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The lichen genus *Phyllopsora* (Bacidiaceae) in the neotropics

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THE LICHEN GENUS PHYLLOPSORA (BACIDIACEAE) IN THE NEOTROPICS

by

LOIS BRAKO

A dissertation submitted to the Graduate Faculty in Biology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1987

This manuscript has been read and accepted for the Graduate Faculty in Biology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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ABSTRACT

THE LICHEN GENUS PHYLLOPSORA (BACIDIACEAE) IN THE NEOTROPICS

by

Lois Brako

Advisor: Professor William R. Buck

A taxonomic monograph is presented for the neotropical species of the lichen genus Phyllopsora Müll. Arg. The genus, as here circumscribed, is placed in the Bacidiaceae and distinguished from other genera by the combined characters of its squamulose to small foliose thallus with obvious prothallus, its ascal type with an amyloid hemispheric dome and narrow, conical masse axiale, its apothecial type composed of highly gelatinized hyphae with no clear distinction between the exciple and the hypothecium and with the same texture found in the center and margin of the apothecium as well as in the paraphyses, and by its small, thin-walled, rarely septate ascospores. The relationship of Phyllopsora with the genera Bacidia, Biatora, Eschatogonia, Physcidia and two newly described genera, is discussed. Type studies have been made for nearly all names included in Phyllopsora. Nineteen species and nine varieties are recognized in the neotropics. One species and one variety are newly described. Six species are reduced to varietal status necessitating new combinations, and 25 names are reduced to synonymy. Fifteen species are excluded from the genus and two new genera are described for four of these species.

The species concept in the genus is reassessed. Most species were found to exhibit great morphological variation. Clarification of their taxonomy has been achieved through comparative anatomy, investigation of lichen substances, and by ecological observations. New chemical data are given for a number of species and chemical strains are recognized for P. buettneri and P. corallina and their varieties. Based on this data the cladistic relationships of the neotropical species are discussed. Keys to the species and varieties are presented, and illustrations are included. Most species are corticolous. Seven of the nineteen species have a pantropical distribution and most of the remaining species are broadly distributed in the New World. A synopsis of the Old World taxa is presented.

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I thank Dr. Amy Rossman and her staff at the National Fungus Collection, Beltsville, Maryland, particularly Jim Plascowitz, who

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

This study represents one of the first attempts to apply modern taxonomic concepts to the systematic treatment of a predominantly tropical group of microlichens. The genus Phyllopsora was chosen because it has not been previously monographed and because it presented problems of both generic definition and species delimitation. The first objective was to determine if Phyllopsora could be reliably circumscribed as a natural group. No single character distinguishes the genus. Rather, it has been defined by a suite of apothecial and thalline characters, some of which are shared by related genera.

The second objective was to reassess the species concept in Phyllopsora. Most species had previously been distinguished by thalline characters, but the extent of environmental variability in these traits had never been critically evaluated. Extensive field studies for all New World taxa were conducted for this purpose as well as for a Flora Neotropica treatment of the genus.

Historical outline

Müller Argau (1894) first described the tribe Phyllopsorae in his systematic survey of New Zealand lichens, including it in his "Series II Thamno-Phylloblastae". He differentiated it by a loosely or moderately fixed squamulose thallus, "gonidia palmellaceae" and biatorine-lecideine apothecia. He included two genera in this tribe, distinguishing Phyllopsora by simple hyaline spores, and Psorella by transversely septate, hyaline spores. He assigned four species (one

doubtful) and one variety to Phyllopsora. Zahlbruckner (1903-1908) presented Müller Argau's tribe as the family Phyllopsoraceae. Zahlbruckner (1926-1927) and Lamb (1963) together attributed 40 species and numerous varieties to Phyllopsora; Clements and Shear (1931) selected Phyllopsora breviuscula (Nyl.) Müll. Arg. as the lectotype of the genus. Poelt (1973) treated Phyllopsora as a member of the Lecideaceae s. lat. Riedl (1973) added one new species, described from Surinam, while Coppins and James (1979) described the first species of the genus from Europe. Schneider (1979) made 18 new combinations in Phyllopsora in his work on the genus Psora, and placed the genus in the Cladoniaceae. The most recent treatment of the genus, by Swinscow and Krog (1981), added three new species and made 7 new combinations. Most recently, Ferraro (1983) described one species from Argentina, and Swinscow and Krog (1985) described another new species, bringing the total of published names to 93. In his reassessment of the inclusive families Lecanoraceae and Lecideaceae, Hafellner (1984) placed Phyllopsora in the Phyllopsoraceae along with Physcidia, and suggested a possible relationship with Hypocenomyce, while placing Psorella in the Bacidiaceae. Most recently, Eriksson and Hawksworth (1986) included Phyllopsora and Psorella in the Bacidiaceae.

As treated by Zahlbruckner (1903-1907, 1926-1927), Phyllopsora is poorly defined. The genus was better delimited by Swinscow and Krog (1981) and Hafellner (1984) with the following characters: 1) a squamulose thallus with an obvious prothallus, 2) an ascal apex composed of a hyaline hemispheric dome staining blue with iodine

surrounding a narrow, conical, lighter staining masse axiale, 3) paraphyses with colorless unswollen apices, and 4) biatorine apothecia with a hypothecium composed of highly gelatinized hyphae. Several genera such as Bacidia, Biatora, Physcidia, Psorella and Eschatogonia have all or some members which share many of these characters and are thought to be closely related to Phyllopsora. In the past, these genera have been separated mostly by vegetative characters, i.e., thallus type and its asexual propagules. In order for vegetative characters to be useful it is important to understand their natural variability in relation to their ecology, especially that of a single thallus or population with regard to age and exposure. Except for their temperate members, most of the taxa of these genera have not been re-examined since their original descriptions. They are represented in herbaria by few collections that are often incomplete or badly mixed. Likewise, apothecial characters, such as hypothecial texture and ascal structure, have previously not been critically examined, partly due to the paucity of material. Therefore, field studies by a lichenologist were highly desirable for critical interpretation of thallus morphology as well as to provide sufficient material for laboratory studies. Extensive field studies conducted during this study contributed over 500 collections of Phyllopsora and related genera to aid in the better delimitation of Phyllopsora and for further assessment of intergeneric relationships.

Many of the 93 taxa that have been described in the genus Phyllopsora seem to be minor variants that may represent no more than

intraspecific variation, and other species have been improperly placed in this genus. In this study, a more uniform species concept is employed to re-evaluate the status of all names and to exclude taxa which clearly belong outside Phyllopsora.

MATERIAL AND METHODS

Close to 3000 collections were studied during this investigation including material on loan from the following herbaria: AAU, B, BG, BM, BUF, CHR, COLO, CTES, FH, FLAS, FLOR, G, GB, GLAM, GOET, GZU, H, INPA, L, LD, LG, LSU, M, MBM, MERF, MIN, NY, O, PC, QCA, RB, S, TO, TUR, U, UPS, US, VEN, W, ZT. Abbreviations follow Index Herbariorum (Holmgren et al., 1981). Material from the private herbarium of Dr. K. Kalb, Neumarkt, West Germany, (Hb. Kalb) was also examined.

Field studies were made by the author in Brazil (1983, 1987), Ecuador (1981-1983), Fiji (1981), Florida, U.S.A. (1985), Panama (1985) and Venezuela (1984-1986). Most of the material collected during these field excursions is deposited at NY, with unicates and duplicates deposited in host countries.

The citation of specimens needs some explanation. For citation of type specimens, I have used square brackets to indicate information which was not in the protologue or, in some cases, was only found on isotypes or syntypes. For all specimens parentheses are used to correct spellings, particularly of place names. I have translated all information except proper names into English, I have converted dates and numbers to a standard form. To indicate duplicate specimens I have used an equals sign followed by the number

of duplicates and an "x" (e.g., L=2x indicates there are 2 duplicates at Leiden).

Sections of thalli and apothecia were usually made by hand with a razor-blade. A freezing microtome was used to cut 10-20 um thick sections of type material and for observation of detailed anatomy. Asci, ascospores and pycnospores were studied in squash preparations. Material was first mounted in water, followed by application of 10% potassium hydroxide (KOH). The iodine reaction of the asci was studied in a solution of potassium-iodide (IKI) and in modified Lugol's solution (MLS: 1 g iodine, 2 g potassium iodide in 300 mls of 100% lactic acid). The iodine reaction was studied both with and without pretreatment with potassium hydroxide.

Ascospores, pycnospores and paraphyses were measured with the accuracy of one um. For measurements of ascospores the mean value ($\bar{X}$) and the standard deviation (SD) were calculated. The dimensions for ascospores are given first in rounded figures achieved by adding and subtracting the standard deviation from the mean value. L. max., L. min., W. min. and W. max., give the minimum and maximum lengths and widths observed. The letter "n" stands for the number of ascospores measured.

Thin-layer chromatography (TLC) was carried out in accordance with Menlove's (1974) modification of standard procedures as described by Culberson and Kristinsson (1970) and Culberson (1972). The thallus was spot-tested with para-phenylenediamine (Pd).

The procedures outlined by Ahmadjian (1967, 1973) were followed to culture and identify the phycobiont of Phyllopsora and some

related taxa, and for study of growth and lichenization. Selected material was initially isolated and cultured on artificial media in Caracas, Venezuela in 1985, where fresh material was abundant and readily available. Material was isolated and cultures were made on the day of collection and to two weeks after collection. Cultures and air-dried material were kept at room temperature or refrigerated at 17°C. Individual cells or groups of algal cells were extracted from intact squamules and placed on Bold's Mineral Medium and Trebouxia Organic Nutrient Media I after a series of cleansing transfers. Only a few attempts to culture the algal cells were successful. These cultures were maintained for a period of several months with weekly transfer to fresh media to avoid bacterial contaminants. Fresh material was sent to Dr. V. Ahmadjian who also made isolations and cultures.

Single ascospores, pycnospores and hyphae were placed on 2% water agar and Malt Yeast Extract Medium and watched for germination and growth. Experiments to isolate the mycobiont were not successful.

MORPHOLOGY AND ANATOMY

The thallus of Phyllopsora species varies from very small patches of a few centimeters in diameter to extensive colonies completely encircling tree trunks. Mature thalli are usually circular or oval in outline. Thallus form may be squamulose, small foliose or rarely crustose or leprose. Most species have a thallus composed of discrete to adjoined and overlapping squamules

(Fig. 19.). The squamules are round to irregular; they may also be elongate, lobulate, or digitate and measure from 0.1 to 1.0 mm in diameter or lobe width. They are often bifurcate at the apex owing to terminal formation of new lobes. Measurements of the squamules were made behind the apex, just behind the bifurcation point or across the diameter of unlobed squamules at their widest point.

The squamules may be placed in three size categories: about 0.1 mm wide, 0.1-0.3 mm wide and (0.3)0.5-1.0 mm wide. In the smallest size category the squamules may be no more than granules which are globose or complanate, elongate or digitate. Examples of this group include P. furfuracea (Fig. 1A), with globose granular squamules, P. minor (Fig. 32B) with complanate squamules, and P. confusa (Fig. 21) with small digitate squamules. Within this size group it is particularly difficult to distinguish digitate squamules from isidia.

The species that produce a small foliose type of thallus usually begin their development as individual squamules which grow in a fan-shaped pattern, elongating and dividing to take the form shown in Fig. 34.

The squamules are adnate to the prothallus or substrate, or ascending. Small globose squamules are generally closely adnate, while the larger or longer-lobed forms are more loosely adnate and are often ascending. All squamules are convex or complanate. In most species the squamules adjoin and overlap. In P. subcrustacea the squamules are so closely adjoined that they form a nearly continuous crust (Fig. 37). In P. parvifoliella the squamules are

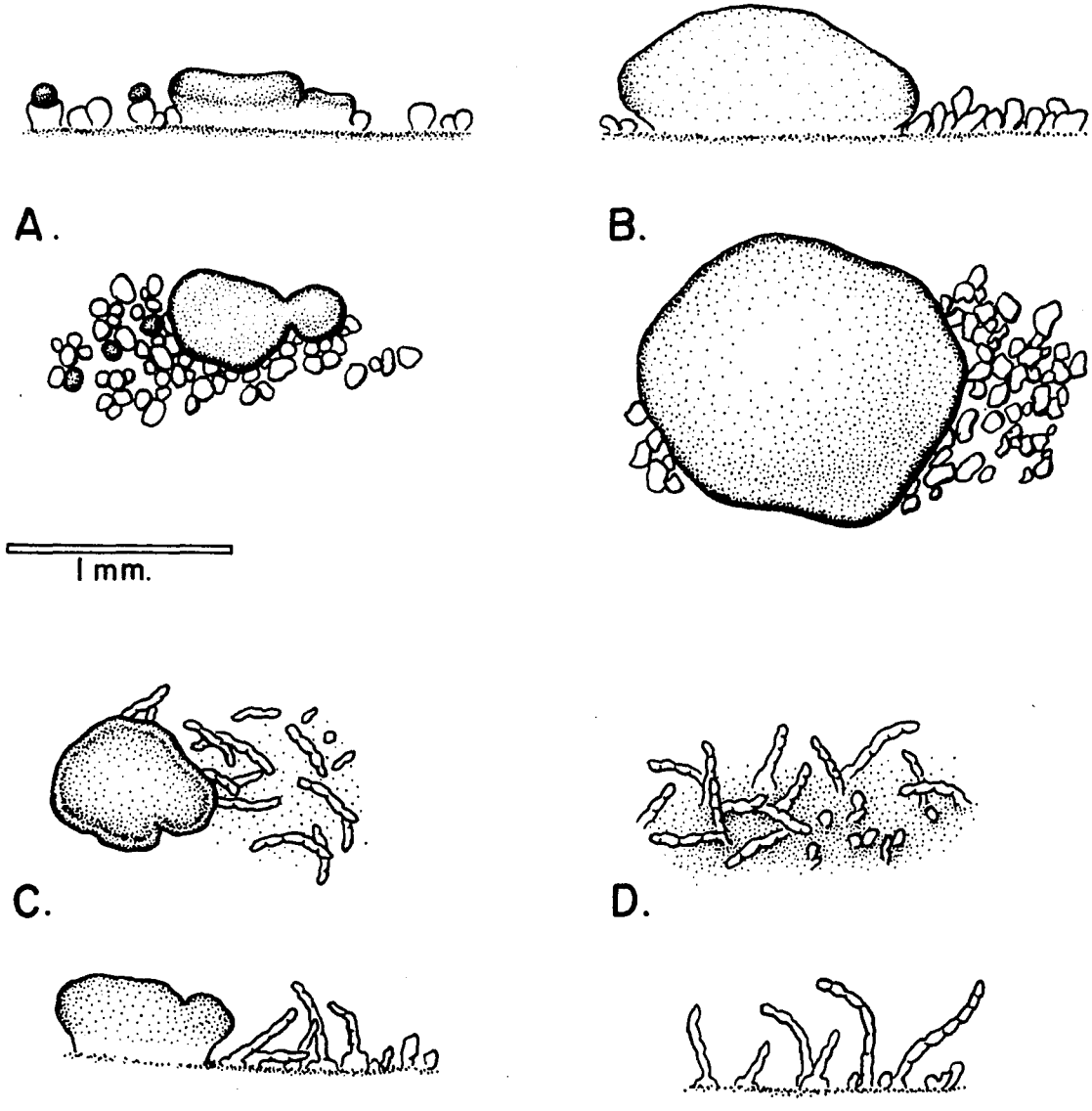


Fig. 1. Developmental stages of Phyllopsora furfuracea.

(for explanation see page 99)

mostly discrete (Fig. 36).

Thallus color varies with age, condition of the thallus and ecology. Young, fresh, healthy thalli are bright green, bluish-gray or golden brown. Dried thalli are white, gray, golden-brown or reddish-brown. In general, thallus color is not useful as a taxonomic character.

The upper surface of the thallus is generally glabrous and shiny (Fig. 34). However, Phyllopsora cuyabensis has a rough, dull upper surface; the convex squamules of P. bibula are fibrillose; and the upper surface of the thallus of P. buettneri is commonly pruinose (the whitish pruina often gives the golden-brown colored squamules a pinkish color in older herbarium specimens.) At the margin, the squamules are rarely glabrous, but usually pubescent or fibrillose. The marginal fibrils are usually fine and pale, but in P. parvifolia var. breviuscula (Fig. 35) they are coarse and reddish.

A prothallus composed of superficial, unlichenized hyphae is always present in Phyllopsora It is either web-like, consisting of fine pale hyphae between the thalline elements, or well developed, forming a distinct fringe around the periphery of the thallus. The prothallus may also form an extensive mat of thick-walled, highly branched and interwoven hyphae between, under and/or around the thalline elements. These thalline elements have a layer of pale or reddish-brown loosely woven hyphae on the lower surface which either interweaves with the hyphae of the prothallus or attaches and anchors directly to the substrate.

