P. rockii***
23. Rhizines simple or furcate, usually sparse 26
26. Soralia pustulate, irregular and mostly laminal ..... ***P. subfatiscens***
26. Soralia with powdery soredia, marginal or subterminal 27
27. Lobes 1–2 mm wide, linear; medulla C+ rose ..... ***P. cryptochlora***
[27. Lobes 3–5 mm wide, sublinear and rotund; medulla C— ***P. cryptochlorophaea*** Hale]

List of Species

The species are listed in alphabetic order with the following information:

Citation with synonymy.

Brief description with diagnostic characters.

Chemistry as determined with thin-layer chromatography: Merck SiO_2—F_{254}-coated glass plates, using two solvent systems simultaneously, benzene-dioxane-acetic (90:25:4 v/v) and hexane-ether-formic acid (5:4:1 v/v), spraying with 10% H_2SO_4 and heating for 10 minutes at 110°C. Identification was made by comparing acetone extracts of the Dominican specimens with known pure compounds or extracts of lichens of proven composition on the same chromatogram; confirmatory microcrystal tests were made in some cases.

World distribution and habitats as determined from literature reports, unpublished notes, and herbarium specimens.

Discussion of important features of the species and their relationships.

Specimens examined: Elliott's material in BM and TUR, Evans material in US, and Hale collections in US with coded localities.

1. *Parmelia antillensis*

Parmelia antillensis Nylander, 1869, p. 264.

P. blastica Vainio, 1896, p. 32. [Type collection: Shawford Estate, Dominica, *Elliott* 899 (BM, lectotype; TUR, isotype).]

TYPE COLLECTION.—Matouba, Guadeloupe, *Husnot* 445 (H, Nylander Herbarium 35200, lectotype; G, P, isotypes).

DESCRIPTION.—Thallus adnate to loosely attached, whitish mineral gray, membranous, 6–10 cm in diameter; lobes subirregular, rotund, imbricate to crowded and convoluted, 4–5 mm wide; marginal cilia sparse; upper surface plane, continuous, becoming white-pruinose at the lobe tips, moderately isidiate, the isidia mostly simple, less than 0.5 mm high; lower surface densely rhizinate except for a narrow naked zone along the margins, black at the center and brown at the margin, the rhizines simple. Apothecia rare, adnate, 3–5 mm in diameter; spores $5–6 \times 7–8\mu$.

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K+ yellow to red, C−, KC−, P+ pale orange (norstictic acid). A trace of salacinic acid is also probably present. The unknown spot accompanying norstictic acid in *P. microblasta* is lacking.

WORLD DISTRIBUTION AND HABITATS.—United States (Tennessee), Mexico, Honduras, West Indies; on hardwoods at mid-elevations (600–2,000 m).

This species is very common on citrus trees in the citrus belt along the west coast and is, in fact, the most commonly collected *Parmelia* on the island. It occurs only on canopy branches in undisturbed rain forest. The closely related nonisidate norstictic acid-containing *P. phlyctina* Hale was not found here. These two Caribbean endemics are the only species in section *Imbricaria* that produce norstictic acid.

SPECIMENS EXAMINED.—Shawford Estate, *Elliott* 1592 (TUR), 900 (BM, TUR, syntype of *P. blastica* Vainio); Laudat, *Elliott* s.n. (TUR), with 912 (TUR). Hale collections: 11 (35796), 14 (s.n., to be distributed in Vězda, *Lichenes Selecti Exsiccati*), 17 (35140), 18 (35592, 35596, 35598), 20 (35755, 35504), 21 (35333).

2. *Parmelia congruens*

Parmelia congruens Acharius, 1810, p. 491.

P. leucochlora Tuckerman in Nylander, 1860, p. 392. [Type collection: Louisiana, *Hale* (FH-Tuck, lectotype; US, isotype). Not *P. leucochlora* (Montagne) Gay, 1852, p. 152 [=*Lecidea*].]

P. cubensis Nylander, 1885, p. 611. [Type collection: Cuba, *Wright, Lichenes cubi* 76 (H, holotype; FH, K, US, isotypes).]

P. uleana Müller-Argau, 1889, p. 506. [Type collection: Morro da Nova Cintra, Rio de Janeiro, Brazil, *Ule* 10 (G, holotype).]

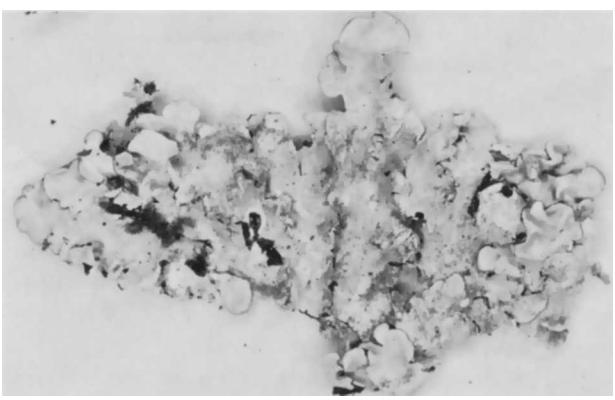

FIGURE 8.—*Parmelia antillensis*, ×1 (*Hale* 35333).

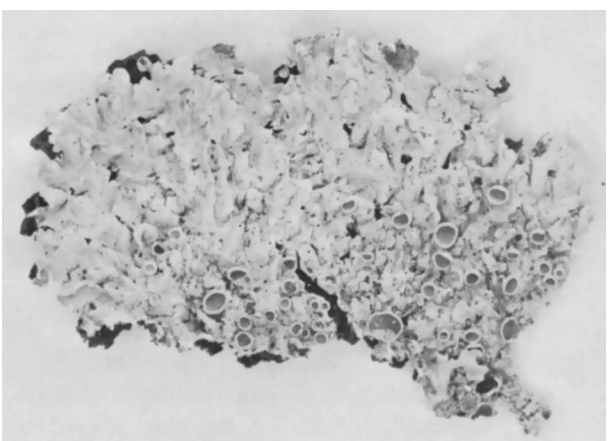

FIGURE 9.—*Parmelia congruens*, ×1, (*Hale* 35636).

P. flavidoglauca Vainio, 1890, p. 65. [Type collection: Caraça, Minas Gerais, Brazil, *Vainio, Lichenes Brasilienses Exsiccati* 1301 (TUR, holotype; BM, FH, UPS, isotypes).]
P. endoxantha Merrill, 1909, p. 73. [Type collection: Sanford, Florida, *Rapp* (FH, holotype).]
P. bipindensis Dodge, 1959, p. 59. [Type collection: Bipinde, Cameroons, *Zenker* 4053 pro parte (K, holotype).]
P. zenkeri Dodge, 1959, p. 74. [Type collection: Bipinde, Cameroons, *Zenker* 4053 (K, holotype; L, isotype).]

TYPE COLLECTION.—North America, *Swartz* (UPS, lectotype).

DESCRIPTION.—Thallus closely adnate on bark, 5–10 cm in diameter, pale greenish mineral gray, often turning chamois in the herbarium; lobes sublinear-elongate, 2–4 mm wide; upper surface plane to convex, more or less maculate, rugulose to minutely pitted with age; medulla white to pale yellow; lower surface light tan to pale olive brown, rugose, moderately rhizinate, the rhizines simple, tan. Apothecia common, adnate, 2–3 mm in diameter; spores 6–8 × 7–9μ.

CHEMISTRY.—Cortex K+ yellowish (traces of atranorin and usnic acid); medulla yellowish with the color reagents (?barbatic acid, ?stictic acid, unknowns). The chemistry is complex and still not resolved. Spots are numerous and streaked on chromatographic plates. The yellowish medulla may be conspicuously developed to very pale.

WORLD DISTRIBUTION AND HABITATS.—Southern United States, West Indies, Mexico, Central America, northern South America, Congo, Angola, Madagascar; on palms, cypress, and hardwoods at low elevation (sea level to 1,200 m).

This widespread tropical species has been poorly understood, as one would surmise from the list of synonyms. The identity of the species in North America, the type locality, has never been established, and when used the name has been applied to species such as *P. caperata* and *P. conspersa*. I have typified *P. congruens* from a fragment in the Uppsala Herbarium, a Swartz specimen, there being no satisfactory material in the Acharian Herbarium (H). It has a light olive-brown lower surface with simple coarse rhizines and lacks cilia and soredia or isidia, four features that make identification of the species more or less unequivocal. *Parmelia hypomiltha* Fée is morphologically very close but has an anthraquinone in the lower medulla. *Parmelia cyphellata* Santesson, known from a single collection in Brazil, is apparently the isidiate counterpart of *P. congruens*.

Parmelia congruens is always corticolous and in Dominica occurs on sheltered cocoa palms in the northwestern part of the island.

SPECIMENS EXAMINED.—Hale collections: 2 (35636), 6 (35775), 7 (35779).

3. *Parmelia costaricensis*

Parmelia costaricensis Nylander in Polakowsky, 1877, p. 225.
P. sublaevigata f. *isidiosa* Müller-Argau, 1880, p. 267. [Type collection: Petropolis, Brazil, *Deventer* 49 (G, holotype).]
P. tropica Vainio, 1896, p. 33. [Type collection: Hermitage Woods, St. Vincent, *Elliott* 276 (BM, lectotpye; TUR, isotype).]
P. tropica var. *deformis* Vainio, 1896, p. 33. [Type collection: St. Vincent, *Elliott* 12 (BM, lectotype).]
P. deformis (Vainio) Vainio, 1907, p. 169.
P. amoena Zahlbruckner, 1908, p. 464. [Type collection: Serro do Ouro Preto, Brazil, *Damazio* 1435 (WU, lectotype; H, isotype).]

TYPE COLLECTION.—Angostura, Costa Rica, *Polakowsky* (H, Nylander Herbarium 35202, holotype).

DESCRIPTION.—Thallus adnate to loosely attached, whitish mineral gray, 6–10 cm in diameter; lobes sublinear to subirregular, 2–6 mm wide; upper surface plane, usually strongly maculate, moderately isidiate, the isidia simple or branched; lower surface moderately rhizinate, black, the rhizines dichotomously branched. Apothecia rare (not seen in Dominica), adnate, 2–7 mm in diameter; spores 4–6 × 8–10μ.

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla negative with color reagents (protoliches-

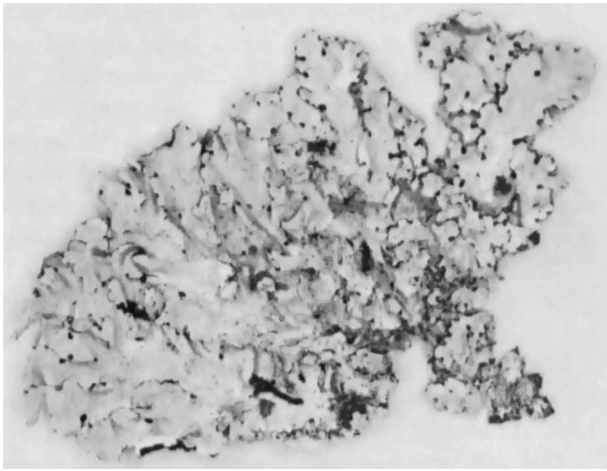

FIGURE 10.—*Parmelia costaricensis*, ×2 (*Hale* 35569a).

terinic acid, possibly intermixed with caperatic acid). As with most fatty acid-containing species of *Parmelia,* the chemistry is not fully elucidated. The present microcrystal tests do not adequately separate fatty acids. In this particular species the feathery crystals from G.E. solution suggest that protolichesterinic acid at least predominates.

WORLD DISTRIBUTION AND HABITATS.—West Indies, Central and South America, Philippines, Indonesia, and Malaysia; on tree trunks and rocks at mid to high elevations (400–3,300 m).

Although Elliott collected some large specimens of *P. costaricensis,* this seems to be a rare lichen in Dominica. It has rather broad lobes in contrast to the more usual linear-elongate lobes of section *Hypotrachyna.* Rhizines form a dense mat. Maculae in the upper cortex are usually conspicuous in New World specimens, less so or absent in Asian populations tentatively identified with *P. costaricensis.* The species is superficially close to *P. imbricatula* (see under that species) and all isidiate specimens with branched rhizines should be color tested with KC, *P. imbricatula* being deep KC+ orange.

SPECIMENS EXAMINED.—Shawford Estate, *Elliott* 1529 (TUR). Hale collection: 14 (35569a).

4. *Parmelia cristifera*

Parmelia cristifera Taylor, 1847, p. 165. [For full synonymy see Hale, 1965, p. 241.]

TYPE COLLECTION.—Calcutta, India, *Wallich* (FH-Tayl, lectotype).

DESCRIPTION.—Thallus loosely attached, light mineral gray, 10–25 cm broad; lobes broad and rotund, 12–20 mm wide; margins of lobes sorediate, the soralia linear; upper surface dull, continuous or becoming cracked with age; lower surface black and sparsely rhizinate at the center, naked and brown along the margins. Apothecia rare (not seen in Dominica), 1–5 mm in diameter; spores 13–18×26–35μ.

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K+ yellow to red, C−, KC−, P+ orange red (salacinic acid).

WORLD DISTRIBUTION AND HABITATS.—Pantropical; on trees and rocks at lower elevations (sea level to 1,500 m).

This common pantropical weed is well developed in Dominica, usually growing on palm trees. It is close to the protocetraric acid-containing *P. dilatata*

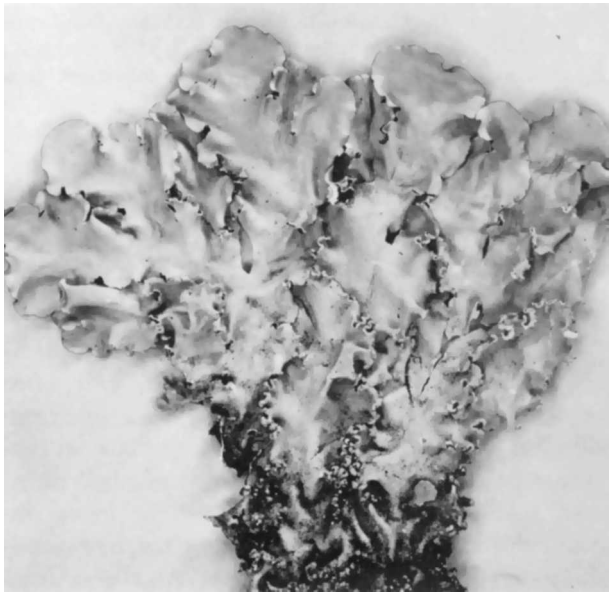

FIGURE 11.—*Parmelia cristifera,* ×1 (*Hale* 35788).

Vainio, which has not yet been found in Dominica. Differences between the two species are cited in Hale (1965). I should add here that through a lapsus calami I listed *P. gardneri* Dodge as a synonym of *P. cristifera,* but this species should be identified with *P. dilatata.* At the same time, *P. sieberi* Dodge, which I called a synonym of *P. dilatata* (p. 245), is a synonym of *P. cristifera.*

SPECIMENS EXAMINED.—Roseau Valley, *Elliott* 1339 (TUR). Hale collections: 1 (35694), 2 (35633), 6 (35788), 9 (35391), 11 (35800, 35802). Roseau Botanical Garden, *Evans* 64 (US).

5. *Parmelia cryptochlora*

Parmelia cryptochlora Vainio, 1896, p. 34.

TYPE COLLECTION.—Laudat, Dominica, *Elliott* 912 (BM, holotype).

DESCRIPTION.—Thallus closely adnate on bark, small, 2–3 cm broad; lobes linear, 1–2 mm wide; upper surface plane, sorediate toward the lobe tips, soralia capitate, up to 1 mm in diameter, the soredia farinose; cilia sparsely developed along the margins, 0.1–0.2 mm long; lower surface black, sparsely rhizinate, the rhizines simple; no apothecia present.

CHEMISTRY.—Cortex K+ yellow (atranorin);

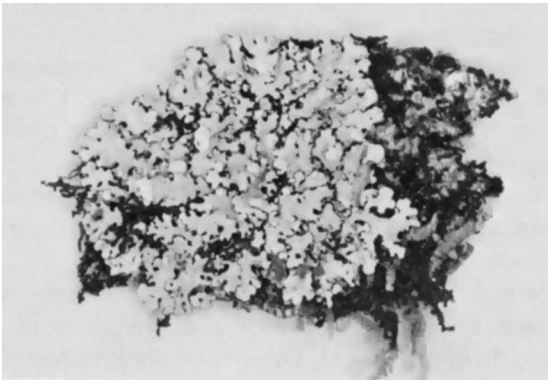

FIGURE 12.—*Parmelia cryptochlora,* ×1½ (*Hale* 35357).

medulla K−, C+, KC+ rose, P− (gyrophoric acid).

WORLD DISTRIBUTION AND HABITATS.—Endemic to Dominica; on hardwoods at mid elevations (600–800 m), entering mossy forest.

The type of *P. cryptochlora* is so fragmentary that I was previously unable to typify it. From the larger specimens that I collected in Dominica, it can now be placed in section *Imbricaria,* most closely allied to *P. dissecta,* an isidiate species. It could be mistaken at first for *P. revoluta* Floerke, but the soredia are capitate and powdery in contrast to the irregular sorediate-pustulate soralia of *P. revoluta.* Rhizines are poorly developed but appear unbranched or at most furcate, whereas in *P. revoluta* the rhizines are at least in major part dichotomously branched.

SPECIMENS EXAMINED.—Hale collection: 20 (35-357).

6. *Parmelia dissecta*

Parmelia dissecta Nylander, 1882, p. 451.

P. laevigata var. *gracilis* f. *furfuracea* Müller-Argau, 1888b, p. 529. [Type collection: Hambi, near Faxina, Brazil, *Puiggari* 47 (G, holotype).]