Isidia are common in the genus. In this treatment I use the

term isidium for all non-dorsiventral finger-like projections that have a continuous cortex, formed either as appendages from the squamules or independently on the prothallus. They may be globose to cylindrical or coralloid. Isidia usually arise from the lamina or margin of the squamules, but they are also found to occur independently on the prothallus, as in P. furfuracea (Fig. 1C,D). Phyllopsora corallina var. phaeobyssina has unusual flattened isidia (Fig. 26). Eleven of the 19 neotropical species of Phyllopsora are isidiate, but in most species the presence or absence of isidia is not a reliable character and cannot be used alone for taxonomic purposes. My own field observations have shown that a single colony of P. corallina var. santensis varies from non-isidiate to densely isidiate on different portions of the same thallus.

Lobules are common in the genus and are extremely variable in shape. Both isidia and lobules are potential diaspores, since they are easily broken off and are found on neighboring mosses, other lichens and bare substrate. Soredia, however, are not known in the genus.

A distinct upper cortex is always present. As observed in cross-section, it is generally composed of a layer of randomly oriented or anticlinally arranged, colorless or pale hyphae. Two extreme types of cortex tissue can be recognized, designated type 1 and type 2 by Swinscow and Krog (1981). Type 1 (Fig. 9) has heavily gelatinized hyphae with narrow lumina that appear net-like. In type 2 (Fig. 10), the lumina are much broader and rarely appear net-like. Intermediate types are common. In species with very small thalline

elements the cortex may appear as a thin gelatinous layer (Fig. 11A). The cortex also varies with developmental stage and ecology. It often contains small granules, perhaps atranorin crystals, which dissolve in KOH.

The photobiont occurs in a more or less continuous layer below the upper cortex. The algae are unicellular and green, with cells 10-15(20) um in diam. (Fig. 11B), and belong to the genus Pseudochlorella Lund (Ahmadjian, pers. comm.). The algal cells are often penetrated by numerous fungal haustoria. A high frequency of haustorial penetration has been found to be common in structurally primitive lichens (Plessl, 1963).

Hyphae from the cortex may extend through the algal layer to the medulla, a layer of loosely woven pale or reddish-brown hyphae that may be covered with granules of lichen substances. The lower surface consists of randomly oriented loosely woven pale or reddish-brown hyphae that may interweave with the hyphae of the prothallus. The surface of these hyphae is at times papillose (Fig. 12), which might be associated with water or nutrient absorption.

The squamulose thallus form with an obvious prothallus characteristic of Phyllopsora is found in other members of the Bacidiaceae and also in members of other families. Within the Bacidiaceae several tropical species with the fundamental characteristics of Bacidia and some taxa previously placed in Psorella have a thallus morphology identical to that of Phyllopsora. Physcidia squamulosa Tuck., with lecanorine apothecia, has a similar

thallus morphology to Phyllopsora. Eschatogonia has squamules which are similar in size, but have a distinct upper and lower cortex (Fig. 44).

In addition to the Bacidiaceae, members of the Psoraceae, Lecideaceae s. lat., Pannariaceae, Pilocarpaceae and Lecanoraceae also have a similar thallus morphology. The squamules of Psora (Psoraceae) are somewhat larger and have a thicker cortex (80-200 um; Timdal, 1984b) than those of Phyllopsora (10-60 um), and the "Scheinrindentype" of cortex found in Psora species is not found in Phyllopsora. Several species of Hypocenomyce (Lecideaceae s. lat.) have squamules similar to Phyllopsora, but they lack a distinct prothallus. Timdal (1984a) described three types of squamules in Hypocenomyce: adnate, bullate or ascending. He recognized several species groups within the genus where anatomical and chemical characters are constant within each group, but the thallus form varies. He then suggested that the morphological similarities in squamule type have evolved independently and are not an indication of close genetic affinity of the species groups.

In the Pannariaceae most species are squamulose with a thick prothallus, but all have Nostoc as a photobiont (Jørgensen, 1978) giving the squamules a distinctive coloration. The squamules in members of the Pilocarpaceae and Lecanoraceae are sometimes very similar to those of Phyllopsora. As a result, the taxa can only be separated by apothecial characters. Primary squamules of some species of Cladonia (Cladoniaceae) may also resemble Phyllopsora squamules, but have a different cortex and usually distinctive

chemistry.

Crocynia pyxinoides Nyl. (Crocyniaceae) has a squamulose-crustose thallus form with an abundant prothallus, but it differs from Phyllopsora in its lack of an upper cortex (Figs. 39 & 40) and green-black pigmentation in the prothallus and apothecia (Fig. 41).

The widespread occurrence of the squamulose thallus form in a broad array of families suggests that it has developed repeatedly and independently in different lineages.

Apothecia are common in most species of Phyllopsora, even in densely isidiate species such as P. isidiotyla. They are biatorine, but may have a dark reddish or golden brown pigment in the exciple and/or hypothecium (Fig. 14). Apothecia are usually round to slightly irregular, to 1.5 mm diam., sessile, and constricted at the base. They are often anchored at the margin with fibrils extending from the exciple and can occur singly or aggregated. New apothecia may also arise directly from the hymenia of older apothecia.

The disc is commonly plane and marginate when young, but usually becomes convex. It is tan, orange or golden-brown to dark red with a slightly paler or darker margin. The surface of the disc is smooth (Fig. 27A). Hyphae extending freely from the exciple may create a byssoid fringe around the apothecia.

The internal organization of the apothecia is relatively uniform. Fig. 13A shows the typical tightly coherent, highly gelatinized hyphae of the exciple and hypothecium which have the same texture as the paraphyses. The texture of the center and the margin is the same. The development of apothecia was first described by

Swinscow and Krog (1981), and my own observations confirm their findings. Apothecial initials are first noticed as small nodules on the surface of the thallus. Generative hyphae within the nodule can be identified by their amyloid reaction in iodine solution. The generative hyphae are surrounded by thalline cortex. As development proceeds, the hymenium begins to take shape, expanding at the margin, forming the disc. The hypothecium then enlarges and gelatinizes. Swinscow and Krog suggest that in some cases the hypothecium is derived mainly from the ingrowth of cortical tissue and in other cases mainly from the gelatinization of medullary tissue already present. The hypothecium continues to spread laterally with the outer layers forming the exciple. The excipular hyphae may continue to grow outward to become the fibrils which attach to the thalline cortex or form a byssoid fringe. There is no clear separation between the hypothecium and the exciple. The hyphae of the hypothecium and exciple and the paraphyses have the same texture. Between the hymenium and hypothecium is generative tissue but it does not form a distinct subhymenium as seen in apothecia of Bacidia rosella (Pers.) De Not.

Within the apothecia of different species, there is some interspecific variation in the dimensions and number of the hyphae present. The hyphae of P. parvifolia have relatively narrow lumina when compared with those of P. intermediella (Fig. 13B) and the apothecia of P. parvifolia are usually convex with a thick hypothecium. The apothecia of P. intermediella are more complanate with fewer hyphae in the hypothecium. The apothecial type found in

Phyllopsora is found elsewhere in Biatora vernalis (L.) Fr. and perhaps in the newly described genus Myelorrhiza (Verdon & Elix, 1986), but I have not yet examined material of Myelorrhiza for confirmation.

Pigments are common in the hypothecium and exciple and they can be seen to vary within a species. In P. corallina var. santensis the exciple is irregularly tinged red. The apothecia of P. furfuracea often contain an orange pigment that becomes brilliant scarlet in KOH. Apothecia of P. chlorophaea are suffused with a dark reddish or purplish-brown pigment which is non-reacting in KOH (Fig. 20A).

The hymenium varies in height from 20-60 um. It is generally colorless but may have orange or brown pigmentation.

Paraphyses in Phyllopsora (Fig. 15A) are relatively broad compared to those of other members of the Lecanorales with the exception of Crocynia pyxinoides (Fig. 42). Wall thickness varies from 0.2-0.5 um diam.; and in length the paraphyses vary with hymenial height. The length to width ratio is 6:1. They are cellular, repeatedly septate and sparsely branched and anastomosing. The apical cells are at most only slightly thickened, usually colorless, but may be covered with gold, orange or brown pigments. The paraphyses are strongly conglutinated, not easily separating in squash preparations.

The structure of the ascus is uniform in the genus (Fig. 15B). It is best observed by applying 10% KOH to a thin section followed by treatment with MLS. Young asci are cylindrical

with thick side walls and a thickened apical dome that stains blue in MLS. At maturity the asci are usually elongate-clavate with a deeply staining apical dome and distinct non-staining conical shaped area, the "masse axiale", at the base of the dome. The asci also commonly have a blue-staining cap over the exterior of the apex. This ascus type agrees with type "L" of Hafellner (1984). The ascospores are liberated by rostrate dehiscence. The asci and parpahyses are generally the same height.

Ascospores vary in size and shape as shown in Fig. 2 and Table 1. They are usually simple, rarely uniseptate, ovoid, ellipsoid or fusiform. Ascospores may germinate within the ascus.

Pycnidia are common in the genus, but are often difficult to find, as they mostly appear as slightly raised areas on the squamule surface (Fig. 34A) and can be confused with apothecial initials. They are globose, 0.1-0.2 mm in diam., and generally partly immersed in the thallus, rarely superficial. The pycnidial wall is tan or reddish brown, KOH-, and the ostiolar region may be more darkly pigmented than rest of the wall. The outer wall is paraplectenchymatous. The inner surface is lined with irregularly shaped conidiophores that may be branched (Fig. 16). Pycnospores are produced apically from elongate, enteroblastic conidiogenous cells. The pycnospores are rod-shaped, 9-15 x 0.5-1.0 um, straight or slightly bent.

CHEMISTRY

Only five of the 19 neotropical species of Phyllopsora have

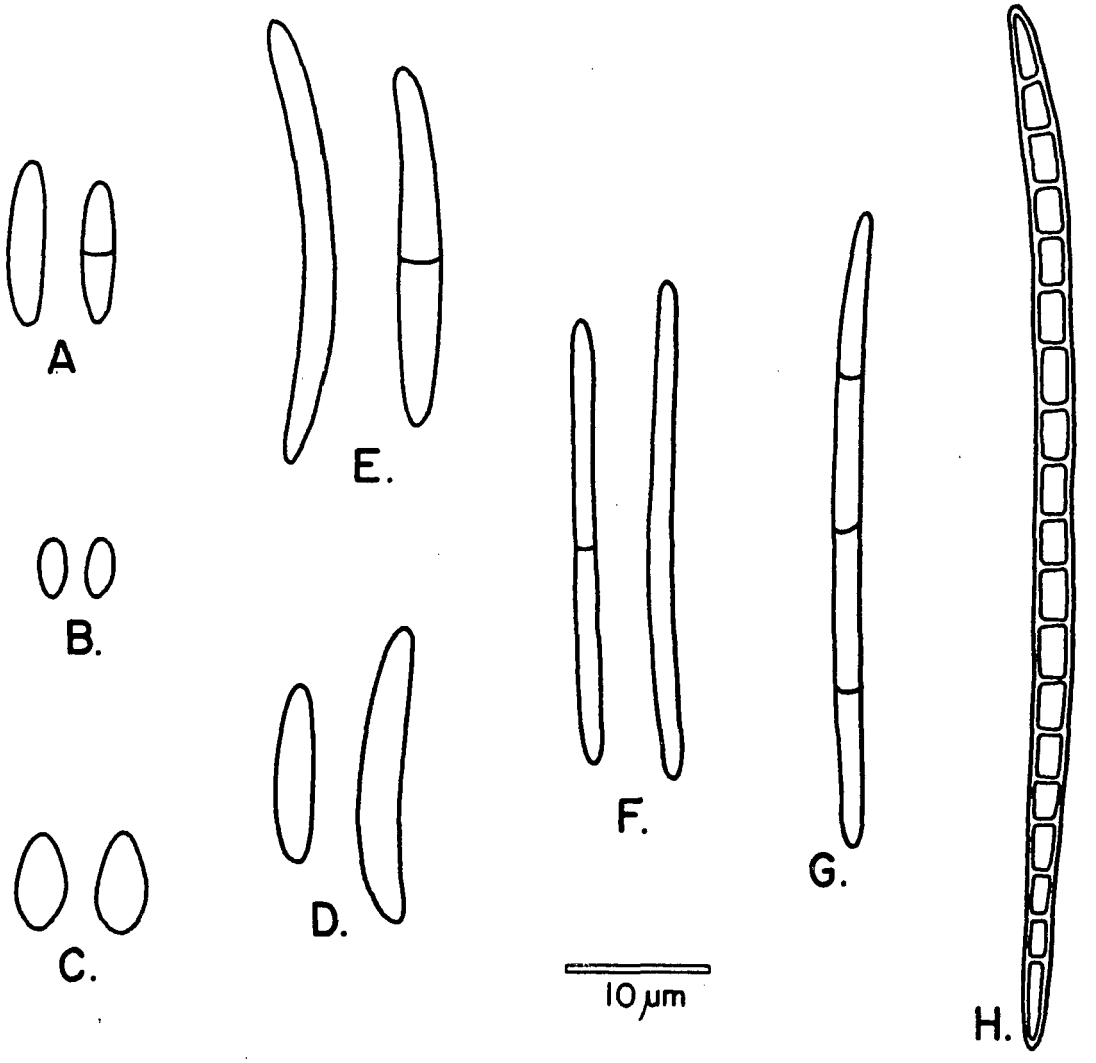


Fig. 2. Ascospores. A) Phyllopsora chlorophaea, B) Phyllopsora glabella, C) Phyllopsora parvifolia var. breviuscula, D) Phyllopsora longiuscula, E) Squamacidia, F & G) Psorellopsis, and H) Bacidia rosella.

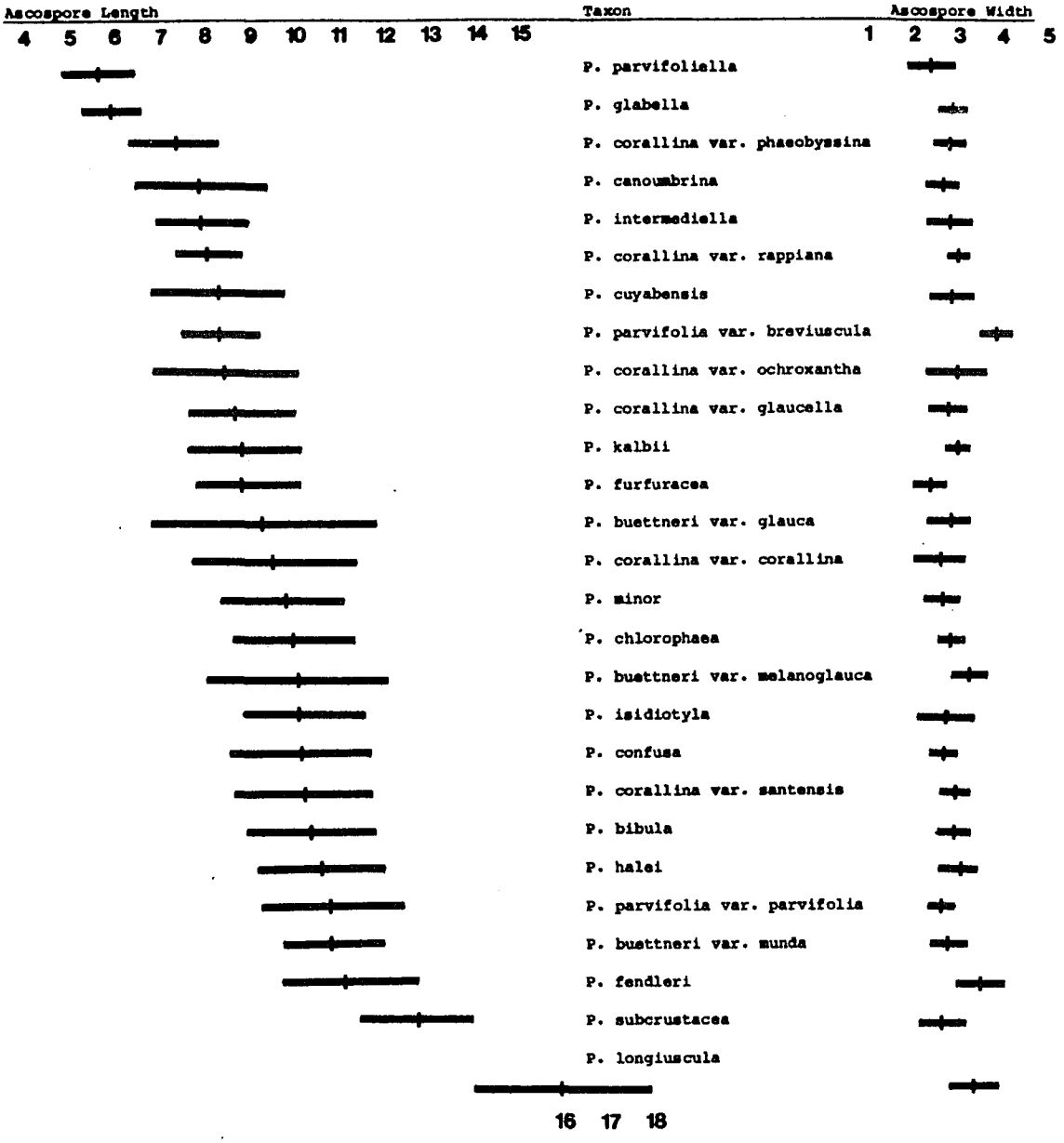


Table 1. Ascospore lengths (left) and widths (right) given in µm, showing the standard deviation (SD) from the mean value ($\bar{X}$).

detectable lichen substances (Table 2). The only substances of known structure are atranorin, pannarin, argopsin and zeorin. Zeorin is the only terpene reported. Other terpenes were often detected, but not consistently, and it is possible they may have originated in the bark or from overgrown bryophytes rather than from the lichen.