P. minarum Vainio, 1890, p. 48. [Type collection: Sitio, Minas Gerais, Brazil, *Vainio, Lichenes Brasilienses Exsiccati* 1040 (TUR, Vainio Herbarium 2689, holotype; BM, FH, UPS, isotypes).]

P. amazonica var. *husnotii* Hue, 1899, p. 158. [Type collection: Martinique and Guadeloupe, *Husnot* 441 (P, holotype).]

P. puiggari Gyelnik, 1931, p. 288. [Based on *P. laevigata* var. *gracilis* f. *furfuracea* Müller-Argau.]

P. camtschadalis var. *epiphylla* Cengia Sambo, 1938, p. 379. [Type collection: Mufindi, Tanganyika, *Balbo* 43 (FI, holotype).]

P. hubrichtii Berry, 1941, p. 102. [Type collection: 1.4 mi. north of Jarvis Store, Knox Co., Kentucky, *Hubricht* 13305 (MO, holotype).]

TYPE COLLECTION.—Fontainebleau, France, *Nylander* (H, Nylander Herbarium 35131, holotype).

DESCRIPTION.—Thallus adnate, 3–8 cm broad; greenish mineral gray; lobes sublinear to irregular, 2–4 mm wide; marginal cilia distinct, 0.3–0.7 mm long; upper surface plane and continuous, moderately to densely isidiate, the isidia cylindrical, erect, simple to branched, up to 0.5 mm high; lower surface moderately rhizinate, the rhizines simple or in part sparsely furcate. Apothecia adnate, 1–3 mm in diameter, the amphithecium isidiate; spores 8–10×12–17μ.

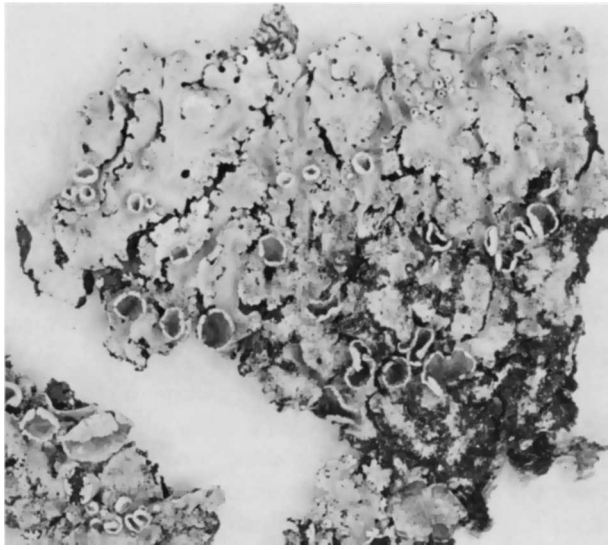

FIGURE 13.—*Parmlia dissecta,* ×1½ (*Hale* 35462).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K−, C+, KC+ rose, P− (gyrophoric acid).

WORLD DISTRIBUTION AND HABITATS.—Pantemperate and pantropical montane; on rocks, conifers, and hardwoods.

Parmelia dissecta, first described from France, was never well understood by most lichenologists who saw it from the tropics, although Vainio correctly identified several specimens from Dominica. There is considerable variation in lobe width, the Dominican material for example being quite robust. Other speci-

mens will have very narrow lobes (about 1 mm wide), but the unifying characters, marginal cilia, isidia, and the C+ color reaction, seem to encompass a single population throughout the wide geographic range. A close relative, *P. horrescens* Taylor, does not occur on Dominica; it has an almost identical range but differs in chemistry (a KC+ unknown that is also present in *P. subfatiscens)* and in having more or less flattened to lobulate isidia, some with apical cilia. In the West Indies *P. horrescens* usually occurs on pine trees at high elevation.

SPECIMENS EXAMINED.—Girondelle, *Elliott* 1584, Roseau Valley, *Elliott* s.n., and Shawford Estate, *Elliott* 1592 (TUR). Hale collections: 13 (35604), 14 (35569), 18 (35593), 20 (35462, 35480, 35486, 35505), and 21 (35356).

7. *Parmelia dominicana*

Parmelia dominicana Vainio, 1896, p. 32.

P. perlata var. *flavogranulosa* Vainio, 1915, p. 13. [Type collection: Mt. Stewart, St. Croix, *Raunkiaer* 433 (TUR, lectotype; C, isotype).]

P. capitulifera Zahlbruckner in Magnusson, 1942, p. 9. [Type collection: Punaluu, Oahu, Hawaii, *Rock* 176 (W, lectotype; BPI, isotype).]

TYPE COLLECTION.—Crater Souffrière, Dominica, *Elliott* 114 (TUR, holotype).

DESCRIPTION.—Thallus loosely adnate, up to 15 cm in diameter, mineral gray with a yellowish tinge; lobes broad and rotund, 8–12 mm wide; sorediate along the margins, soralia orbicular to linear, the soredia powdery, distinctly yellowish, cilia lacking; lower surface black and sparsely rhizinate, naked and brown in a zone along the margin. Apothecia rare, 3–5 mm in diameter; spores 5–7 × 16–18μ.

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K— or faint yellow, C—, KC—, P+ red orange (protocetraric acid). Usnic acid is present in the soredia.

WORLD DISTRIBUTION AND HABITATS.—Tropical America, Angola, Congo, Rhodesia, Hawaii; on trees at lower elevations (sea level to 1,200 m).

Parmelia dominicana is a distinct and easily recognized species on Dominica and over most of its range. In some regions, however, there is intergradation with *P. dilatata* Vainio, which in general has more irregular sparse soralia, mostly on short marginal lobules, and white soredia, although traces of usnic acid may be present in the upper cortex. Both species contain protocetraric acid.

It was evident that Vainio was confused on the identity of his new species. The holotype is corticolous and has the distinct yellowish soralia so characteristic of *P. dominicana.* In his later publication, however, he identified identical material from Prince Rupert as *P. perlata* var. *flavogranulosa* and called several rock-inhabiting specimens from St. Thomas *P. dominicana.* This latter material on rock is *P. mordenii* (see under the species).

Parmelia dominicana occurs mostly on palm trees along the west coast in Dominica and is the most common lichen in the Roseau Botanical Garden. It does not occur in the rain forest.

SPECIMENS EXAMINED.—Prince Rupert, *Elliott* 1310 (TUR). Hale collections: 1 (35674), 2 (35632A, 35640), 6 (35785), 7 (35792), and 8 (35756A). Roseau Botanical Garden, *Evans* 57 (NY) and 59 (US).

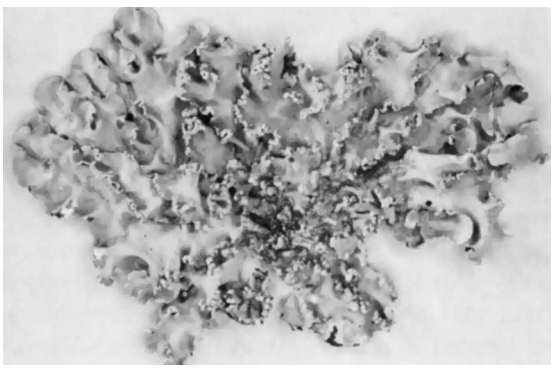

FIGURE 14.—*Parmelia dominicana,* ×1 (*Hale* 35785).

8. *Parmelia endosulphurea*

Parmelia endosulphurea (Hillmann) Hale, 1965, p. 251.

P. tinctorum var. *endosulphurea* Hillmann, 1940, p. 8. [For full synonymy see Hale (1965, p. 251).]

TYPE COLLECTION.—Mexico, *Orcutt* 4728 (MO, lectotype).

DESCRIPTION.—Thallus large, loosely adnate, 10–20 cm broad, light greenish mineral gray; upper surface plane, densely isidiate, the isidia cylindrical, simple to branched; medulla pale orange yellow; lower surface black and sparsely rhizinate at the center, dark brown and naked in a broad zone at

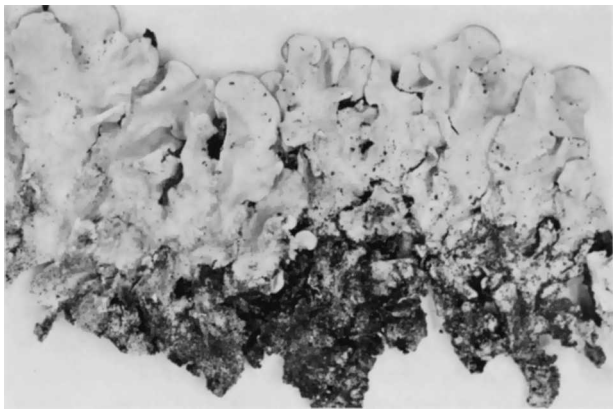

FIGURE 15.—*Parmelia endosulphurea,* ×1 (*Hale* 35786).

the margins. Apothecia not common, 5–8 mm in diameter; spores 6–9×19–23μ.

CHEMISTRY.—Cortex K+ yellowish (atranorin); medulla deeper yellow with color reagents (unidentified substances present). TLC plates give streaks of unresolved spots. The yellow pigment may be secalonic acid or a related compound (Yosioka et al., 1968, p. 2090).

WORLD DISTRIBUTION AND HABITATS.—Pantropical but rare outside of the Caribbean region; on conifers and hardwoods at low elevations (sea level to 1,000 m).

Until the yellow-orange medulla is exposed, this species can be mistaken for *P. tinctorum,* which has a white medulla and coarser, almost granular isidia. *Parmelia endosulphurea* has also been misidentified as *P. sulphurata* Nees and Flotow, a ciliate species with brilliant vulpinic acid in the medulla.

Parmelia endosulphurea is the commonest foliose lichen on cultivated palm trees in Dominica on both the Caribbean and Atlantic sides of the island. Strangely it was not collected by Elliott.

SPECIMENS EXAMINED.—Hale collections 1 (35-675), 5 (35543), 6 (35786, s.n., to appear in Weber's *Lichenes Exsiccati),* 7 (35789), 9 (35383), 10 (35-708), 11 (35795), and 12 (35381).

9. *Parmelia fungicola*

Parmelia fungicola Lynge, 1914, p. 129.

P. coronata f. *isidiosa* Müller-Argau, 1888a, p. 56. [Type collection: Paraguay, *Balansa* 4157 (G, holotype; K, W, isotypes).]

P. pseudocoronata Gyelnik, 1931, p. 289. [Based on *P. coronata* f. *isidiosa* Müller-Argau.]

TYPE COLLECTION.—Santa Anna da Chapada, Mato Grosso, Brazil, *Malme* 2438B (S, holotype).

DESCRIPTION.—Thallus closely adnate on bark, fragile, pale olive-gray, 2–3 cm in diameter; lobes sublinear-elongate, 0.2–1.0 mm wide; margins entire to lobulate with bulbate cilia; upper surface plane, shiny, lobulate-isidiate; lower surface black, short rhizinate, the rhizines branched. Apothecia adnate, coronate, 0.7–2.0 mm in diameter, amphithecium with retrorse rhizines; spores bicornute, 3–4×9–10μ.

CHEMISTRY.—Cortex K+ yellowish (atranorin); medulla K−, C− or C+, KC+ rose, P− (gyrophoric acid). Insufficient material of the species is available for full chemical analysis. Some C− material may not contain gyrophoric acid.

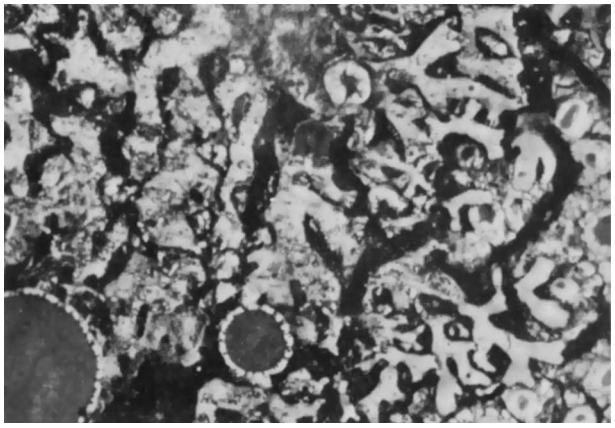

FIGURE 16.—*Parmelia fungicola,* ×5 (*Wetmore* 3925 from Dominican Republic).

WORLD DISTRIBUTION AND HABITATS.—Caribbean region, Brazil, Paraguay; on trees at low elevation (sea level to 400 m).

The marginal bulbate cilia immediately identify this tiny lichen as a member of section *Bicornuta,* somewhat related to *P. laevigatula* Nylander but differing in chemistry, thinner thallus, and prostrate lobulate isidia.

SPECIMENS EXAMINED.—Bois Serpé, *Imshaug* 32758, 32760, 32762 (MSC).

10. *Parmelia imbricatula*

Parmelia imbricatula Zahlbruckner, 1909, p. 168.
P. laevigata f. *isidiosa* Müller-Argau, 1891, p. 377. [Type collection: Ootacamum, Nilgherries, India, *Foulkes* (K, holotype; G, isotype).]
P. lobulifera var. *luteoreagens* Degelius, 1941, p. 61. [Type collection: Myrtle Point, Mt. LeConte, Tennessee, *Degelius* (DEGEL, lectotype).]
P. inconstans Zahlbruckner in Magnusson and Zahlbruckner, 1944, p. 94. [Type collection: Kahaluamano, Kauai, Hawaii, *Rock* 175 (W, holotype; US, isotype).]

TYPE COLLECTION.—Near Barra Mansa, Itapecirica, Sao Paulo, Brazil, *Schiffner* (W, holotype; MICH, isotype).

DESCRIPTION.—Thallus adnate, 5–10 cm in diameter, whitish mineral gray but turning pale tannish in the herbarium; lobes sublinear-elongate, 2–3 mm wide; upper surface plane, shiny, strongly maculate, moderately isidiate, the isidia thin, rarely branched, sometimes darkening at the tips; lower surface densely rhizinate, the rhizines dichotomously branched. Apothecia rare (not seen in Dominica), 2–10 mm in diameter; spores 7–10 × 11–16μ.

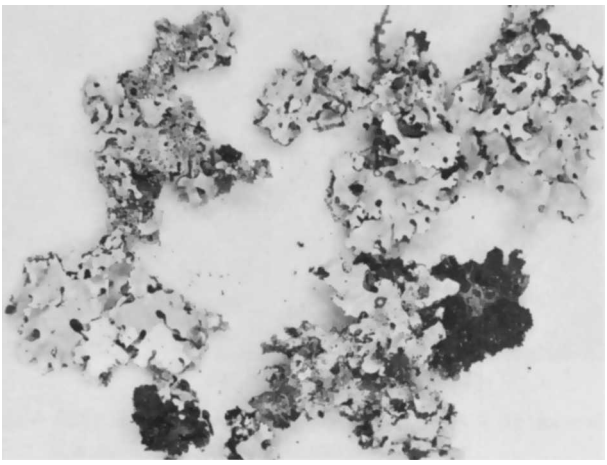

FIGURE 17.—*Parmelia imbricatula,* ×1 (*Hale* 35345).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K−, C+, KC+ yellowish orange, P− to faint (barbatic acid, 4-O-demethylbarbatic acid, obtusatic acid, "norobtusatic acid," and other unknowns). The information on chemistry has been kindly supplied by Dr. C. F. Culberson, who is studying the complex chemistry of the barbatic acid-containing *Parmeliae*. The distinct KC+ orange reaction is a characteristic of these species.

WORLD DISTRIBUTION AND HABITATS.—Southeastern United States, West Indies, Mexico and Central America, Brazil, Hawaii, Taiwan, Philippines, Malaysia, and Thailand; on conifers and hardwoods at mid to high elevations (1,000–3,500 m).

This common pantropical montane lichen (although lacking in Africa) is characterized by isidia and presence of barbatic acid. Close relatives are the sorediate *P. laevigata,* also known from Dominica, and nonsorediate *P. boliviana* Nylander. A nearly morphologically identical isidiate species with evernic acid instead of barbatic is *P. bogotensis* Vainio, which does not occur in the Lesser Antilles.

Parmelia imbricatula is a rain forest lichen in Dominica, seemingly rather rare. It could be misidentified as *P. costaricensis* without a chemical test with KC.

SPECIMEN EXAMINED.—Hale collection: 21 (35345).

11. *Parmelia laevigata*

Lichen laevigatus Smith, 1808, p. 1852.
Parmelia laevigata (Smith) Acharius, 1814, p. 202.
P. boliviana var. *cephalota* Zahlbruckner, 1925–26, p. 16. [Type collection: Loma Frai Jorge, Coquimbo, Chile, *Skottsberg* 448 (W, holotype; S, isotype).]

TYPE COLLECTION.—Anglesey, Caernarvonshire, North Wales, England, *Davies* (LINN, holotype).

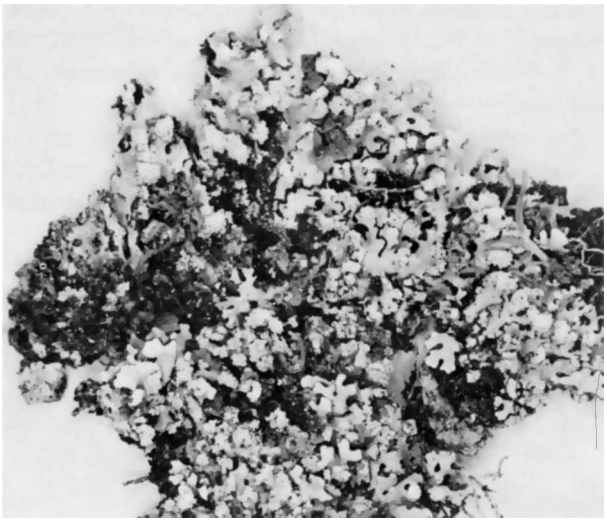

FIGURE 18.—*Parmelia laevigata,* ×1 (*Hale* 35467).