A number of unknown substances occur in the genus, but their structural analysis and identification were beyond the scope of this work. The relative positions of these compounds are shown in Fig. 3. The unknown compounds are given letter names corresponding to names used by Swinscow and Krog (1981) or are taken from the first letter of the taxon where the compound has been found. When more than one unknown occurs in a taxon, a number is given after the letter.

Compounds found in Phyllopsora:

Atranorin, Rf. 7:7:7, appears as a dark spot in short wave UV light. After sulfuric acid treatment the spot turns dull- yellow-brown. It is Pd+ yellow. Small yellowish granular crystals of atranorin can be observed in the cortex on the outer walls of the hyphae.

Pannarin, Rf. 7:7:7, in long wave UV light produces a white fluorescence. After sulfuric acid treatment the spot turns bluish-gray. It is Pd+ yellow-orange.

Argopsin (1'chloropannarin), albicans unknown 2 of Swinscow and Krog, Rf. 6-7:7:7, in long wave UV light produces a yellowish

fluorescence. After sulfuric acid treatment the spot turns brown. It is Pd+ orange.

Unknown A, albicans unknown 1 of Swinscow and Krog, Rf. 6:6:6, in long wave UV light produces a yellow fluorescence. After sulfuric acid treatment the spot is colorless or gray. It is Pd+ yellow. Elix (pers. comm.) suggests this substance may be norargopsin.

Unknown B, Rf. 6:6:6, in long wave UV light produces a dull orange fluorescence. After sulfuric acid treatment the spot is colorless or faint orange. It always occurs with argopsin, so the Pd reaction is not known.

Unknown C, Rf. 5-6:6:6:, in long wave UV light produces a faint fluorescence. After sulfuric acid treatment the spot turns brown. It is Pd-.

Unknown G1, Rf. 7:7:7:, appears as a dark spot in short wave UV light. After sulfuric acid treatment it turns brown. It is Pd-.

Unknown G2, Rf. 6-7:6-7:?, appears as a dark spot in short wave UV light . After sulfuric acid treatment it turns brown. It is Pd-.

Unknown H1, haemophaea unknown of Swinscow and Krog, Rf. 5:5:3, in long wave UV light produces a white fluorescence After sulfuric acid treatment the spot turns gray. It is Pd-.

Unknown H2, Rf. 6-7:6-7:4, in long wave UV light produces a faint fluorescence. After sulfuric acid treatment it is colorless. It is Pd-.

Unknown H3, Rf. 4:4:3, not visible under UV light. After sulfuric acid treatment a pink spot appears. It is Pd-.

Unknown M, Rf. 6:6:6:, in long wave UV light produces a faint fluorescence. After sulfuric acid treatment it turns pale yellow. It is Pd-.

Unknown O1, ochroxantha unknown 1 of Swinscow and Krog, Rf. 6:5:6, in long wave UV light produces a yellow fluorescence. After sulfuric acid treatment it turns bright yellow-orange. It is Pd+ orange.

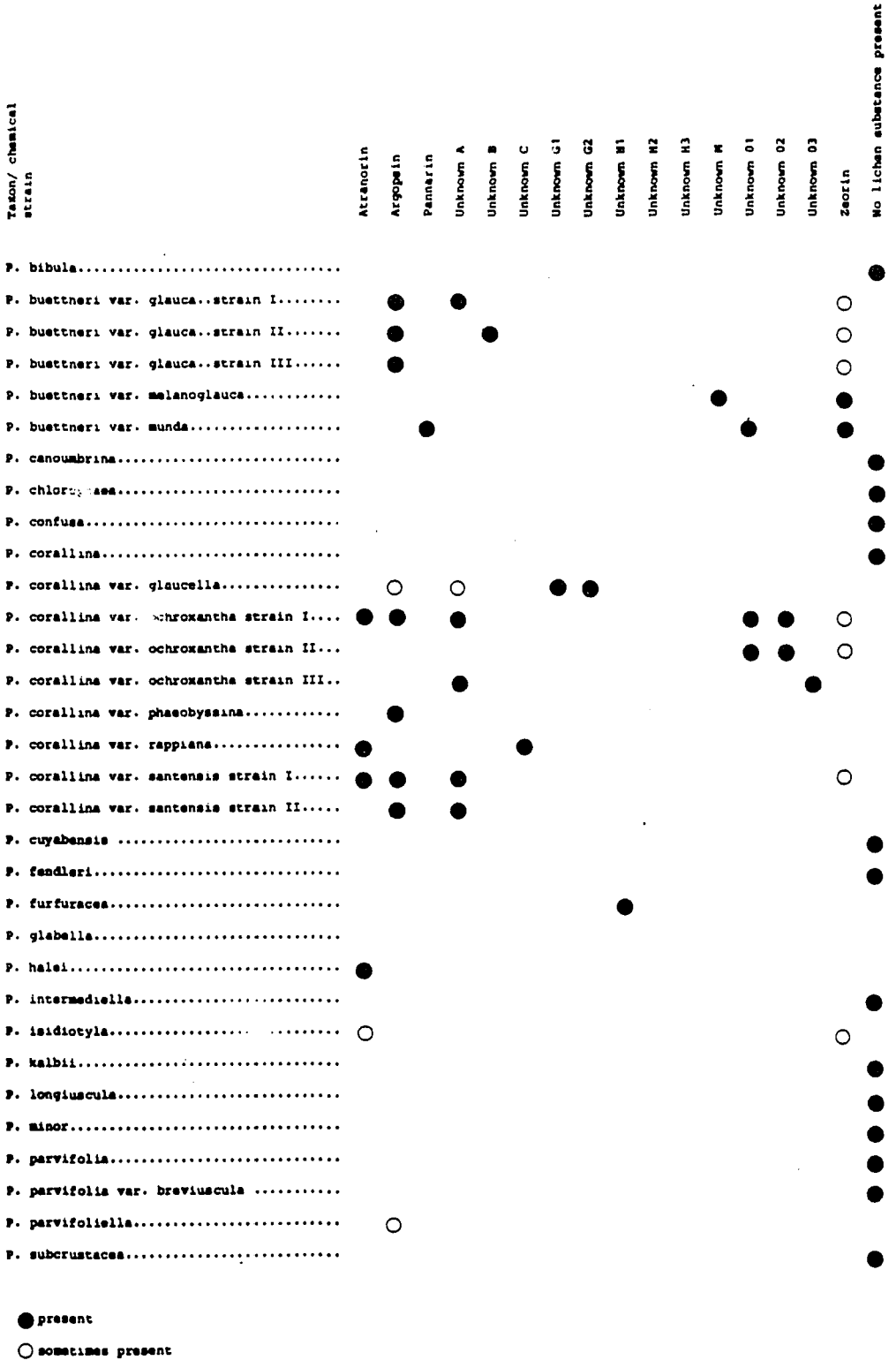
Unknown O2, Rf. 7-8:7:8, in long wave UV produces a yellow fluorescence. After sulfuric acid treatment it turns yellow or green. The Pd reaction is not known.

Unknown O3, Rf. 6-7:6-7, appears as a dark spot in short wave UV light. After sulfuric acid treatment it turns brown. It is Pd- or weakly Pd+ yellow.

Zeorin, Rf. 4:4:4, not visible in UV light. After sulfuric acid treatment it turns brownish to purplish gray. It is Pd-.

Pigments occur in the thallus and apothecia and need further study.

Table 2. Lichen substances.



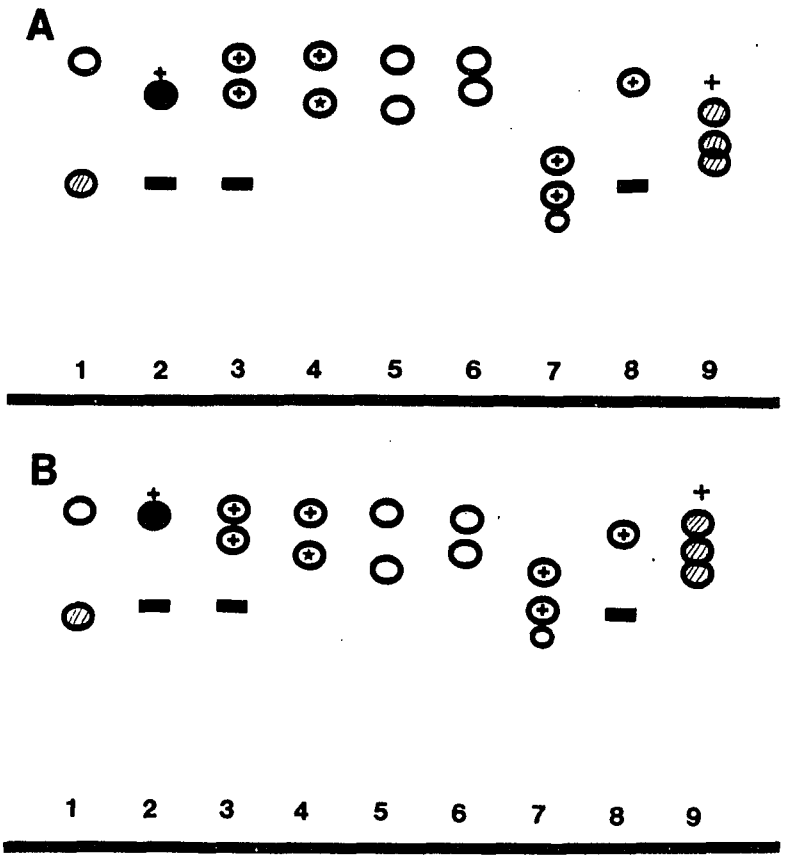


Fig. 3. Diagram of chromatograms in solvents A=TDA, B=HEF of some lichen substances occurring in Phyllopsora: ◍ denotes substances which turn bright yellow after treatment with dilute sulfuric acid and heat; ● indicates the dark blue-gray spot characteristic of pannarin; ▬ indicates zeorin; ★ implies an orange fluorescence and + implies a pale yellow fluorescence under long wave ultraviolet light. Reference 1 is norstictic acid and atranorin; 2. zeorin and pannarin; 3. unknown A and argopsin; 4. unknown B and argopsin; 5. unknown C and atranorin; 6. unknowns G1 and G2; 7. unknowns H3, H1, H2; 8. zeorin and unknown M; 9. unknowns O1, O2 and O3.

The pigment found in the apothecia of P. furfuracea may be parietin.

There is a long history of controversy concerning the use of natural product chemistry in the systematics of lichenized fungi. Recently, a symposium was devoted to this subject and addressed the biogenetic relationships of the lichen substances, correlation and non-correlations of chemical variation patterns with lichen morphology and geography, and biological and ecological considerations of lichen substances (W. Culberson, 1986). In this treatment, I follow the guidelines proposed by Hawksworth (1976) for determination of the taxonomic status of chemical races with some modifications. He proposes four basic patterns of variation: 1) replacement of one substance by one or more biogenetically distinct substances, 2) replacement of one substance by one or more biogenetically closely related substances, 3) presence of accessory substances, and 4) variation in concentration of substances. In Phyllopsora, consideration of chemical substances as taxonomic characters is complicated by the fact that there are so many unknown compounds. It is, therefore, impossible in many cases to distinguish between patterns 1 and 2. Another possible pattern, proposed by Lamb (1977), accounts for the loss of substances, i.e., deletion chemistries or deficient strains.

Examining the spectrum of lichen compounds found in Phyllopsora, atranorin, the only para-depside found in the genus, is not useful as a taxonomic character as it occurs in the cortex of hundreds of species of lichens in many families. Likewise, zeorin, a triterpenoid found in three of the neotropical species of

Phyllopsora, is also found widespread in many lichen families, giving no clues to relationships. The most interesting compounds found in the genus are the biogenetically closely related depsidones pannarin and argopsin. Pannarin is reported elsewhere from species of unrelated genera including Pannaria, Lecanora, Megalospora, Psoroma and Pseudocyphellaria. Argopsin is reported from Argopsis, Biatora, Erioderma and Micarea. Pannarin and argopsin both occur at Rf. 7, and are distinguished by the color of their spot after sulfuric acid treatment, but it could not be determined if the substances occur together. Compounds designated unknown A, unknown O1, O2, and O3 may be biogenetically related to argopsin.

In P. buettneri there are four chemical races as shown in Fig. 5, which seem to follow the replacement pattern of Hawksworth (1976). I have recognized these at the level of variety as they correlate with only slight differences in morphology and the distribution patterns are not certain. In P. buettneri var. glauca and P. corallina vars. ochroxantha, and santensis, I recognize chemical strains because the variation seems to be an additive pattern of accessory compounds which may prove closely related, and there are no correlating differences in morphology, ecology or distribution. In P. corallina s. lat. this could also be interpreted as a case of deletion chemistry with the full potential chemistry found in P. corallina var. ochroxantha and P. corallina var. corallina having lost all potential for production of lichen substances.

Among the remaining taxa there are several examples where the

occurrence of unknown compounds correlated with well defined morpholgical differences and were used for separation of species, as in P. furfuracea.

DISTRIBUTION AND ECOLOGY

Phyllopsora has a largely pantropical distribution (Fig. 4), very similar to that of Megalospora (Sipman, 1983) and Coccocarpia (Arvidsson, 1982). A single species, P. rosei, is found well into northern Europe, but its inclusion in the genus is doubtful. Of the 19 species found in the neotropics, nine are pantropical. Those restricted to the neotropics generally have a broad distribution (Fig. 7). Phyllopsora corallina var. corallina occurs as far north as Illinois, while P. parvifolia has the southernmost range, to 27°S in northeastern Argentina. Apparent disjunctions occur in P. corallina var. phaeobyssina and P. fendleri. Phyllopsora corallina var. phaeobyssina is currently known from localities in the West Indies, Venezuela and Brazil, but this kind of large gap in the species range may likely be an artifact of the small number of collections for such uncommon taxa. Phyllopsora subcrustacea is only known from Paraguay and P. bibula has only been collected from the Juan Fernandez Islands off the Chilean coast.

There is no clear distribution pattern to the chemical varieties detected in the genus (Figs. 5, 6). Although the greatest chemical diversity is found in the New World species, these have been much better collected and studied than the Old World taxa. Also, different chemical varieties generally occur sympatrically.

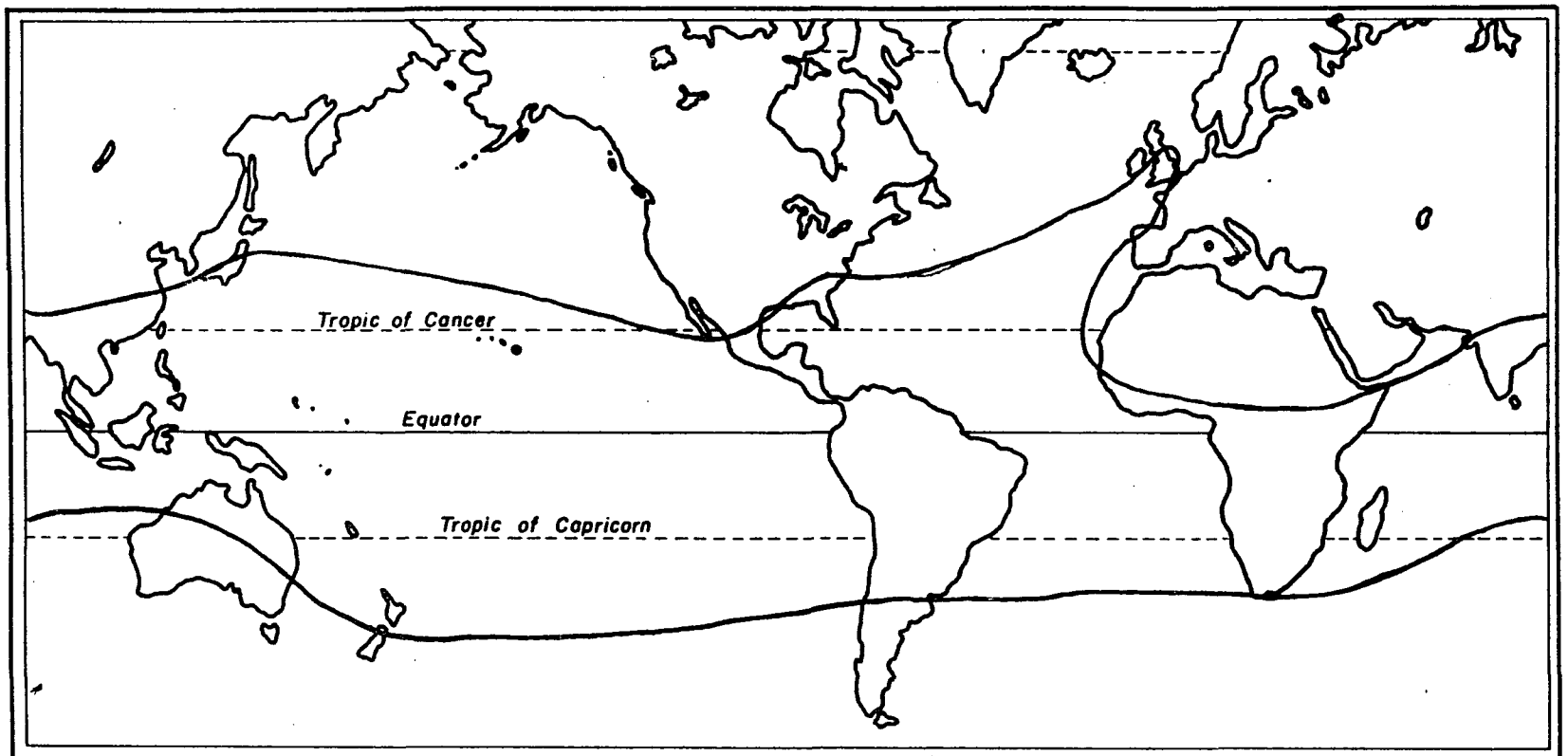


Fig. 4. Worldwide range of Phyllopsora.

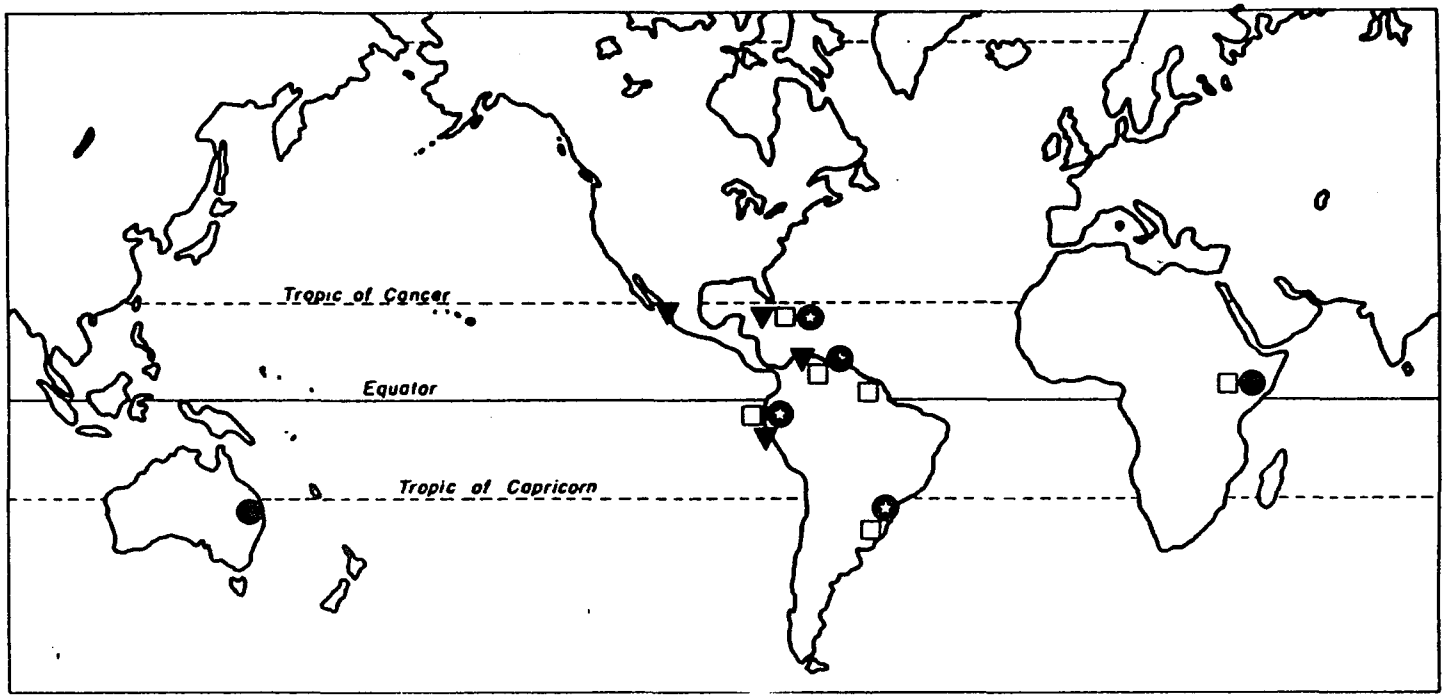


Fig. 5. The worldwide distribution of Phyllospora buettneri - P. buettneri var. buettneri (●), P. buettneri var. glauca (□), P. buettneri var. melanoglauca (▼), and P. buettneri var. munda (✪).

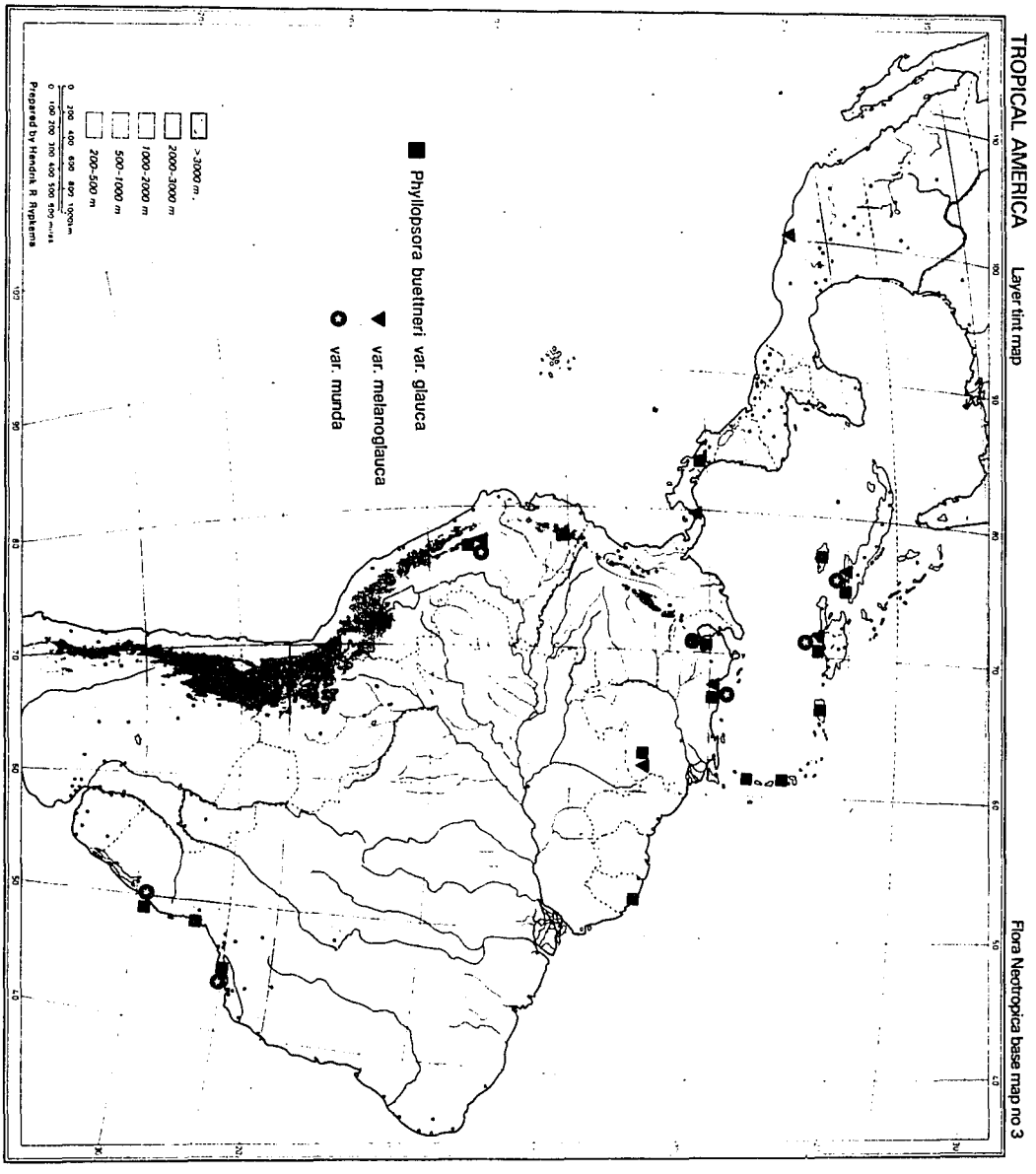


Fig. 6. Neotropical distribution of Phyllopsora buettneri.

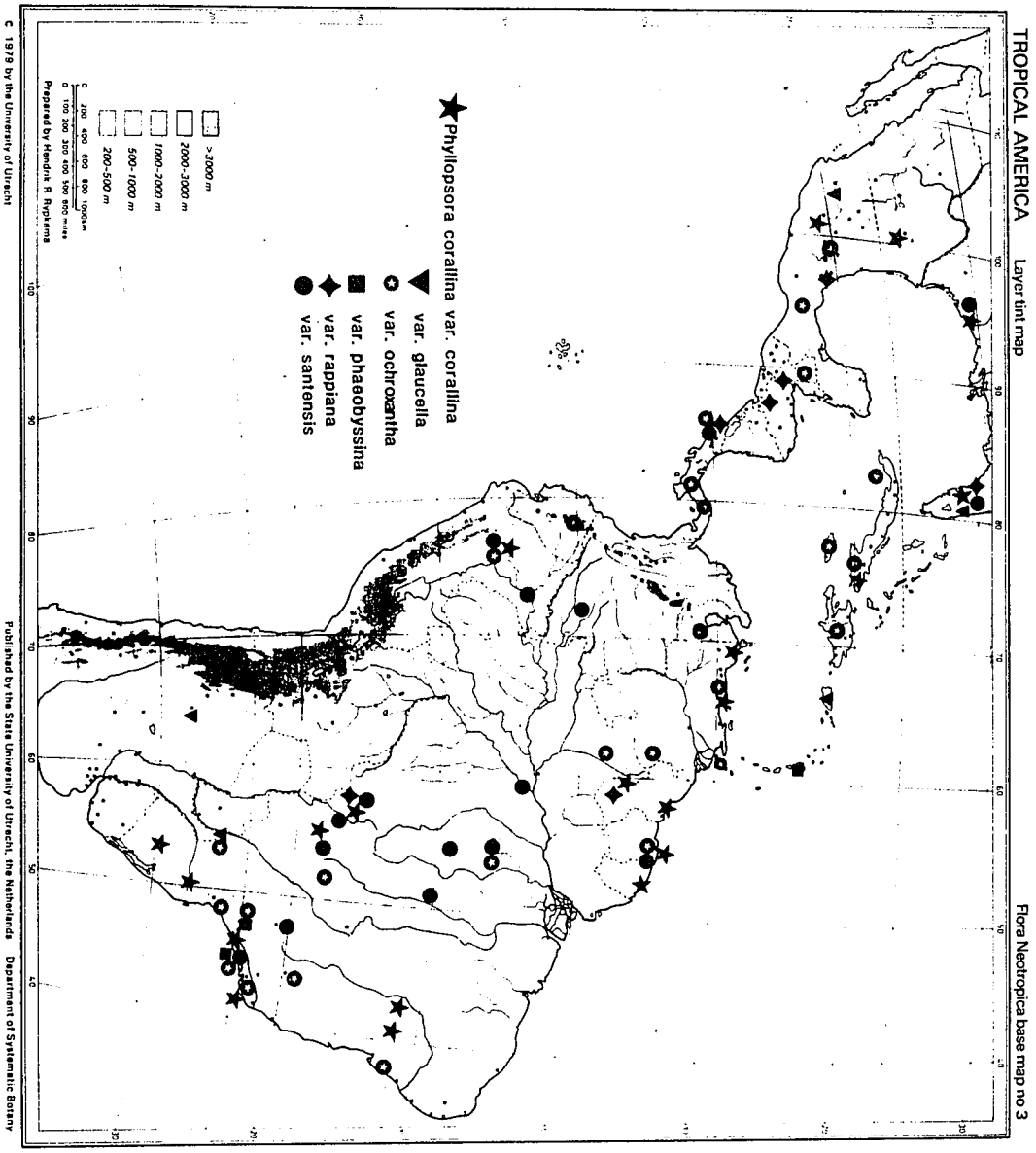


Fig. 7. Neotropical distribution of Phyllopsora corallina.

The widespread distribution of most species of Phyllopsora could be an indication of historic, geologically related distribution or recent long distance dispersal.

Most species of Phyllopsora are corticolous, some may also grow on rock or over bryophytes, but are almost never found on leaves or dead wood. Phyllopsora species occur on a broad range of woody angiosperms. Several taxa were found to occur on trunks of Araucaria angustifolia in southern Brazil, but Phyllopsora is rarely found on other gymnosperms. Members of the genus prefer the lower, main trunks of living trees. Two or three different species of Phyllopsora are at times found growing on the same tree trunk.

The altitudinal range of Phyllopsora is from sea level to 3000 m. Phyllopsora parvifolia is found in coastal forests, but also occurs to 2650 m. Phyllopsora fendleri appears to be restricted to high altitudes between 1200 and 2800 m. Species of Phyllopsora are most common in humid subtropical montane forests between 500 and 2000 m, as is the case for the family Megalosporaceae (Sipman, 1983). Both groups are also found at lower elevations on islands such as the Galapagos, or in coastal areas where local cloud condensation leads to high humidity levels. In drier areas such as savannas, Phyllopsora is restricted to gallery forests. Phyllopsora and the Megalosporaceae, however, are rare in tropical lowland rainforest, which Sipman (1983) attributes to high temperature intolerance in the Megalosporaceae. In addition, Phyllopsora may be intolerant of very low light intensities in high canopied forests, as I observed in central Amazonia, where the Thelotremataceae are the

dominant corticolous epiphytes. Phyllopsora species prefer partially shaded habitats and individuals that occur in full sunlight often show some bleaching or browning of thallus color.

Many lichen species commonly found growing in the same habitat with Phyllopsora share a similar squamulose thallus form with obvious prothallus. These include members of Eschatogonia, Physcidia, Psorellopsis, species with the fundamental characters of Bacidia, and even some members of the Pilocarpaceae and Lecanoraceae. Other genera commonly found growing together with Phyllopsora include Catinaria, Crocynia, Coenogonium, Chiodecton, Megalospora and Porina.

All species of Phyllopsora have potential for sexual reproduction as all form apothecia with ascospores at some point in their development. There are no strictly sterile species. Ascospore size ranges from 4-20 um, which is normal for wind dispersal (van Zanten & Pőcs, 1981, p. 505). Thallus fragments may also be transported by wind. Asexual reproduction is achieved in part by isidia, which occur in 61% of the neotropical taxa. Isidia are potential short-distance dispersal units (Henssen & Jahns, 1973), and may be an important mechanism for local range extensions. Ascospores, isidia and thallus fragments may also be transported by rainwater or by animals, particularly insects. All isidiate species are also able to produce apothecia allowing for a "mixed strategy" of sexual and asexual reproduction. Lawrey (1980) suggested that temperate lichen species as a group exhibit mixed strategies much more frequently than tropical species. Phyllopsora does not fit this tendency.

SYSTEMATIC POSITION OF *PHYLLOPSORA* AND PHYLOGENTIC RELATIONSHIPS

Our current lack of base line data for microlichens limits the discussion of systematic relationships of *Phyllopsora*. The genus was placed in the order Lecanorales (Poelt, 1973) because of its squamulose to small foliose thallus, open, round disk-shaped apothecia with radiate exciple, true paraphyses and thick walled, I+ blue asci.

Following reassessment and realignment of the broadly defined families Lecideaceae and Lecanoraceae by Hafellner (1984) and subsequent modifications by Eriksson and Hawksworth (1986), *Phyllopsora* seems well placed in the family Bacidiaceae. The Bacidiaceae are considered a monophyletic group based on the synapomorphy of asci with an amyloid hemispheric dome containing a narrow, conical non-amyloid masse axiale. Nineteen genera are currently included in the family. Phylogenetic analysis of the family is not possible at this time because most of these genera are poorly understood. The characters which best separate the genera are basic apothecial form, types of paraphyses, and ascospores. Little is known about the ontogeny of these structures, so discussion must be limited to general morphology. The genera which share the most characters with *Phyllopsora* are *Bacidia*, *Biatora*, *Eschatogonia* and two additional newly described genera, *Psorellopsis* and *Squamacidia*. *Psorellopsis* is used here to accommodate several species which previously were assigned to *Psorella*. The type of *Psorella*, *P. pannarioides* (Knight) Müll. Arg., has characters which separate it from other species that have been included in the genus. Three of

these species are distinguished as a separate genus that will be described elsewhere. A working description of Psorellopsis, and discussion of included species are presented in Appendix I. Squamacidia includes one species formerly placed in Phyllopsora, with one new variety. It will also be formally described in a separate publication, and is included in Appendix I.