DESCRIPTION.—Thallus adnate, 3–8 cm broad, greenish mineral gray; lobes linear-elongate, 1.5–3.0 mm wide; upper surface shiny, maculate, pustulate-sorediate, soralia subterminal, capitate; lower surface black, densely rhizinate, the rhizines dichotomously branched. Apothecia very rare (not seen in Dominica).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K−, C+ pale orange or C−, KC+ deep orange, P− or P+ faint yellow (barbatic acid, 4-O-demethylbarbatic acid, obtusatic acid, "norobtusatic acid," and other unknowns). This is the same barbatic acid complex present in *P. imbricatula.*

WORLD DISTRIBUTION AND HABITATS.—United States (South Dakota, North Carolina), West Indies, Mexico, Colombia, Juan Fernandez and Chile, and Europe (Spain to Norway); on trees and rocks (montane in the tropics, 1,000–3,300 m).

Parmelia laevigata is a well known European species that has often been misidentified in the tropics. It is quite common in southern South America, very rare in North America, and sporadic in its occurrence in montane tropical regions. The distinguishing features are the initially pustulate subterminal soralia, maculae, the presence of the barbatic acid complex, and the branched rhizines. It is actually morphologically identical with *P. rockii,* which contains evernic and lecanoric acids. The species is rather common in Dominica, occurring typically in the rain forest zone.

SPECIMENS EXAMINED.—Morne Couliabon, *Elliott* 1556, 1559 (TUR); Roseau Valley, *Elliott* 1321 (TUR). Hale collections: 15 (35520), 18 (35592), 19 (35722), 20 (35467), 21 (35336, 35363).

12. *Parmelia laevigatula*

Parmelia laevigatula Nylander,1885, p. 614.
P. hookeri Taylor, 1847, p. 169. [Type collection: St. Vincent, *Guilding* (FH-Tayl, lectotype; BM, isotype).]

TYPE COLLECTION.—Guiana, South America, *Le Prieur* (H, Nylander Herbarium 35653, lectotype).

DESCRIPTION.—Thallus closely adnate on bark, rather thick, 3–9 cm in diameter, whitish mineral gray; lobes linear, short, 0.5–2.0 mm wide; marginal bulbate cilia dense, conspicuously inflated, often apically ciliate; upper surface plane to convex, continuous, moderately isidiate, the isidia simple or branched, up to 0.3 mm high; lower surface black, densely rhizinate, the rhizines richly branched. Apothecia adnate, 1–5 mm in diameter, the exciple coronate; spores 3–4×5–7μ.

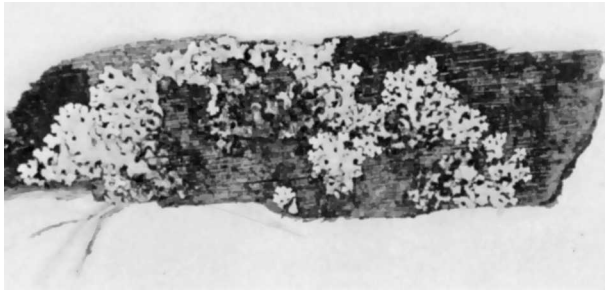

FIGURE 19.—*Parmelia laevigatula,* ×1 (*Hale* 35687).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K−, C+, KC+ red, P− (lecanoric acid).

WORLD DISTRIBUTION AND HABITATS.—Southeastern United States, West Indies, and northern South America; on palms and hardwoods at lower elevations (sea level to 1,200 m).

Parmelia laevigatula is a typical lichen of dry scrub woodlands in Dominica. The thallus is whitish and the marginal bulbate cilia unmistakable under a hand lens. Related species that do not occur on Dominica include *P. confoederata* Culberson, a much smaller lichen without isidia in southeastern United States, and *P. scortella* Nylander, similar externally but with an olive greenish cast and gyrophoric acid.

SPECIMENS EXAMINED.—Hale collections: 1 (35687) and 10 (35441).

13. *Parmelia martinicana*

Parmelia martinicana Nylander, 1885, p. 609.

TYPE COLLECTION.—Martinique, *Tardin* (H, holotype).

DESCRIPTION.—Thallus adnate, 3–9 cm broad, pale tan mineral gray; lobes irregular, subrotund, short, 2–5 mm wide; upper surface becoming rugose toward the center, densely isidiate, isidia initially papillate, cylindrical to irregularly thickened, simple or branched, rarely turning granular at the tips; lower surface black and sparsely rhizinate at the center, rugose, brown, and naked in a narrow zone at the margin. Apothecia not seen.

CHEMISTRY.—Cortex K+ yellowish (atranorin);

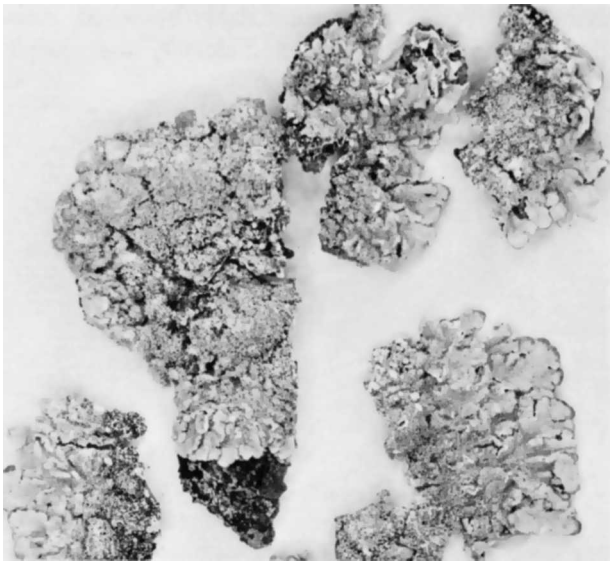

FIGURE 20.—*Parmelia martinicana*, ×1 (*Hale* 35761).

medulla K−, C+, KC+ rose, P+ orange red (gyrophoric and protocetraric acids). The presence of gyrophoric acid was first demonstrated by Dr. S. Kurokawa on material in US. I confirmed his crystal tests with TLC. This unsuspected combination of acids has recently been found in the *P. caperata* group (W. L. Culberson, in litt.).

WORLD DISTRIBUTION AND HABITATS.—West Indies (Bermuda to Trinidad); on hardwoods in dry scrub woodland (sea level to 1,000 m).

This is one of the few conspicuous foliose lichens in the dry scrub woodland. The isidia are sometimes quite deformed with a tendency to become granular. Closely related *P. raunkiaeri* Vainio, another West Indian endemic, does have definitely pustular sorediate isidia and protocetraric acid but appears to lack gyrophoric acid.

SPECIMENS EXAMINED.—Morne Couliabon, *Elliott* 1538 pro parte (TUR). Hale collections: 2 (35632), 3 (35654), 4 (35660, 35662), 5 (35544), and 8 (35761).

14. *Parmelia microblasta*

Parmelia microblasta Vainio, 1890, p. 57.

P. caraccensis f. *isidiosa* Müller-Argau, 1891, p. 376. [Type collection: Mauritius, s.c. (K, holotype; G, isotype).]

P. revoluta f. *isidiosa* Müller-Argau, 1891, p. 378. [Type collection: Brazil, *Sowerby* (G, holotype).]

P. propagulifera Vainio, 1899, p. (123). [Type collection: Bogota, Colombia, *Weir* 72 (K, holotype).]

P. kilauae Zahlbruckner in Rechinger, 1911, p. 30. [Type collection: Kilauea Volcano, Hawaii, *Rechinger* 3383 (W, holotype).]

P. jamaicensis Vainio, 1915, p. 23. [Type collection: Jamaica, *Boergesen* (TUR, Vainio Herbarium 2997, lectotype; C, isotype). Not *P. jamaicensis* (Acharius) Sprengel (=*Usnea*).]

P. endorosea Zahlbruckner, 1928, p. 203. [Type collection: Mt. Pangerango, Java, *Schiffner* 3304 (W, holotype).]

P. isidiata var. *albula* Gyelnik, 1930, p. 31. [Type collection: Oaula Island, Hawaii, *Rock* 103 (BP, holotype).]

P. albula (Gyelnik) Gyelnik, 1931, p. 286.

P. pseudoalbula Gyelnik, 1931, p. 286. [Type collection: Kauai, Hawaii, *Kueche* P-6 (BP, holotype; BPI, isotype).]

P. mauritiana Gyelnik, 1931, p. 288. [Based on *P. caraccensis* f. *isidiosa* Müller-Argau.]

P. pseudorevoluta Gyelnik, 1931, p. 289. [Based on *P. revoluta* f. *isidiosa* Müller-Argau.]

P. honoluluana Gyelnik, 1934, p. 155. [Type collection: Honolulu, Hawaii, *Faurie* 443 (BP, holotype).]

P. subramigera var. *primaria* Gyelnik, 1934, p. 165. [Type collection: Waialeale, Kauai, Hawaii, *Faurie* 68 (BP, holotype; P, isotype).]