Some species of the above genera have been confused with Phyllopsora because they also have a squamulose thallus with an obvious prothallus and biatorine apothecia. Phyllopsora can be separated from the other genera by the combined characters of its ascus type, its apothecial type composed of highly gelatinized hyphae with no clear distinction between the exciple and hypothecium, the similar texture in the center and at the margin, and by its small, thin walled, rarely septate ascospores (Table 3).

Bacidia De Not., as typified by B. rosella, has an apothecial pattern with a cup-shaped exciple and distinct hypothecium and subhymenium of different textures. The ascospores are multiseptate and thick-walled (Fig. 2H). Bacidia as currently recognized is heterogeneous; it is a very large genus that is widespread in tropical and temperate areas, and in need of clarification.

Biatora Th. Fr., as typified by Biatora vernalis (L.) Fr., can be distinguished from Phyllopsora by its ascus type. It has the basic type found in the family with the addition of a darker staining area around the masse axiale. Biatora vernalis has the same apothecial pattern as Phyllopsora, but has somewhat larger, thicker walled ascospores. Also, B. vernalis has a crustose thallus and appears to

Table 3. Comparison of genera.

Genus	Phyllopsora	Psorellopsis	Squamacidia	Physcidia	Eschatogonia	Bacidia rosella	Biatora vernalis
Ascal type	Bacidia-type	Bacidia-type	Bacidia-type	Bacidia type	Bacidia type	Bacidia type	Biatora type
Apothecial type	Biatorine Phyllopsora type	Biatorine non-Phyllopsora type	Biatorine non-Phyllopsora type	Lecanorine	Biatorine non-Phyllopsora type	Biatorine non-Phyllopsora type	Biatorine Phyllopsora type
Spores	thin-walled simple-uni-septate 7-22 x 2-5	thin-walled uni-multi septate 20-40 x 1.5-3	thin-walled simple-uni septate 25-40 x 2.5-4	thin-walled uni- multi septate 12-25 x 1-3	thin-walled uni- multi septate 12-20 x 2-3	thick-walled multi-septate 60-65 x 3-5	thick-walled simple-uni-septate 12-15 x 3-5
Pycnospores	rod-shaped	rod-shaped	?	rod-shaped	rod-shaped	?	?
Thallus	squamulose-small foliose	squamulose	squamulose	squamulose-foliose	squamulose	crustose	crustose
Vegetative Propagules	+/- isidia +/- lobules	+/-lobules	isidia	+/-isidia	+/- lobules	none	none
Thallus Cortex	Type 1,2,1-2	Type 1	Type 1	Type 1	single layer of cells	prosoplect.	prosoplect.
Phycobiont	Pseudochlorella	Pseudochlorella	?	Pseudochlorella	Pseudochlorella	?	?
Lichen Substances	atranorin argopsin pannarin zeorin unknowns	atranorin	fumar-protocetraric acid lobaric acid	atranorin divaricatic acid	unknowns	atranorin	none
Distribution	subtropical tropical	tropical	tropical	tropical	tropical	temperate	temperate

be primarily a temperate genus. Biatora efflorescens Nyl., an unusual sorediate species, also resembles Phyllopsora in apothecial anatomy and has argopsin which would be further evidence in support of a close relationship between Biatora and Phyllopsora.

Eschatogonia Trevisan, a genus comprised of a few tropical species that have squamulose thalli, is often collected together with Phyllopsora. It can be distinguished from Phyllopsora by its apothecial type, with a distinct subhymenium, and by the presence of a lower cortex. The cortex has an distinct outer layer of uniformly arranged cells that is an autapomorphy for the genus (Fig. 44). The ascospores are slightly larger than those found in Phyllopsora, and are usually septate.

Psorellopsis is also commonly found growing together with Phyllopsora. The thallus morphology can be identical. It is distinguished from Phyllopsora by its apothecial pattern with an obvious subhymenium (Figs. 46 & 47) and by its longer, often multiseptate ascospores. The ascospores have thinner walls than do ascospores of B. rosella. This taxon needs more investigation as regards its separation from Bacidia.

Squamacidia can be separated from Phyllopsora and other genera in the Bacidiaceae by its thick pale apothecial margin. Apothecial anatomy is closest to that of Phyllopsora but the hyphae of the exciple are expanded at the margin and covered with granules. The ascospores are broader than in Phyllopsora and somewhat irregular in shape. The thallus is squamulose and often has a bright scarlet pigment. The genus is thus far only known from the tropics. A

distinct group of lichen substances, fumarprotocetraric acid, lobaric acid, and unknown compounds have been detected for the genus.

Comparing Phyllopsora to other genera in the Bacidiaceae, we find many shared characters. Evolution seems to have been conservative because there are so few unique characters for generic separation. The most useful are the apothecial characters, but these need ontogenetic study. There is great deal of variability in vegetative characters, perhaps due to ecological pressures. Within the Bacidiaceae, Phyllopsora has a relatively rich chemistry and lichen substances may also prove to be important for generic separation in the family.

Phylogenetic analysis (Henning, 1966) was used to assess relationships of the neotropical species of Phyllopsora. Character polarity was determined by the outgroup comparison method (Platnick, 1979; Humphries & Funk, 1984) with Biatora vernalis as the outgroup. The relationship of the species of Phyllopsora is illustrated by a cladogram (Fig. 8). The characters and character states used for the cladogram are listed in Table 4. Eleven characters were used. Analysis of herbarium specimens during the course of this study provided the data to define characters. Table 5 contains the data matrix used in this analysis. The data set was analyzed using Swofford's phylogenetic package, PAUP (version 2.4.1) run on an IBM-XT using the global swapping option. The output produced 200 equally parsimonious trees, so consensus trees were produced. Both the Adams (1972) consensus tree and the strict consensus tree have a large number of unresolved taxa. The Adams tree is more resolved and

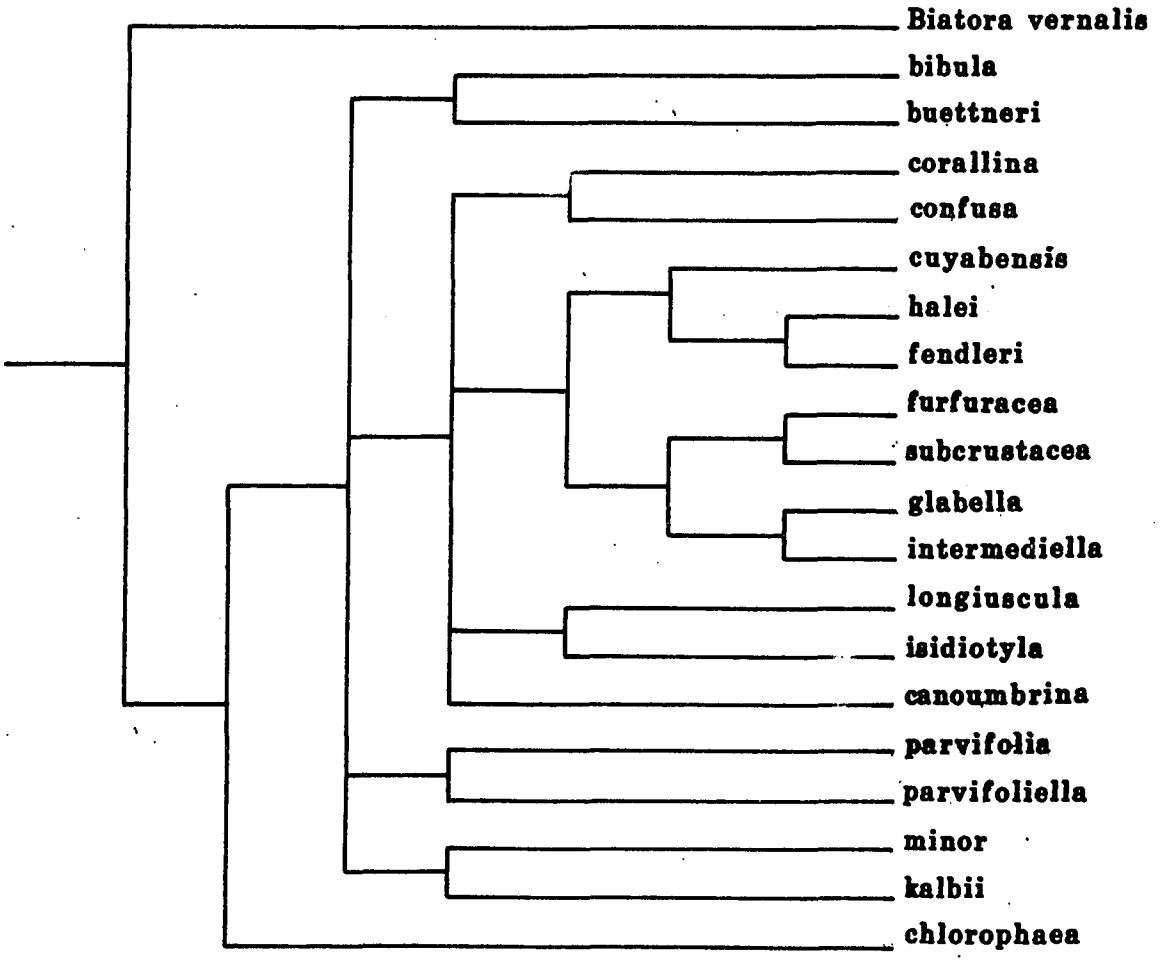


Fig. 8. Cladistic relationship of neotropical species of Phyllopsora with the outgroup Biatora vernalis.

Table 4. Character and character state used in the cladistic analysis.

	0	1
1. Ascal type	Biatora type	Phyllopsora type
2. Ascospore length	Over 15 um	Under 15 um
3. Ascospore wall	Thick	Thin
4. Ascospore septation	Present	Absent
5. Thallus type	Crustose	Squamulose/foliose
6. Squamule size	na	Maximum 0.1 mm
7. Squamule size	na	Maximum 1.0 mm
8. Upper surface	Glabrous	Pubescent
9. Isidia	Absent	Present
10.Cortex	Not Type 1 or 2	Type 1 or 2
11.Pd+ orange	Absent	Present

Table 5. Data matrix.

Taxa/ character	1	2	3	4	5	6	7	8	9	10	11
Biatora vernalis	1	1	0	0	0	0	0	0	0	0	0
P. bibula	0	1	1	1	1	0	0	0	0	1	0
P. buettneri	0	1	1	1	1	0	0	1	1	1	1
P. canoumbrina	0	1	1	1	1	1	0	0	1	0	0
P. chlorophaea	0	1	1	0	1	0	0	0	0	1	0
P. confusa	0	1	1	1	1	0	0	0	1	1	0
P. corallina	0	1	1	1	1	0	0	0	1	1	1
P. cuyabensis	0	1	1	1	1	0	1	0	1	1	0
P. fendleri	0	1	1	1	1	0	1	0	0	1	0
P. furfuracea	0	1	1	0	1	1	0	0	1	1	0
P. glabella	0	1	1		1	0	0	0	1	1	0
P. halei	0	1	1	1	0	0	1	1	1	1	0
P. intermediella	1	1	1	1	1	0	0	0	1	0	0
P. isidiotyla		1	1	1	1	1	0	0	1	0	0
P. kalbii		1	1	1	1	0	0	0	1	1	0
P. longiuscula	1	0	1	1	1	0	0	0	1	0	0
P. minor	0	1	1	1	1	1	0	0	0	1	0
P. parvifolia	0	1	1	1	1	0	1	0	0	1	0
P. parvifoliella	0	1	1	1	1	0	0	0	1	1	0
P. subcrustacea	0	1	1	1	1	1	0	0	1	1	0

is presented in Fig. 8.

Phyllopsora species are separated from Biatora vernalis by the following characters: type of ascus tip, thin ascospore wall, squamulose thallus form, and type of cortex. Phyllopsora chlorophaea is the sister group of all other species based on its non-isidiate thallus and septate ascospores.

Several species groups can be recognized. Phyllopsora intermediella, P. longiuscula, P. isidiotyla and P. canoumbrina form one group based on their small, isidiate squamules and very thin, non-type 1 or 2 cortex. Phyllopsora minor also has squamules of ca. 0.1 mm width, but is separated from the above group as it is non-isidiate.

The species with squamules of 1.0 mm form another group. In this group, P. fendleri and P. parvifolia are not isidiate, P. cuyabensis and P. halei are isidiate.

Among the remaining taxa both P. buttneri and P. corallina have the ability to produce Pd+ lichen substances. The relationship of the other taxa is unresolved.

DELIMITATION OF SPECIES AND INFRASPECIFIC TAXA

Delimitation of species and interspecific taxa in lichenology is notoriously difficult as the biology of lichens is so poorly understood (Kärnefelt, 1979; Sipman, 1983; Tehler, 1983). According to the International Code of Botanical Nomenclature (Article 13) a lichen "species" refers only to the fungal component. The "biological species" concept implies knowledge of sexuality and

genetics that is not available for the genus Phyllopsora. An "evolutionary species" concept is also inapplicable as we have no evidence for speciation events. The "taxonomic species" concept separates species by morphological differences or in lichens by chemical differences. Even this rather simplistic approach is difficult in Phyllopsora, since there are relatively few unique characters, and most character states form a continuum. The only viable alternative is a utilitarian species concept.

In the present monograph, I follow Gradstein (1975) and Sipman (1983) in requiring two or more independent characters for separation of taxa at the species level. Taxa that have constant single character differences correlated with geographical separation are separated from their nearest relatives at the level of subspecies. No subspecies could be recognized in this treatment.

The rank of variety is used for taxa that differ from their nearest relative by only one character and are not fully separated geographically. Varieties recognized in this treatment are distinguished by chemical differences, mostly additive chemistry, and slight morphological differences.

In the past, most Phyllopsora species were separated by single character differences, usually in squamule morphology, color of the thallus, prothallus, or apothecia, secondary chemistry or ascospore dimensions. For separation of species in this study I have had to use a combination of characters and have concentrated on mycological characters. Squamule morphology is useful in some species. Color of the thallus and prothallus is not useful as it is highly variable in

most species. Apothecial pigments are sometimes useful. Chemistry is used for separation of species only when it correlates with other differences. Ascospores sizes are broadly overlapping in many species.