P. subramigera var. *imbricata* Gyelnik, 1934, p. 165. [Type collection: Kilauea, Hawaii, *Faurie* 857 (BP, holotype).]

P. kilauae var. *honoluluana* (Gyelnik) Gyelnik, 1935, p. 37.

P. kilauae var. *ramicola* Gyelnik, 1935, p. 37. [Illegitimate name based on *P. kilauae* var. *kilauae*.]

P. abstrusa var. *imbricata* (Gyelnik) Gyelnik, 1938, p. 17.

P. abstrusa var. *subramigera* (Gyelnik) Gyelnik, 1938, p. 17. [Based on *P. subramigera* var. *primaria* Gyelnik.]

P. neopropagulifera Gyelnik, 1938, p. 39. [Based on *P. propagulifera* Vainio.]

P. endorubra f. *imbricatiformis* Gyelnik, 1938, p. 277. [Type collection: Bogota, Colombia, *Apollinaire* (BP, holotype).]

P. laxiuscula Magnusson, 1942, p. 8. [Type collection: Puu Kukui, Maui, Hawaii, *Skottsberg* 5919 (S, holotype).]

P. vestitula Zahlbruckner in Magnusson and Zahlbruckner, 1944, p. 97. [Type collection: Kauai, Hawaii, *Kueche* 14 (W, holotype; BPI, isotype).]

P. norstictica Hale, 1959, p. 128. [Based on *P. jamaicensis* Vainio.]

Pseudevernia mauritiana (Gyelnik) Dodge, 1959, p. 182.

TYPE COLLECTION.—Caraça, Minas Gerais, Brazil, *Vainio, Lichenes Brasilienses Exsiccati* 1214 (TUR, lectotype; BM, UPS, isotypes).

DESCRIPTION.—Thallus adnate to loosely attached, 5–10 cm in diameter, pale greenish yellow; lobes sublinear-elongate, 1–3 mm wide; upper surface plane, shiny, moderately to densely isidiate, the isidia tall, simple to coralloid-branched; lower surface black, densely rhizinate, the rhizines dichotomously branched, usually forming a mat around the lobe

margins. Apothecia 2–5 mm in diameter, adnate, spores 6–8 × 10–13μ.

CHEMISTRY.—Cortex K+ yellowish (usnic acid present, atranorin absent); medulla K+ yellow turning red, C—, KC—, P+ orange (norstictic acid, traces of salacinic acid, and an unknown forming a deep yellow H_2SO_4+ spot below norstictic and above stictic acid). This unknown has also been found closely related nonisidiate *P. enderythraea* Zahlbruckner from South America. It cannot be crystallized in a G.A.o-T. solution, which was used to test types of the synonyms listed above, but was confirmed in the types of *P. isidiata* var. *albula* and *P. endorosea* with TLC.

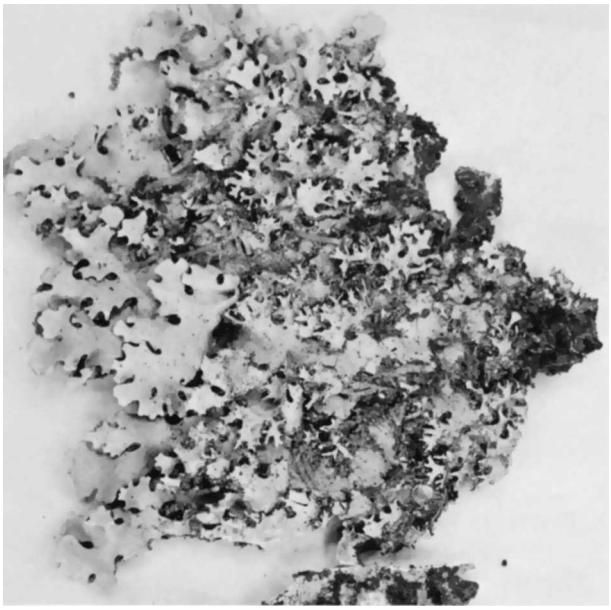

FIGURE 21.—*Parmelia microblasta*, ×1 (*Hale* 35450).

WORLD DISTRIBUTION AND HABITATS.—Pantropical in montane regions (but absent in Africa); on conifers and hardwoods at mid to high elevations (500–2,400 m).

Parmelia microblasta is one of the commonest lichens in montane areas of the tropics, being especially well developed in Hawaii and the West Indies. The long list of synonyms is remarkable since the range of variation is very small. The species is characterized by a unique combination of isidia, the yellow color, branched rhizines, and norstictic acid. I collected *P. microblasta* in abundance at Giraudel on roadside trees but found it nowhere else on the island.

SPECIMEN EXAMINED.—*Hale* collection: 20 (35450).

15. *Parmelia mordenii* Hale, new species

Thallus adnatus, saxicola, lobis sorediatis, soraliis crassis, pro parte subfatiscentibus medulla K—; apothecia ignota.

Thallus adnate on lava, 4–6 cm broad, whitish mineral gray; lobes irregular, rotund, 5–8 mm wide; upper surface smooth to rugose, often transversely cracked with age, margin and in part surface of lobes sorediate, coarse to subfatiscent, soralia linear to orbicular; lower surface black and sparsely rhizinate except for a brown and naked zone around the margins, rhizines simple; apothecia unknown.

TYPE COLLECTION.—Dominica: North of Coulibistri, elevation about 30 m, collected by M. E. Hale, no. 35649; holotype in US, isotypes in BM and UPS.

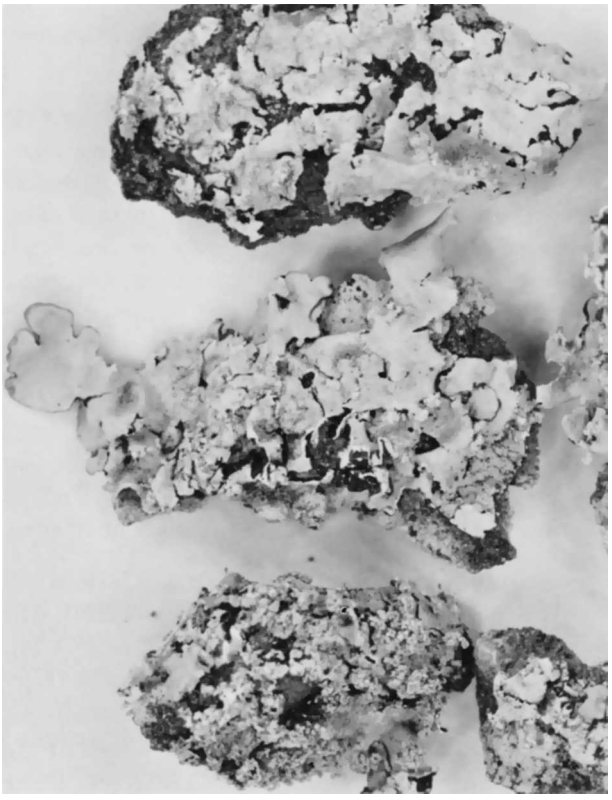

FIGURE 22.—*Parmelia mordenii*, ×1 (*Hale* 35649).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K+ yellow (atranorin), C—, KC—, P— or P+ faint yellow (caperatic acid probably intermixed with protolichesterinic acid). The crystal tests with G.E. show typical branched-globular crystal masses of caperatic acid.

WORLD DISTRIBUTION AND HABITATS.—Mexico, West Indies (Dominica, St. Thomas, Grenada); on rocks in dry scrub woodland at lower elevations (sea level to 1,200 m).

Parmelia mordenii is characterized by a whitish mineral gray thallus growing adnate on rocks. The upper surface may become transversely cracked with age and rugose. The soralia are largely marginal, sometimes forming small subfatiscent coralloid structures as in *P. fasciculata* Lynge (see Hale 1965, p. 252). A K+ yellow medullary reaction (except that for stictic acid) is rather rare in *Parmelia,* since atranorin is normally a constituent of the cortex only. The broad, subirregular to sublinear rotund lobes and the naked zone below place the species in subgenus *Amphigymnia* section *Amphigymnia.* See discussion under *P. dominicana* regarding Vainio's confusion of this species.

The closest relative is the pantropical weed *P. praesorediosa* Nylander, which differs in these characters: corticolous habitat, generally smaller, shorter lobes, thinner greenish thallus, finer soredia often produced in linear crescent-shaped or labriform soralia without formation of subfatiscent structures, and the K— medullary reaction (although there may be a faint yellow color with K in a few specimens). The diagnostic acid, caperatic acid, is the same.

Parmelia mordenii is found rather commonly on sheltered lava outcrops in the scrub woodland in Dominica. It occurs in a similar habitat in Mexico.

SPECIMENS EXAMINED.—DOMINICA: Rodneys Rock, *Hale* 35540, 35807 (US). ST. THOMAS: Magensbay, *Boergesen,* and MaFolly, *Biese* (TUR). MEXICO: CHIAPAS: west of Ococoautla, *Hale* 20612 (US); VERACRUZ: Teocello Canyon, *Hale* 21142 (US), and 9 km each of Jalapa, *Hale* 19421 (US). GRENADA: Fort George, *Imshaug* 16187 (MSC, US). PUERTO RICO: Along 149, central mountains, *Nash* (US).

16. *Parmelia peralbida*

Parmelia peralbida Hale, 1965, p. 257.

TYPE COLLECTION.—Jamaica, *Hart* 124 (FH-Tayl, holotype; BM, isotype).

DESCRIPTION.—Thallus loosely attached, 5–10 cm in diameter; lobes broad and rotund, 8–12 mm wide; upper surface plane, sparsely to moderately isidiate, the isidia thin, cylindrical; lower surface black, sparsely rhizinate toward the center, the outer margin naked and brown. Apothecia rare (not seen in Dominica), up to 4 mm in diameter; spores simple, $5–7 \times 8–10\mu$.

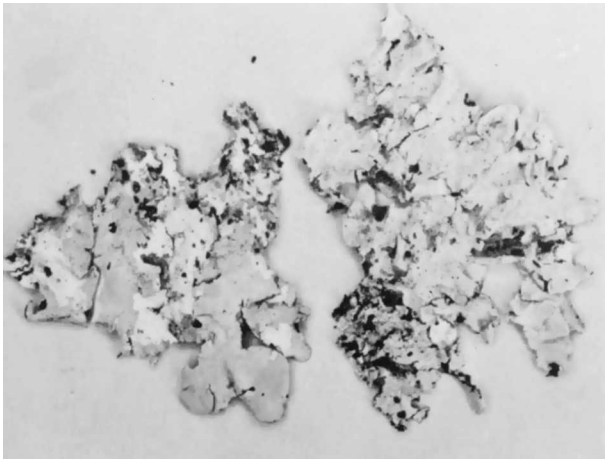

FIGURE 23.—*Parmelia peralbida,* ×1 (*Hale* 35454).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K—, C—, KC—, P+ orange red (protocetraric acid).

WORLD DISTRIBUTION AND HABITATS:—Mexico, Honduras, and the West Indies; on hardwoods (mossy forest) at higher elevations (600–1,500 m).

This rare lichen could be mistaken for *P. tinctorum* Nylander, a lowland species with coarser subgranular isidia and different chemistry (P—, lecanoric acid). The collections from Dominica definitely establish *P. peralbida* as a high elevation rain forest or mossy forest lichen, thus ecologically as well as chemically distinct from *P. tinctorum.*

SPECIMENS EXAMINED.—Hale collections: 20 (35454) and 21 (35353).

17. *Parmelia praesorediosa*

Parmelia praesorediosa Nylander, 1891, p. 18. [For full synonymy see Hale 1965, p. 258.]

TYPE COLLECTION.—Singapore, *Almquist* (H, Nylander Herbarium 35547; S, isotype).

DESCRIPTION.—Thallus adnate to loosely adnate on bark, 5–10 cm in diameter, light mineral gray to greenish gray; lobes 4–7 mm wide, subrotund; upper surface plane; margins of lobes sorediate (in part sublaminal), soredia powdery in orbicular, linear, or typically crescent-shaped soralia, cilia lacking; lower surface black and sparsely rhizinate at the center, brown and naked in a narrow zone along the margins. Apothecia (not seen in Dominica) rare, 4–10 mm in diameter; spores 7–10 × 15–21 μ.

FIGURE 24.—*Parmelia praesorediosa*, ×1 (*Hale* 35389).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K− or K+ very faint yellowish, C−, KC−, P− (caperatic acid possibly with protolichesterinic acid intermixed). The G.E.-precipitated crystals are mostly globular.

WORLD DISTRIBUTION AND HABITATS.—Pantropical on palms and hardwoods at lower elevations (sea level to 1,200 m).

This common lichen is usually collected on planted trees, palm, citrus, etc. It is quite variable although easily separated from other sorediate *Amphigymnia* species by the P− reaction. The thallus and lobes are distinctly smaller than in *P. cristifera* Taylor or *P. dilatata* Vainio, two common P+ associates of *P. praesorediosa*. The relationship to the rock-inhabiting *P. mordenii* is discussed under that species.

SPECIMENS EXAMINED.—Hale collections: 1 (35682), 2 (35700), and 9 (35389). Roseau Botanical Garden: *Evans* 50, 51, 60 (US).

18. *Parmelia pseudosinuosa*

Parmelia pseudosinuosa Asahina, 1951, p. 329.
P. anaptychioides Kurokawa in Hale and Kurokawa, 1964, p. 165. [Type collection: Pico Trujillo, Cordillera Central, Dominican Republic, *Wetmore* 3617 (MSC, holotype; US, isotype).]

TYPE COLLECTION.—Shimohirano-mura, Prov. Shinano, Japan, *Takahashi* 99 (TNS, holotype).

DESCRIPTION.—Thallus adnate, 3–9 cm in diameter, light mineral gray; lobes linear-elongate, 1–3 mm wide; upper surface plane, sorediate, the soralia mainly subterminal, capitate, 1–2 mm in diameter; lower surface moderately rhizinate, the rhizines dichotomously branched. Apothecia rare (not seen in Dominica); spores 6–8 × 8–10 μ.

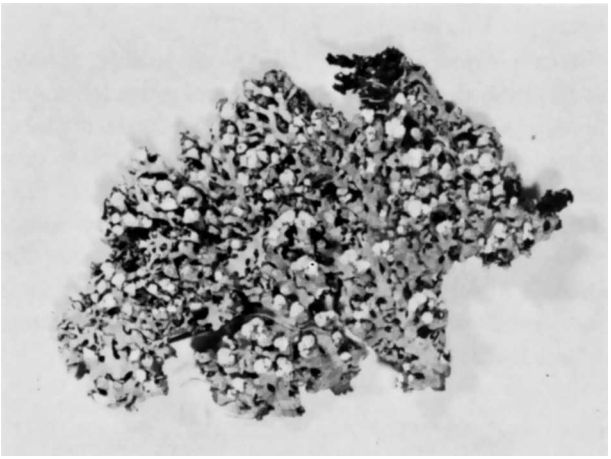

FIGURE 25.—*Parmelia pseudosinuosa*, ×1 (type of *P. anaptychioides*).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K−, C−, KC− or KC+ faint rose, P+ red (protocetraric acid).

WORLD DISTRIBUTION AND HABITATS.—West Indies, Chile, South and West Africa, Japan, Taiwan, Philippines, Malaysia, Hawaii; on trees (conifers or hard-

woods) at mid to higher elevations (200–2,500 m).

This small, rather inconspicuous lichen was first described from Japan but appears to be pantropical in distribution, occurring in montane habitats. It is never abundant. The most important features are the subterminal soredia and the P+ red reaction caused by protocetraric acid. *Parmelia rockii* or *P. laevigata* are superficially similar but in general have a larger thallus and a P— reaction. Reexamination of the type of *P. anaptychioides* showed that it is apparently a smaller form of *P. pseudosinuosa* and not a distinct species.

SPECIMENS EXAMINED.—Hale collection: 20 (35458, 35488).

19. *Parmelia rockii*

Parmelia rockii Zahlbruckner, 1912, p. 379.

P. subbahiana Zahlbruckner in Magnusson, 1942, p. 8. [Type collection: Kilauea, Kauai, Hawaii, *Faurie* 65 (W, lectotype; P, isotype).]

P. majuscula Zahlbruckner in Magnusson and Zahlbruckner, 1944, p. 92. [Type collection: Kahaluamano, Kauai, Hawaii, *Rock* 174 (W, lectotype).]

TYPE COLLECTION.—Kauai, Hawaii, *Rock* 7 (W, holotype; US, isotype).

DESCRIPTION.—Thallus adnate to loosely adnate, 5–12 cm in diameter, whitish mineral gray; lobes sublinear-elongate, 1–6 mm wide; upper surface plane, shiny, maculate, pustulate, the pustules mostly subterminal, usually becoming coarsely sorediate; medulla white except for pale yellow-orange spots under the soralia; lower surface black, densely rhizinate, the rhizines dichotomously branched. Apothecia rare (not seen in Dominica), adnate, 2–8 mm in diameter; spores 5–7 × 11–14μ.

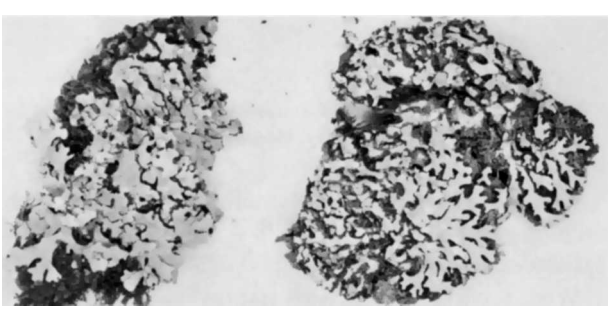

FIGURE 26.—*Parmelia rockii*, ×1 (*Hale* 35586).

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K—, C+, KC+ rose, P— (evernic acid and traces of lecanoric acid).

WORLD DISTRIBUTION AND HABITATS.—Southeastern United States (Virginia and North Carolina), West Indies, Mexico and Central America, northern South America, South Africa, southeast Asia, Hawaii; on rocks and trees at higher elevations (650 to 2,500 m).