TAXONOMIC TREATMENT

Key to the species of Phyllopsora and associated taxa

1. Thallus smooth to areolate-crustose 2
   2. Isidiate; prothallus with a yellow pigment; granules present in the cortex; ascus tip with a broad masse axiale Lecidea stylophora (p. 166)
   2. Not isidiate; prothallus white; granules lacking; ascus tip with a narrow conical masse axiale Lecidea thaleriza (p. 168)

1. Thallus small foliose or squamulose
   3. Apothecia with a distinct difference in texture of the margin and the center; ascospores more than 20 um long
      4. Lobaric acid present Squamacidia (p. 157)
      4. Lobaric acid lacking Psorellopsis (p. 152)
   3. Apothecia with no difference in texture of the margin and center; ascospores less than 20 um long
      5. Lobes generally more than 0.3 mm wide
         6. Thallus Pd-
            7. Upper cortex greater than 50 um thick
               8. Thallus lobes short; prothallus white; ascospores ellipsoid to short fusiform,

9.5-13 x 3-4 um

P. fendleri (p. 96)

8. Thallus lobes elongate; prothallus pale to reddish; ascospores less than 10 um long

9. Thallus squamulose; ascospores 5.5-6.5 x 2.5-3 um long *P. glabella* (p. 104)

9. Thallus small foliose; ascospores 7.5-9.5 x 3.5-5 um

P. parvifolia var. *breviuscula* (p. 124)

7. Upper cortex less than 50 um thick

10. Upper surface rough; squamules white

P. cuyabensis (p. 94)

10. Upper surface smooth; squamules green to brown

11. Thallus lobes broad, 0.5-1 mm wide, lobulate, often densely so, never isidiate; ascospores ellipsoid to short fusiform, 9.5-12.5 x 2.5-3 um

P. parvifolia var. *parvifolia* (p. 118)

11. Thallus lobes narrow, 0.3-0.5 um, not lobulate, usually isidiate

12. Ascospores ovoid, 5-6.5 x 2-3 um

P. parvifoliella (p. 126)

12. Ascospores ellipsoid, 7.5-9 x 3

13. Thallus containing atranorin and unknown C

P. corallina var. *rappiana* (p. 88)

13. Thallus lacking detectable lichen substances

P. corallina var. corallina (p. 74)

6. Thallus Pd+

14. Thallus Pd+ yellow, only atranorin; at center more or less crustose with discrete to adjoined squamules at the margin; upper surface ecorticate at the margin; hypothecium reddish brown throughout P. halei (p. 105)

14. Thallus Pd+ orange-red; thallus squamulose; upper surface corticate at margin; hypothecium in part tinged red

15. Thallus pruinose

16. Upper cortex 50 um thick; argopsin, unknown A or B, +/- zeorin P. buettneri var. glauca (p. 54)

16. Upper cortex less than 40 um thick

17. Unknown M, terpene, zeorin

P. buettneri var. melanoglauca (p. 59)

17. Pannarin, unknown O1, zeorin

P. buettneri var. munda (p. 60)

15. Thallus not pruinose

18. Squamules not lobulate or isidiate, ascending exposing a thick layer of white interwoven hyphae below; argopsin, unknown A or B, +/- zeorin

P. buettneri var. glauca (p. 54)

18. Squamules usually lobulate or isidiate,

ascending only slightly at the margins;
chemistry various

19. Unknown O present

P. corallina var. *ochroxantha* (p. 79)

19. Unknown O lacking

20. Unknown G present

P. corallina var. *glaucella* (p. 78)

20. Unknown G lacking

21. Isidia globose to coralloid, laminal and marginal, erect; argopsin, unknown A, +/- zeorin

P. corallina var. *santensis* (p. 89)

21. Isidia marginal, flattened, horizontal; only argopsin

P. corallina var. *phaeobyssina* (p. 87)

5. Lobes less than 0.3 mm wide

22. Thallus Pd+ orange

23. Medulla containing a orange pigment

Biatora pyrrhomelaena (p. 161)

23. Medulla not containing an orange pigment

P. corallina var. *santensis* (p. 89)

22. Thallus Pd-

24. Thallus isidiate

25. Isidia small and delicate, often finely branched; apothecia with abundant pale fibrils from the margin *P. isidiotyla* (p. 110)

25. Not as above

26. Squamules grayish to white; apothecia dark brown P. kalbii (p. 111)

26. Squamules greenish to brown; apothecia tan to reddish

27. Apothecia section pigmented orange, commonly KOH+ scarlet to purple; haemophaea unknowns in thallus P. furfuracea (p. 97)

27. Apothecia section not pigmented orange, KOH-; no detectable lichen substances

28. Squamules granular

29. Thallus cortex 20 um thick; apothecia with a bright red margin P. subcrustacea (p. 128)

29. Thallus cortex 5-10 um thick; apothecia with a tan or brown margin P. canoumbrina (p. 62)

28. Squamules not granular

30. Isidia small, poorly developed, never globose or coralloid P. confusa (p. 66)

30. Isidia well developed

31. Isidia globose to short coralloid; cortex over 25 um thick; ascospores ellipsoid to

short fusiform 7.5-10.5 x 2-3 um

P. corallina var. *corallina* (p. 74)

31. Isidia irregular in shape; cortex less than 10 um; apothecia with abundant red hyphae from the margin

32. Apothecial margin darker than the disc; ascospores less than 10 um long *P. intermediella* (p. 107)

32. Apothecial margin paler than the disc; ascospores greater than 10 um long *P. longiuscula* (p. 113)

24. Thallus not isidiate

33. Apothecia completely suffused in red-brown pigment *P. chlorophaea* (p. 63)

33. Apothecia not completely suffused in red-brown pigment

34. Apothecia with an orange pigment; unknown H in the thallus *P. furfuracea* (p. 97)

34. Apothecia not so

35. Squamules translucent; cortex with an orange pigment; pycnospores bent *P. bibula* (p. 50)

35. Squamules not translucent; cortex tan, pycnospores straight

36. Squamules closely adnate; cortex less than 10 um thick *P. minor* (p. 115)

36. Squamules in part ascending; cortex 25 um thick *P. confusa* (p. 66)

DESCRIPTION OF THE GENUS

Phyllopsora Müll. Arg.

Bull. Herb. Boissier 2(Appendix 1): 11. 1894.

Type species: Phyllopsora breviuscula (lectotype designated by Clements & Shear, 1931).

Thallus squamulose, small foliose, rarely appearing crustose. Squamules 0.1-1.0 mm wide. Isidia common, sometimes dominating the thallus. Upper cortex 10-60 um thick, consisting of anticlinally oriented, thin- to thick-walled hyphae with round to narrowly cylindrical lumina, commonly containing lichen substances. Photobiont in a continuous layer, green, unicellular, 5-15 um diam., genus where known Pseudochlorella. Medulla usually poorly developed, of loosely woven and non-amyloid hyphae, frequently containing lichen substances. Lower cortex absent. Lichen substances: argopsin, atranorin, pannarin, zeorin and numerous unknown compounds.

Apothecia to 1.5 mm diam., simple or aggregated, attached laminally to the squamules. Disc plane to convex, margin often slightly raised, tan to dark reddish-brown, epruinose. Exciple composed of radiating hyphae, tan to golden-brown or dark red, sometimes containing crystals. Hypothecium tan to golden-brown, or dark red, sometimes containing crystals, KOH- or KOH+ scarlet or purplish-red. Hymenium 20-60 um tall, amyloid, epihymenium indistinct or a thin gelatinous layer with slight pigmentation, KOH-. Paraphyses cellular, straight, sparingly branched and anastomosing, apical cell slightly swollen, length to width ratio

6:1. Asci elongate-clavate, with a well developed tholus with a paler, conical masse axiale. Ascospores eight in the ascus, simple to uniseptate, colorless, ovoid, ellipsoid to fusiform, smooth-walled, without a halo, (4.5)5-20x 2-5 um.

Pycnidia spherical, immersed in the thallus to superficial, outer wall tan to reddish brown, ostiole pale to brown pigmented. Conidiophores irregular in shape, sometimes branched. Conidiogenous cells elongate, enteroblastic. Pycnospores rod-shaped, straight or bent, 7-15 x 0.5-1 um.

In this study Phyllopsora is narrowly defined to include only species fitting all of the diagnostic characteristics listed below. Diagnostic characterization:

Thallus squamulose, small foliose, rarely crustose; lower surface not corticate, prothallus always present; apothecia biatorine, exciple and hypothecium of the same texture as the paraphyses; paraphyses highly gelatinized, length to width ratio 6:1; ascospores simple to once septate, ovoid to short fusiform, less than 20 um long, colorless, thin walled.

DESCRIPTION OF NEOTROPICAL SPECIES OF PHYLLOPSORA

Phyllopsora bibula (Tayl.) Swinscow & Krog, Lichenologist 13: 239. 1981. Lecanora bibula Tayl., Lond. J. Bot. 6: 160. 1847. Type: Chile. Juan Fernandez Islands, Apr 1830, Bertero 1648 (holotype FH-TAYLOR 684; isotypes, BM, fatty acids reported by Swinscow & Krog, 1981, G, H-NYL 20540, H-NYL P.M. 4109, PC-MONTAGNE). Fig. 17A.

Thallus squamulose, squamules translucent, round to irregular-elongate, 0.1-0.3 mm wide, convex, closely adjoined, adnate to slightly ascending, Pd-. Upper surface fibrillose, fibrillose at the margin. Isidia lacking. Cortex type 1-2, 30 um thick, cortical gelatin orange. Prothallus pale. Lichen substances: fatty acids reported by Swinscow and Krog (1981).

Apothecia common. Disc plane to slightly convex, tan to reddish-brown. Margin slightly raised and darker than the disc. Exciple tinged red, KOH-. Hypothecium tinged red, KOH-. Hymenium pale, 35 um tall. Epihymenium not obvious. Ascospores simple, ellipsoid to short fusiform, 9.5-11.5 x 2.5-3 um (LENGTH: X=10.36, SD= 0.96, L. min. 9.0, L. max. 12.0,; WIDTH: X=2.98, SD=.27, W. min. 2.7, W. max. 3.2; n= 10).

Pycnidia tan to reddish-brown, mostly immersed in the thallus. Pycnoconidia rod-shaped, bent, 9-14 x 1 um.

Distribution: Juan Fernandez Islands.

This species is only known from the original material. The squamules are very shiny and translucent. Zahlbruckner (1926-1927) listed this as a synonym of P. parvifolia, but the squamules are much smaller in P. bibula. Phyllopsora bibula is closest to P. corallina var. corallina, but P. bibula has smaller, more fibrillose squamules, it lacks isidia, and has an orange color in the cortex. The pycnospores are distinctly bent.

Phyllopsora buettneri (Müll. Arg.) Zahlbr., Cat. Lich. Univ. 4: 396. 1926. Psora buettneri Müll. Arg., Bot. Jahrb. Syst. 15:

506. 1893. Lecidea buettneri (Müll. Arg.) Stiz., Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1893-94: 246. 1895. Type: Togo. Bismarksburg, Büttner s.n. (holotype, G, pannarin and zeorin; isotype, BM).

Thallus squamulose, squamules elongate, incised or lobulate, 0.3-1.0 mm wide, complanate to thick and convex, adjoined and overlapping, adnate to ascending, Pd+ orange. Upper surface pubescent or obviously pruinose, fibrillose at the margin. Isidia globose to cylindrical or lacking. Cortex type 1-2, 35-50 um thick. Prothallus abundant, red. Lichen substances: argopsin, pannarin, zeorin, and unknown compounds A, B, M & O1.

Apothecia common. Disc plane to convex, tan to dark red. Margin not raised, concolorous with the disc or darker. Exciple tan to tinged red, KOH- or KOH+ purple. Hypothecium partly red pigmented, KOH- or KOH+ purple. Hymenium colorless, 30 um tall. Epihymenium not obvious. Ascospores simple, short fusiform 6-13 x 2-3 um.

Pycnidia common, dark reddish brown, partially immersed in the thallus. Pycnospores rod-shaped, straight, 9-10 x 1 um.

This species is distinguished by its pubescent or pruinose, incised, lobulate or isidiate squamules and distinct chemistry. The isidia are often heavily pruinose and fibrillose. Four varieties are recognized by differences in chemistry. The squamule morphology varies greatly.

Key to varieties of Phyllopsora buettneri:

1. Thallus containing unknown M — var. melanoglauca
1. Thallus lacking unknown M
    2. Thallus containing unknown O — var. munda
    2. Thallus lacking unknown O
        3. Thallus containing pannarin — var. buettneri
        3. Thallus containing argopsin — var. glauca

Phyllopsora buettneri var. **buettneri**. Fig. 17B.

The type variety is distinguished by its chemistry of pannarin and zeorin. The squamules are 0.3-1 mm wide and heavily pruinose. The upper cortex is 40 um thick.

Distribution: Kenya, Tanzania, Uganda; Australia: Queensland.

Specimens examined: AUSTRALIA. Queensland: Six km from Yabba Creek, no. 2 turnoff, Sep 1981, Krog AU 27/12 (O).

KENYA. Western Prov.: Kakamega District, Kakamega Forest, near forest station, 1700 m, 20 Jan 1970, R. Santesson 21688 (UPS), 21 Jan 1970, R. Santesson 21833 (UPS).

UGANDA. Bugisu District: North Bugisu, one half km N of ford over Sasa River, 2800 m, Jun 1970, Swinscow 2U 45/49B (BM). Masaka District: Bukoto, N edge of Malabigambo Forest, 1100 m, Dec 1971, Swinscow 3U 25/8 (BM). West Mengo District: Mawakota, Mpanga Forest Reserve, 1500 m, Jan 1968, Manum s.n. (BM), Jun 1970, Swinscow 2U 41/4 (BM).

TANZANIA. Tanga Prov.: Usambara Prov., Amani, 900 m, 9 Jan 1971, Moberg 1480D, 1464A (UPS), Vitikainen 9292 (H).

Phyllopsora buettneri var. **glauca** (B. de Lesd.) Brako, comb. nov.

Phyllopsora parvifolia var. glauca B. de Lesd., Rev. Bryol. Lichénol. 7: 60. 1934. Type: Cuba. [Oriente:] Loma del Gato, 1100 m, Jul 1931, Hioram 9098 (lectotype, HAC, designated by Vězda, 1969 in hb., fragment NY, argopsin, unknown A, zeorin); isosyntype: Cuba. Scala Victoria, 800 m, Hioram 8909 (UPS). Fig. 18A.

Distribution: Central America, West Indies, South America, and Africa.

This variety differs from var. buettneri by its chemistry of argopsin, unknown A, +/- unknown B, and +/- zeorin, and its squamules which are usually smaller (ca. 0.3 mm wide), thicker (upper cortex 50 um thick), more ascending and less frequently pruinose than those of the other P. buettneri varieties. The ascospores are 7-12 x 2.5-3 um (LENGTH: X=9.25, SD=2.5, L. min. 7.0, L. max. 12.5; WIDTH: X=2.74, SD=.42, W. min. 2.0, W. max. 3.6; n=50).

Chemical strains: Chem. strain I: argopsin, unknown A, and +/- zeorin. Chem. strain II: argopsin, unknown B, and +/- zeorin. Chem. strain III: argopsin and +/- zeorin.

Chemical strain I:

Specimens examined: PANAMA. Panamá: Along the Llano-Carti Rd, 400 m, 24 Nov 1985, Brako 8371 (NY).

DOMINICAN REPUBLIC. Independencia: Sierra de Baoruco, 30 km S

of Puerto Escondito, 1940 m, 25 Jan 1987, Buck 14618 (NY).

CUBA. Santiago de Cuba: La Gran Piedra, SE of peak, 1000 m, 2 Apr 1982, Harris 14216 (HAC, NY), 4 Apr 1982, Harris 14325, 14379 (HAC, NY), 6 Apr 1982, Harris 14555 (HAC, NY), 7 Apr 1982, Harris 14656 (HAC, NY).

GRENADA. 17 Oct 1905, Broadway s.n. (NY).

VENEZUELA. Anzoátegui: Cerro Peonía, above Los Pajaritos, 2-3 Dec 1981, Davidse & Gonzáles 19971 (VEN). Distrito Federal: Caracas, track from Altamira to La Selva, 1900 m, 13 Jan 1979, Sipman 10691 (B). Mérida: Sierra Nevada de Santo Domingo, Páramo de Mucubají, 3500 m, 11 Oct 1981, López-Figueiras & Lindstrom 26986 (MERF). Miranda: El Vulcán, above Baruta, 1200-1400 m, 4 May 1986, Brako 8678 (NY). Trujillo: Near the T.V. tower, at the base of Páramo la Nariz, on the Carache-Las Palmas road, 2400 m, 24 Jan 1980, López-Figueiras 22033 (MERF).

TRINIDAD. 10 mile track, Arima Road, Jan 1958, Fleming s.n. (NY).

BRAZIL. Paraná: Prainhas, near Porto de Cima, 100 m, 16 Jan 1987, Hatschbach & Brako 8845 (NY). Rio Grande do Sul: South of Torres, on road to Camping Itapeba, 10 m, 9 Jan 1987, Falkenberg & Brako 3604, 3605, 3606, 3608, 3609, 3614, 3615, 3616 (NY). São Paulo: Campos do Jordão, 150 km NE of São Paulo, 1700 m, 25 May 1978, Kalb & Plöbst 20 (Hb. Kalb); Ilha Comprida, 3 m, 15 Jul 1979, Kalb 163 (Hb. Kalb), 2 m, 1 Nov 1980, Kalb 313 (Hb. Kalb.); Morro Grande near Cotia, ca. 25 km from São Paulo, 850 m, 27 Sep 1980, Kalb 309 (Hb. Kalb); Rio Itaguaré, ca. 20 km E of Bertioga, 13 Apr 1980, Kalb

325, Lich. Neotropici 291 (BM, COLO, H, M, US).

KENYA. Central Prov.: Kirinyaga District, Mt. Kenya, S of Castle Forest Station, 2000 m, Feb 1972, Krog 48/176 (O), 1800 m, Feb 1977, Swinscow 5K 5/12 (BM). Coast Prov.: Kwale District, Shimba Hills, 480 m, Feb 1972, Swinscow K 43/1 (BM). Eastern Prov.: Meru District, Mt. Kenya, 2100 m, Feb 1974, Swinscow 3K 16/19 (BM).

TANZANIA. Tanga Prov.: Usambara Prov., 1894, Holst 1431 (G); Lushoto District, Lutindi Forest, Holst 3330 p.p. (G).

UGANDA. Masaka District: Bukoto Co., Malabigambo Forest, 1100 m, 1980, Swinscow 3U 25/8, 3U 25/9 (BM).

Chemical Strain II:

Specimens examined: COSTA RICA. Cartago: Turrialba, 650 m, 21-22 Feb 1986, Berry 4571 (NY).

PANAMA. Panamá: Along trail to Cerro Brewster from Río Pacoura valley, 670 m, 18-21 Nov 1985, Brako 8267, 8277, 8289 (NY); along the Llano-Carti Road, 400 m, 24 Nov 1985, Brako 8360, 8370, 8372, 8383, 8385 (NY); Cerro Jefe-Alto Pacoura road, 28 Nov 1985, Brako 8497 (NY).

CUBA. Santiago de Cuba: La Gran Piedra, 1.5 km SE of peak, 1000 m, 3 Apr 1982, Harris 14279 (HAC, NY). Without prov.: La Prenda, Hioram 5314 (US); Wright, Lich. Cub. 186 (BM, G, L=2x, M, UPS); Wright, Lich. Cub. ser. 2, 728 (G).

JAMAICA. Feb & Mar 1905, Cummings 44 (COLO, NY, O).

DOMINICAN REPUBLIC. La Vega: La Sal, 1100-1200 m, 29 Apr 1982, Harris 15005 (NY).

PUERTO RICO: Caribbean National Forest, Luquillo Division, El Yunque Recreation Area, 500 m, 5 Mar 1981, Buck 4090A (NY); trail from Hwy 988 to Río Mameyes, 100-150 m, 6 Mar 1981, Buck 4195 (NY).

DOMINICA. Dom-Can Logging Area, Newfoundland, 240 m, Jan 1969, Hale 35230 (US).

ST. VINCENT. Bow Woods, 240 m, Elliott 135 (BM).

VENEZUELA. Bolivar: Parque Nacional Canaima, La Gran Sabana, on road from Aeropuerto Luepa to Kavanayen, 11 Apr 1985, Brako 8183 (NY). Falcón: Sierra de San Luis, Sabana de Paraguariba, 1400 m, 13 Oct 1984, López-Figueiras 31083 (MERF). Miranda: El Vulcán, above Baruta, 1200-1400 m, 1-4 May 1986, Brako 8668, 8686B (NY).

TRINIDAD. Mora Forest, east of Sangre Grande, 8-9 Mar 1920, Britton & Hazen 390 (NY); 10 mile track, Arima Road, Jan 1958, Fleming s.n. (NY); Guiaguiare, 20 May 1957, Fleming s.n. (NY).

FRENCH GUIANA. Cayenne, ex hb. Montagne (H-NYL 20552, L); 1878, Leprieur 754 (G).

PERU. San Martín: Cerro Escalera (ca. 20 km road distance NE of Tarapoto), 900-1100 m, 13 Mar 1981, R. Santesson & Thor P72:20, P72:53, P72:59, P72:73 (UPS). Cuzco: Ca. 11 km S of Pillcopata, 850 m, 28 Mar 1981, R. Santesson & Thor P102:21 (UPS).

BRAZIL. Paraná: Reserva Ecológica Sapitanduva between Morretes and Antonina, 100 m, 17-18 Jan 1987, Hatschbach & Brako 8860 (NY). São Paulo: Praia de Peruibe near Itanhaém, 5 m, 30 Mar 1980, Kalb 229 (Hb. Kalb); along the Rio Itaguaré, ca. 20 km E of Bertioga, 13 Apr 1980, Kalb 231 (Hb. Kalb), Kalb 325, Lich. Neotropici 291 (BM, COLO, H, M, US); Ilhabela, along the road from Ilhabela to Praia dos

Castelhanos, 250 m, 7 Jul 1979, Sipman et al. 13444 (B); mangrove swamp near Praia de Pernube, near Itanhaém, sealevel, 9 Jul 1979, Sipman et al. 13548 (B), 13553 (B, NY).

KENYA. Central Prov.: Kiriyaga District, Mt. Kenya, S of Castle Forest Station, 1800 m, Feb 1977, Swinscow 5K 5/12 (BM).

TANZANIA. Tanga Prov.: Usambara, Holst 3330 p.p. (G); Kwambuga, 1894, Holst 1431 (G).

Chemical Strain III:

Specimens examined: CUBA. Oriente: Loma del Gato, 900 m, 11 Jul-14 Aug 1921, León et al. 10232 (NY).

DOMINICAN REPUBLIC. Independencia: Sierra de Baoruco, 30.5 km S of Puerto Escondito, 1940 m, 25 Jan 1987, Buck 14634 (NY); 23.5 km S of Puerto Escondito at intersection of road to Charco Colorado, 1750 m, 24 Jan 1987, Harris 20455 (NY); Charco de la Paloma, 48.4 km S of Puerto Escondito, 1800 m, 25 Jan 1987, Harris 20672 (NY).

COLOMBIA. Choachi, 2600 m, Lindig 706 (H-NYL P.M. 4113, M), 803 (M), 2791 (H-NYL 20548).

TRINIDAD. 10 mile track, Arima Road, Jan 1958, Fleming s.n (NY=2x).

ECUADOR. Tungurahua: Baños, N slope of Tungurahua, 2300 m, Aptroot & Hensen 10726 (U).

BRAZIL. Paraná: Reserva Ecológica Sapitanduva, between Morretes and Antonina, 100 m, 17-18 Jan 1987, Hatschbach & Brako 8885, 8886, 8887, 8888, 8899 (NY).

Phyllopsora buettneri var. **melanoglauca** (Zahlbr.) Brako, comb. et stat. nov.

Phyllopsora melanoglauca Zahlbr., Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. 83: 133. 1909. Type: Brazil. São Paulo: Near Iguape, 20-100 m, Aug 1901, Schiffner s.n. (holotype, W; isotype, BM, unknown M, terpene, zeorin). Fig. 18B.

Distribution: Central America, West Indies and northern South America.

This variety is identical in morphology and anatomy to var. buettneri. It differs from var. buettneri by its chemistry of unknown M, and zeorin. It is thus far known only from the neotropics. It is reduced to a variety as the chemical difference cannot be given much taxonomic importance until more fully investigated. The ascospores are 8-12 x 3-3.5 um (LENGTH: X=10.1, SD=2.07, L. min. 7.0, L. max. 14.0; WIDTH: X=3.2, SD=0.41, W. min. 2.5, W. max. 3.5; n=15).

Specimens examined: MEXICO. Guerrero: Mun. General Heliodoro Castillo, 31 km N of El Paraiso on road to Puerto del Gallo, 2000 m, 9 Jun 1985, Thomas & Contreras 3766A (NY).

PANAMA. Panamá: Along trail to Cerro Brewster from Río Pacoura Valley, 670 m, 18-21 Nov 1985, Brako 8258 (NY).

CUBA. Wright, Lich. Cub. 180 (BM=2x, G=2x, L=2x, M, UPS, US), 186 (BUF, FH-TUCK 2919, M).

DOMINICAN REPUBLIC. Pedernales: Las Abejas, 1150 m, 7 May

1982, Buck 8348 (NY), Harris 15563 (NY).

VENEZUELA. Aragua: 6.5 km from Colonia Tovar along the La Victoria-Tovar road, 6 Apr 1986, Brako 8610 (NY). Bolivar: Parque Nacional Canaima, La Gran Sabana, on road from Aeropuerto Luepa to Kavanayen, 10 Apr 1985, Brako 8164 (NY). Miranda: El Vulcán, above Baruta, 1200-1400 m, 4 May 1986, Brako 8674 (NY).

PERU. San Martín: Lamas, Cerro Blanco (ca. 58 km W-WNW of Tarapoto), 1000 m, 14 Mar 1981, R. Santesson & Thor P73:4 (S).

Phyllopsora buettneri var. **munda** (Malme) Brako, comb. et stat. nov.

Lecidea munda Malme, Ark. Bot. 28A(7): 49. 1936.

Phyllopsora munda (Malme) Zahlbr., Cat. Lich. Univ. 10: 377. 1939. Type: Brazil. Rio Grande do Sul: Hamburgerberg, near São Leopoldo, 18 Oct 1892, Malme, Lich. Regnell. 617b (holotype, S, pannarin, unknown O1, zeorin). Fig. 19A.

Lecidea schizophylloides Malme, Ark. Bot. 28A(7): 45. 1936.

Phyllopsora schizophylloides (Malme) Schneider, Biblioth. Lich. 13: 178. 1979. Type: Brazil. Rio Grande do Sul: Silveira Martins, 7 Mar 1893, Malme, Lich. Regnell. 1251B (holotype, S, pannarin, unknown O1, zeorin).

Distribution: West Indies and South America.

Similar in morphology to var. buettneri, this variety differs by its chemistry of pannarin, unknown O1 and zeorin. The ascospores

are 10-12 x 2.5-3 um (LENGTH: X=10.98. SD=1.17, L. min. 9.0, L. max. 13.0; WIDTH: X=2.84, SD=0.34, W. min. 2.0, W. max. 3.5; n=25).

Specimens examined: CUBA. Santiago de Cuba: La Gran Piedra, 1000-1200 m, 4 Apr 1982, Harris 14379 (HAC, NY), 6 Apr 1982, Harris 14559 (HAC, NY); Arroyo Negro, ca. 4 km SE of La Gran Piedra, 1000 m, 5 Apr 1982, Harris 14444 (HAC, NY); vicinity of Museo de la Francesca "La Isabelita", ca. 2 km SE of La Gran Piedra, 1000 m, 7 Apr 1982, Harris 14592 (HAC, NY).

DOMINICAN REPUBLIC. Independencia: Sierra de Baoruco, 23.5 km S of Puerto Escondito at intersection of road to Charco Colorado, 1750 m, 24 Jan 1987, Harris 20493, 20495 (NY).

VENEZUELA. Aragua: 6.5 km from Colonia Tovar along the La Victoria-Tovar road, 6 Apr 1986, Brako 8605, 8617, 8619 (NY). Mérida: La Carbonera, 2100-2200 m, 17 Dec 1984, Brako 8110 (NY), 2300 m, 22 Jan 1979, Sipman & López-Figueiras 11028 (B). Miranda: El Vulcán, above Baruta, 1 May 1986, Brako 8662 (NY), 4 May 1986, Brako 8688 (NY).

PERU. San Martín: Cerro Escalera (NE of Tarapoto), NW of tunnel, 1000 m, 15 Mar 1981, R. Santesson & Thor P74:122 (S).

BRAZIL. Rio de Janeiro: Itatiáia, 1850 m, 28 July 1966, Eiten & Eiten 7495 (NY); between Registro do Picú and Agulhas Negras, 1800 m, 14 Mar 1980, Kalb 221 (Hb. Kalb). Santa Catarina: Between Uribiçi and Capivara Alta on road to Braço do Norte, 1040 m, 12 Jan 1987, Falkenberg 3731, 3798 (NY). São Paulo: Campos do Jordão, at base of Pico de Itapeva, 1760 m, 25 Jan 1987, Brako 8925 (NY).

Phyllopsora canoumbrina (Vainio) Brako, comb. nov.

Lecidea canoumbrina Vainio, Proc. Amer. Acad. Arts 58: 135. 1923. Type: Trinidad. Maraval Valley, Jan-Apr 1913, R. Thaxter 19 (holotype, FH). Fig. 19B.

Lecidea parvifolia var. subgranulosa Tuck., Proc. Amer. Acad. Arts 6: 273. 1866. Biatora parvifolia var. subgranulosa (Tuck.) Tuck., Syn. N. Amer. Lich. 2: 8. 1888. Psora parvifolia var. subgranulosa (Tuck.) Müll. Arg., J. Linn. Soc., Bot. 29: 219. 1893. Phyllopsora parvifolia var. subgranulosa (Tuck.) Müll. Arg., Bot. Jahrb. Syst. 20: 264. 1894. Type: Cuba. [Oriente:] Monte Verde, 6 Apr, Wright, Lich. Cub. 185 (lectotype here designated, FH-TUCK 2923, piece marked "w", also in this packet are P. furfuracea and P. intermediella; isolectotypes, BM, BUF, G=3x, L=2x, L-6889, no lichen substances, M, UPS, US).

Thallus squamulose, squamules minute, closely adnate, initially granular, irregularly crenate to lobed, ca. 0.1 mm wide, complanate to convex, discrete or adjoined, mostly closely adnate, Pd-. Isidia cylindrical. Upper surface glabrous, fibrillose at the margin. Cortex a thin gelatinous layer, 5-10 um thick. Prothallus abundant, reddish. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan. Margin not raised, concolorous or darker than the disc. Exciple tan to tinged red in patches, KOH-. Hypothecium tan to golden brown, KOH-.

Epihymenium not obvious. Hymenium tan, 40 um tall. Ascospores simple, ellipsoid to short fusiform, 6.5-9.5 x 2.5-3 um (LENGTH: X=7.95, SD=1.46, L. min. 6.0, L. max. 11.0; WIDTH: X=2.63, SD=0.36, W. min. 2.0, W. max. 3.0; n=30).

Pycnidia common, tan, superficial on the prothallus. Pycnospores rod-shaped, straight, 9 x 1 um.

This species is distinguished by its minute squamules, small to medium-size spores and lack of chemistry.

Distribution: Central America, West Indies and South America.

Specimens examined: GUATEMALA. Petén: Near Tikal, 300 m, 9-10 Jan 1979, Kalb & Plöbst 73 (Hb. Kalb).

CUBA. Wright s.n. (FH-TUCK 2922).

VENEZUELA. Amazonas: Río Negro, base of Cerro de la Neblina, 140 m, 20 Feb 1984, Buck 11028 (NY, VEN).

BRAZIL. Acre: Vizinhança de Sena Madureria, 1 Nov 1980, Nelson et al. 491 (INPA, NY). Santa Catarina: Blumenau, 1891, Ule 96 (G).

Phyllopsora chlorophaea (Müll. Arg.) Zahlbr., Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. 83: 133. 1909.

Psora chlorophaea Müll. Arg., Flora 70: 320. 1887. Type: Brazil. São Paulo: Apiahy (Apiaí), Jun 1881, Puiggari 1721 (holotype, G, no lichen substances; isotype, W). Fig. 20B.

Lecidea haemophaea var. subparvifolia Müll. Arg., Flora 60: 473. 1877. Phyllopsora subparvifolia (Müll. Arg.) Müll. Arg., Hedwigia 34: 114. 1895. Type: Venezuela. Distrito Federal: Caracas, Ernst 114 (holotype, G, no

lichen substances).

Lecidea furfuracea f. schizophylla Vainio, Acta Soc. Fauna Fl. Fenn. 7(2): 47. 1890. Lecidea schizophylla (Vainio) Malme, Ark. Bot. 28A(7): 43. 1936. Type: Brazil. Minas Gerais: Lafayette, 1885, Vainio, Lich. Bras. Exs. 335 (holotype, TUR-VAIN 22641, terepenes reported by Swinscow & Krog, 1981; isotype, ZT).

Thallus squamulose, squamules round to elongate, lobed and incised, 0.1-0.3 mm diam., complanate to convex, closely adjoined and overlapping, adnate to ascending, Pd-. Upper surface glabrous, fibrillose at the margin. Isidia lacking. Cortex type 1-2, to 20 um thick. Prothallus abundant, red. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan to dark reddish brown. Margin slightly raised and darker than disc. Exciple dark red, KOH-. Hypothecium dark red, KOH-. Hymenium colorless, 35 um tall. Epihymenium not obvious. Ascospores simple or uniseptate, ellipsoid to short fusiform, 8.5-11.5 x 2.5-3 um (LENGTH: X=10.0, SD=1.42, L. min. 7.5, L. max. 13; WIDTH: X=2.87, SD=0.29, W. min. 2.25, W. max. 3.5; n=50).

Pycnidia common, slightly emergent from thallus, brown. Pycnospores rod-shaped, straight, 9-12 x 0.5-1 um.

Distribution: Central America, West Indies, South America and Africa.

This species is distinguished by its small to medium size,

non-isidiate, thin squamules, lack of chemistry, a dark red-brown, KOH- pigmentation throughout the exciple and hypothecium, a colorless hymenium, and medium size ascospores. It is closest to non-isidiate forms of P. confusa which usually have more narrow squamules and are never pigmented throughout the exciple and hypothecium.

Specimens Examined: COSTA RICA. San José: La División, 2000 m, 25 Feb 1986, Berry 4576, 4577, 4578a (NY).

CUBA. Santiago de Cuba: Arroyo Negro, 1000 m, 5 Apr 1982, Buck 7693 (HAC, NY). Without prov.: Wright, Lich. Cub. ser. 2, 107 (H-NYL 20546).

JAMAICA. Hart 34 (NY), 1884, Hart 153 (FH-TUCK 2923).

HAITI. Dept. de la Grand'anse: Massif de la Hotte, 710 m, 13 Nov 1982, Buck 9083 (NY).

DOMINICAN REPUBLIC. Pedernales: Las Abejas, 3900 ft, 13 Mar 1980, Buck 4361, 4376 (NY), 3800 ft, 7 May 1982, Buck 8362 (NY), 3600 ft, 5 May 1982, Harris 15367 (NY). Independencia: Sierra de Baoruco, 23.5 km S of Puerto Escondito, 1750 m, 24 Jan 1987, Harris 20473, 20480, 20487, 20489 (NY); Charco de la Paloma, 48 km S of Puerto Escondito, 1800 m, 25 Jan 1987, Harris 20670, 20671 (NY).