Parmelia rockii is very common in the mountains of the tropics, especially in Hawaii and Central America, but has usually been misidentified. It is the pustulate-sorediate member of a chemically identical group that includes isidiate *P. bogotensis* Vainio and nonsorediate, nonisidiate *P. pulvinata* Fée. It is morphologically parallel to the *P. laevigata* group, which differs in containing the barbatic acid complex (see discussion under *P. imbricatula*). In Dominica, *P. rockii* behaves as a rain forest species but appears to be quite rare, although common elsewhere in the West Indies.

SPECIMEN EXAMINED.—Hale collection: 15 (35586).

20. *Parmelia subcrinita*

Parmelia subcrinita Nylander, 1890, p. 26.

TYPE COLLECTION.—Japan: Hirosaki, *Almquist* (H, Nylander Herbarium 35479, neotype).

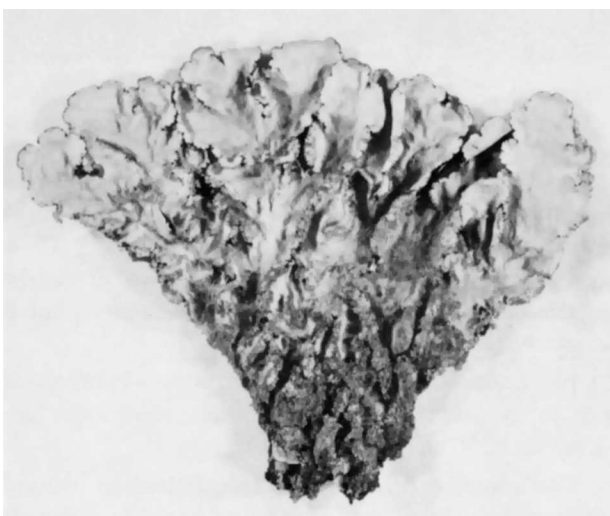

FIGURE 27.—*Parmelia subcrinita*, ×1 (*Plitt* from Jamaica).

DESCRIPTION.—Thallus loosely adnate, 10–20 cm in diameter, whitish mineral gray; upper surface plane, dull, reticulately cracked in older parts, becoming white-pruinose at the tips, isidiate, isidia cylindrical, up to 0.3 mm high, simple or branched; margins of lobes ciliate, cilia short, 1–2 mm long; lower surface black and sparsely rhizinate at the center, brown and naked in a broad zone at the margins. Apothecia rare, 3–6 mm in diameter; disc imperforate; spores 8–10 × 12–14μ.

CHEMISTRY.—Cortex K+ yellow (atranorin); medulla K+ yellow turning red, C−, KC−, P+ orange (salacinic acid). There may be unknown substances accompanying these acids but their identity is not clear.

WORLD DISTRIBUTION AND HABITATS.—United States, Mexico, Central and South America, West Indies, Azores, Japan, Indonesia, Sabah; on rocks but also on trees at lower to midelevations (sea level to 2,000 m).

This species was collected in Dominica only on rocks at Rodneys Rock. It has previously been confused with *P. crinita* Acharius, which contains stictic acid and is smaller and more fragile. There is intergradation with *P. subisidiosa* (Müller-Argau) Dodge, which has rhizines more or less to the margin below, a strongly reticulately cracked cortex to the edge of the lobes, and more marginal or localized isidia. In some parts of its range *P. subcrinita* could be confused with *P. subtinctoria* Zahlbruckner, an isidiate species with shiny maculate cortex and a mostly brown lower surface with fine rhizines to the margin.

SPECIMEN EXAMINED.—Hale collection: 35729 (to appear in Weber, *Lichenes Exsiccati)*.

21. *Parmelia subfatiscens*

Parmelia subfatiscens Kurokawa in Hale and Kurokawa, 1964, p. 134.

TYPE COLLECTION.—Louis Trichardt, Zoutpansberg, Transvaal, Union of South Africa, *Almborn* 6443 (LD, holotype; US, isotype).

DESCRIPTION.—Thallus adnate on bark, 4–7 cm in diameter, greenish mineral gray; lobes sublinear-elongate, 0.5–1.5 mm mide; marginal cilia distinct, to 1.0 mm long; upper surface plane, continuous, pustulate laminally and subterminally, pustules not turning noticeably sorediate; lower surface black, densely rhizinate, the rhizines simple. Apothecia rare

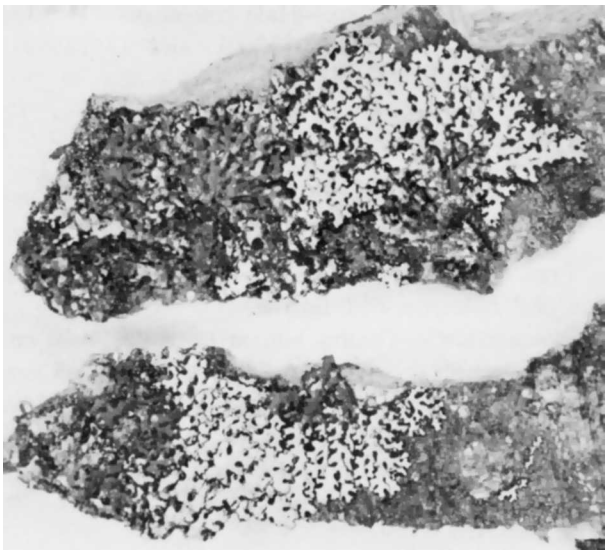

FIGURE 28.—*Parmelia subfatiscens*, ×1 (*Hale* 35121).

(not seen in Dominica), adnate, 1.5–4.0 mm in diameter; spores 8–9 × 12–14μ.

CHEMISTRY.—Cortex K+ yellowish (atranorin); medulla K−, C−, KC+ rose, P− (unknown substances). TLC analyses of the holotype of *P. subfatiscens* and the Dominican material are essentially identical in the major H_2SO_4+ spots. Two deep bluish spots appear in the benzene-dioxane solvent system, one above gyrophoric and the second near gyrophoric; in hexane-ether the main spot is near gyrophoric, the second below gyrophoric. The same components are known from *P. horrescens* Taylor, a closely related isidiate species. According to Dr. C. F. Culberson, one of these is related to or the same as glomelliferic acid.

WORLD DISTRIBUTION AND HABITATS.—West Indies, South Africa; on hardwood trees at mid-elevations (600–2,000 m).

Parmelia subfatiscens was first described from South African material. It was later identified in collections from Jamaica, following a distribution pattern known so far for *P. exsplendens* Hale and *P. livida* Taylor. The African type has scattered cilia among the pustules, but these are lacking in Dominica. This is a strictly rain forest lichen confined to the upper canopy of the trees and not easily collected except from felled trees. It belongs in section *Imbricaria* in the *P. dissecta-P. horrescens* group.

SPECIMENS EXAMINED.—Hale collections: 14 (35-558), 16 (35290, 35289, 35360), and 17 (35094, 35108, 35121, 35144, 35145).

22. *Parmelia subramigera*

Parmelia subramigera Gyelnik, 1931, p. 281. [For full synonymy see Hale, 1964, p. 471.]

TYPE COLLECTION.—Rainbow Fall, Hawaii, *Faurie* 856 (BP, holotype; BM, isotype).

DESCRIPTION.—Thallus adnate on rocks, 4–10 cm broad, greenish yellow; lobes linear-elongate, 2–3 mm wide; upper surface moderately isidiate, the isidia cylindrical, simple; lower surface pale brown, moderately rhizinate, the rhizines brown, simple. Apothecia rare (not seen in Dominica.)

FIGURE 29.—*Parmelia subramigera*, ×1 (*Hale* 35778).

CHEMISTRY.—Cortex K— (usnic acid); medulla K—, C—, KC—, P+ red (fumarprotocetraric acid and "sublimbatic" acid). TLC analyses have shown that "sublimbatic" acid is a constant accessory substance except in Japan where it is lacking. This unknown also occurs with fumarprotocetraric acid in other *Xanthoparmeliae* (*P. hypomelaena* Hale, *P. subconspersa* Nylander, and *P. subfuscescens* Nylander) and in subgenus *Parmelia* section *Relicinae* (*P. ramossissima* Kurokawa and *P. sublimbata* Nylander). It is recognized on TLC plates as a spot just below fumarprotocetraric in n-butanol-acetone.

Parmelia subramigera is the commonest, sometimes the only member of subgenus *Xanthoparmelia* occurring in tropical regions. On the northern border of its range it intermingles with a series of chemical populations that share essentially the same morphology: *P. plittii* Gyelnik (containing stictic and norstictic acids), *P. mexicana* Gyelnik (salacinic acid), *P. kurokawae* Hale (psoromic acid), and *P. dierythra* Hale (norstictic acid). These are discussed in Hale, 1964, p. 470.

In Dominica, *P. subramigera* is rather common on lava rocks all along the west coast. There are not many herbarium specimens because the thallus is difficult to collect from the rocks.

SPECIMENS EXAMINED.—Hale collection: 4 (35-778). Rodneys Rock, *Robinson* s.n. (US).

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