VENEZUELA. Amazonas: Río Negro, base of Cerro de la Neblina, 140 m, 25-28 Nov 1984, Brako 7521b, 7526 (NY, VEN). Bolivar: La Gran Sabana, 11 Apr 1985, Brako 8179a, 8181a (NY). Distrito Federal: Caracas, 1876, Ernst 114, (G), 1878, Ernst 45 (G). Mérida: La Carbonera, Finca San Eusebio, along the Mérida-La Azulita road, 2200-2300 m, 13 Apr 1976, López-Figueiras 13714 (MERF), 8 Oct 1977,

López-Figueiras & Keogh 14099 (MERF). Miranda: El Vulcán, above Baruta, 1200-1400 m, 4 May 1986, Brako 8685, 8687 (NY). Tachira: Pata de Gallina, 900 m, 28 Feb 1981, López-Figueiras & Rodrigues 25645b (MERF).

BRAZIL. Minas Gerais: Between Vila Monte Verde and Camanducaia, 1300 m, 28-29 Feb 1980, Kalb 314 (Hb. Kalb); Lafayette, 1885, Vainio, Lich. Bras. Exs. 318 (TUR-VAIN 22640), 366 (TUR-VAIN 22642). Rio Grande do Sul: Hamburgerberg, 10 Oct 1892, Malme, Lich. Regnell. 615 (UPS); Serra dos Padres near Cruz Alta, 21 Apr 1893, Malme, Lich. Regnell. 1275 (S); Santo Angelo near cachoeira, 30 Jan 1892, Malme, Lich. Regnell. 236a (S); Serra dos Valles near Cruz Alta, Malme, Lich. Regnell. 236b (G, US, BM). São Paulo: Campos do Jordão, 150 km NE of São Paulo, 1700 m, 25 May 1978, Kalb & Plöbst 20 (Hb. Kalb); Morro Grande near Cotia, 25 km W of São Paulo, 850 m, 27 Aug 1980, Kalb 309 (Hb. Kalb).

KENYA. Central Prov.: Kirinyaga District, Mt. Kenya, 2 km NW of Irangi Forest station, 2000 m, Feb 1977, Swinscow 5K 4/53 (BM).

Phyllopsora confusa Swinscow & Krog, Lichenologist 13: 229. 1981.

Type: Kenya. Central Prov.: Kirinyaga District, Mt. Kenya, 2 km N of Irangi Forest Station, in damp deciduous forest near River Ena, $0^{\circ}20'S$, $37^{\circ}28'E$, 2000 m, Feb 1972, Krog & Swinscow K 48/177 (holotype, O, no lichen substances). Fig. 21.

Thallus squamulose, squamules elongate to flabellate, deeply incised, 0.1-0.3 mm diam., adjoined and overlapping, complanate to convex, adnate to ascending, Pd-. Upper surface glabrous, glabrous

to occasionally fibrillose at the margin. Isidia present or lacking. Cortex type 2, 25 um thick, cortex often extending to the underside of the squamules. Prothallus thin, pale to reddish. Lichen substances: none detected.

Apothecia common. Disc plane to slightly convex, tan, orange or golden-brown. Margin slightly raised, concolorous, paler or darker than the disc. Exciple pale to tinged red in patches, KOH-. Hypothecium pale to golden-brown, KOH-. Hymenium pale tan, 40 um tall. Epihymenium not obvious. Ascospores simple, short fusiform, 8.5-12 x 2.5-3 um (LENGTH: X=10.2, SD=1.56, L. Min. 8.0, L. max. 16; WIDTH: X=2.67, SD=0.26, W. min. 2.25, W. max. 3.5; n=50).

Pycnidia not seen.

Distribution: Pantropical.

This species may prove to be a heterogeneous group. Individuals with the above morphology are united by the characters: small thalline elements without erect isidia, a thin upper cortex, medium ascospore size and no detectable chemistry. The shape of the squamules is very variable as is pigmentation in the apothecia. These differences may prove to be important and need further investigation. This species is closest to P. chlorophaea which is distinguished by its completely red-pigmented apothecia and its broader squamules.

Specimens examined: HONDURAS. Quebrado el Gallo, NE slope of Cerro de Uyuca, 900 m, 14 Mar 1951, Morton 7045 (US).

NICARAGUA. Zelaya: Vicinity of Bluefields, 21 Apr-23 May 1949,

Standley 20125 (F).

PANAMA. Panamá: Along the Llano-Carti road, 400 m, 24 Nov 1985, Brako 8358 (NY).

CUBA. Camaguey: Cubito Prov., midway between Camaguey and La Gloria, 19-21 Feb 1941, Johnson s.n. (NY=2x). Isle of Pines: San Juan, 15-17 Mar 1916, Britton et al. 15491 (NY=2x). Santiago de Cuba: "Monte Kentucky", ca. 5 km SE of La Gran Piedra, ca. 1000 m, 5 Apr 1982, Harris 14424 (HAC, NY).

DOMINICAN REPUBLIC. La Vega: Arroyo Piedrosa, 1.2 km from Monabao on road to Jarabacoa, 11 May 1982, Harris 15679A (NY); km 17 on Jarabacoa-La Vega road, 11 May 1982, Harris 15750 (NY); Santiago, Parque Nacional J. Armando Bermudez, along trail along Río Los Guanos, near La Ciénaga, 3500-4000 ft, 12 Jan 1987, Harris 19737 (NY). San Juan: Along stream just E of "La Compartición", along trail up Pico Duarte, 2350 m, 14 Jan 1987, Buck 14196 (NY).

ST. VINCENT. Richmond Peak, 800 ft, Elliott 264 (BM).

VENEZUELA. Aragua: La Mora, W of Colonia Tovar, 1200 m, Dec 1986, Brako 8510, 8511 (NY). Falcón: Top of mountain ridge 25 km NE of Coro along La Negrita-Curimagua road, above La Chapa, 1250 m, 18 Jan 1979, Sipman & Van der Werff 10899 (B, MERF). Mérida: Sierra de St. Domingo, Páramo de Mucubaji, 3500 m, 28 Mar-7 May 1969, Hertel & Oberwinkler 10474 (M), 11 Oct 1981, López-Figueiras 26986 (MERF); El Paramito, near El Morro, 2650 m, 21 Dec 1977, López-Figueiras 14704 (MERF); Monte Zerpa, above La Hechicera, near Mérida, 2000 m, 2 Apr 1980, López-Figueiras 22773 (MERF), 4 Dec 1980, López-Figueiras 25009

(MERF); Valley of the Río Chama, 1600 m, 21 Jan 1979, Sipman 10977 (B, MERF). Sucre: Peninsula de Paria, Cerro de Río Arriba, 700 m, 10-12 Aug 1966, Steyermark & Rabe 96279 (US).

TRINIDAD. St. Ann's Heights, 17 Mar 1920, Britton 684 (NY).

BRAZIL. Bahia: Rio Vermelho, 10 Nov 1894, Malme, Lich. Regnell. s.n. (S). Mato Grosso: 35 km S of Cuiabá, 120 m, 4 Jul 1980, Kalb 273 (Hb. Kalb); Chapada dos Guimarães, 800 m, 7 Jul 1980, Kalb 277 (Hb. Kalb), 9 Jul 1980, Kalb 281 (Hb. Kalb); 10 km NE of Chapada dos Guimarães, 680 m, 9 Jul 1980, Kalb 282 (Hb. Kalb); Buritî, 19 Jan 1894, Malme, Lich. Regnell. 2268 (FH, S, US), 20 Jan 1894, Malme, Lich. Regnell. 2267C (S), 4 Jun 1894, Malme, Lich. Regnell. s.n., 2737E (S); Santa Anna da Chapada, 7 Mar 1894, Malme, Lich. Regnell. 2515B (S). Mato Grosso do Sul: 30 km S of Campo Grande, 550 m, 14 Nov 1979, Kalb 199 (Hb. Kalb). Minas Gerais: Vila Monte Verde, 30 km E of Camanducaia, 1500 m, 8 Aug 1978, Kalb & Plöbst 95, Lich. Neotropici 342 (M, US), 1500-1800 m, 7-11 Aug 1978, Kalb & Plöbst 44 (Hb. Kalb); Fazenda São Mateus E of Camanducaia, 1800 m, 30 Nov 1980, Kalb 315 (Hb. Kalb); Monte Verde, 1750 m, 3 Jul 1979, Sipman 13053 (B, NY), 13068 (B). Pará: Serra do Cachimbo, Aeroporto Cachimbo, ca. 430-480 m, 27 Apr 1983, Brako & Dibben 6241 (INPA, NY); Rio Jamanxím, 974-1024 km N of Cuiabá, ca. 300 m, 10-15 May 1983, Brako & Dibben 7031 (INPA, NY); Santarem, Spruce, Lich. Amaz. And. 210 (BM=3x). Paraná: Reserva Ecológica Sapitanduva, between Morretes and Antonina, 100 m, 17-18 Jan 1987, Hatschbach & Brako 8854, 8866, 8870, 8879, 8883B, 8896 (NY); near Cacatu, 17 Jan 1987,

Hatschbach & Brako 8907 (NY). Rio de Janeiro: Itatiáia, between Registro do Picú and Agulhas Negras, 850 m, 22 Jul 1978, Kalb & Plöbst 40 (Hb. Kalb), 1800 m, 23 Jul 1978, Kalb & Plöbst 37, 161 (Hb. Kalb). Santa Catarina: Between Uribiçi and Capivara Alta on road to Braço do Norte, 1040 m, 12 Jan 1987, Falkenberg 3723 (NY); Pinheiral and Ruderal Riozinho, 1000 m, 22 Jan 1957, Smith & Reitz 10287 (US=2x). São Paulo: Serra de Paranapiacaba, 80 km SW of São Paulo, 700 m, 24 Mar 1978, Kalb & Plöbst 4 (Hb. Kalb); Campos do Jordão, 1700 m, 25 May 1978, Kalb & Plöbst 20B (Hb. Kalb); Pico de Itapeva, above Campos do Jordão, 1820 m, 14 Nov 1978, Kalb & Plöbst 50 (Hb. Kalb); near Socorro, 130 km N of São Paulo, 700 m, 14 Apr 1979, Kalb & Assis 174, Lich. Neotropici 241 (BM, COLO, H, M, US); near Cachoeiras de Emas, ca. 15 km NE of Piraçununga, 550 m, 14 Jun 1979, Kalb & Plöbst 145 (Hb. Kalb); São Sebastião, 400 m, 6 Jul 1979, Kalb 156 (Hb. Kalb), 600 m, 7 Jul 1979, Sipman 13408 (B); Serra do Garrãozinho, between Moji das Cruzes and Bertioga, 850 m, 29 Mar 1980, Kalb 227 (Hb. Kalb); Serra de Paranapiacaba, 60 km SW of São Paulo, above Juquitiba, 550, 27 Apr 1980, Kalb 233 (Hb. Kalb); Fazenda São João near Rio Claro, 600 m, 16 Aug 1980, Kalb 302, 302c (Hb. Kalb); Morro Grande near Cotia, 850 m, 27 Aug 1980, Kalb 309B (Hb. Kalb).

CHILE. Cautin, Villa Rica, 12 Jan 1953, Thomasson s.n. (UPS).

PARAGUAY. Alto Paraná: Reserva Biologica del Itabó, ca. 37 km NNW of Hernandarías, 250 m, 15 Oct 1984, Buck 12408 (NY). Amambay: Parque Nacional Cerro Corá, along trail up Cerro Muralla, 300 m, 19

Oct 1984, Buck 12507 (NY). Central District: Asunción, Villa Morra, 14 Aug 1893, Malme, Lich. Regnell. 1471 (S, UPS), 151 (S). Paraguarí: Parque Nacional Ybycuí, trail along Arroyo Mina, ca. 200 m, 5 & 7 Oct 1984, Buck 11981 (NY). San Lorenzo: Ciudad Universitaría, 1 Nov 1984, Bordas 152A (NY). Without prov.: Colonia Risso, 28 Sep 1893, Malme, Lich. Regnell. 1864F (S), 7 Oct 1893, Malme, Lich. Regnell. 1897A, 1897B (S), 20 Oct 1893, Malme, Lich. Regnell. 1944B (S); Gran Chaco on the Río Negro, 14 Sep 1893, Malme, Lich. Regnell. s.n. (S).

UNITED STATES: Florida: Hillsborough Co., Hillsborough State Park, 8 Mar 1947, Schallert 1145 (US); Seminole Co., Sanford, 5 Jul 1911, Rapp 34 (FH), Jul 1911, Rapp 59 (US), 160 (FH), Jan 1930, Rapp s.n. (FLAS), Mar 1930, Rapp s.n. (UPS). Louisiana: Iberia Parish, Weeks Island, 14 mi S of New Iberia, 4 Aug 1958, Pursell 3368 (COLO); St. Martin Parish, St. Martinville, 17 Oct 1894, Langlois s.n. (NY).

KENYA. Rift Valley Prov.: Kajiado, Ngong Hills, 2360 m, 3 Jan 1971, Moberg 1411 (UPS). Western Prov.: Kakamega, Kakamega Forest, Preston-Mafham 16 (BM); near Yala River, 5-7 km S of Kakamega Forest Station, 1500-1700 m, 21 Jan 1970, R. Santesson 21810, 21824, 21826, 21836A,B (UPS). Lindaret Farm, Apr 1938, Davoli 4 (UPS).

TANZANIA. Arusha Prov.: Mt. Meru, E slope, road to the crater, 2000 m, 17 Jan 1970, R. Santesson 21490, 21560 (UPS); ca. 2 km N of Kitot Camp, 7 Jan 1971, R Santesson 22983 (UPS). Kilimanjaro Prov.: Mt. Kilimanjaro, W slope, 1700 m, 21 Jan 1970, R. Santesson 20978

(UPS). Tanga Prov.: Usambara Mts., 1894, Holst 3328 (G); Amani, 900 m, 9 Jan 1971, Moberg 1481 (UPS), R. Santesson 23276 (UPS).

Phyllopsora corallina (Eschw.) Müll. Arg., Bot. Jahrb. Syst. 20: 264. 1894. Lecidea corallina Eschw. in Martius, Fl. bras. enum. pl. 1(1): 256. 1833. Parmelia corallina (Eschw.) Mont. in Sagra, Hist. fis. Cub., Bot. 4: 216. 1838. Biatora corallina (Eschw.) Hook. f. & Tayl. in Hook., Fl. Antarct. 2: 537. 1847. Psora corallina (Eschw.) Müll. Arg., Flora 71: 527. 1888. Phyllopsora parvifolia var. corallina (Eschw.) B. de Lesd., Lich. Mex. 20. 1914. Type: Brazil. Bahia, Martius s.n. (holotype, M, no lichen substances; fragments, H-NYL 20483, G).

Thallus squamulose, squamules round or elongate and digitate-lobulate, 0.1-0.5 mm wide, complanate to convex, adnate to somewhat ascending, Pd- or Pd+ orange. Upper surface glabrous, pubescent and fibrillose at the margin. Isidia rare to abundant, globose to cylindrical. Cortex type 1-2, 25-45 um thick, containing crystals. Prothallus scant, pale to red. Lichen substances: argopsin, unknown A, unknowns O1, O2, pannarin, zeorin, additional unknowns or none detected

Apothecia common. Disc plane to convex with age, orange to dark red. Margin slightly raised, concolorous or darker than the disc. Exciple tan to tinged red at the margin, KOH- or KOH+ purple. Hypothecium tan or tinged red, KOH- or KOH+ slight purple-red where

tinged red. Hymenium tan with occasional red-brown pigmentation, 35-45 um tall. Epihymenium not obvious. Ascospores simple or uniseptate, ellipsoid to short fusiform,

Pycnidia common, tan, orange-brown or golden-brown, partly immersed in the thallus. Pycnospores rod-shaped, straight, 8-11 x 1 um.

This species is distinguished by its small to medium-size squamules, abundant isidia and reddish apothecia. Four varieties are recognized based on chemistry correlated with some morphological variation.

Key to varieties of Phyllopsora corallina:

1. Thallus Pd-
    2. Thallus containing unknown C — var. rappiana
    2. Thallus lacking unknown C — var. corallina
1. Thallus Pd+
        3. Isidia elongate, marginal, flattened, horizontal; containing only atranorin — var. phaeobyssina
        3. Isidia globose to cylindrical, laminal and marginal, erect, or isidia lacking
            4. Thallus containing unknown O — var. ochroxantha
            4. Thallus lacking unknown O
                4. Thallus containing unknown G — var. glaucella
                4. Thallus lacking unknown G, containing argopsin, unknown A, +/- zeorin — var. santensis

Phyllopsora corallina var. corallina

Lecidea parvifolia var. corallina Tuck., Proc. Amer. Acad. Arts 6: 273. 1864. Phyllopsora parvifolia var. corallina (Tuck.) Merrill, Bryologist 30: 85. 1927, hom. illeg., non (Eschw.) B. de Lesd., 1914. Type: Cuba. Wright, Lich. Cub. 184e (lectotype designated by Swinscow & Krog, 1981, FH-TUCK 2923, no lichen substances; isolectotypes, BM, G, L, M, UPS). Fig. 22A.

Lecidea densiflorae Vainio, Bot. Mag. (Tokyo) 35: 67. 1921. Phyllopsora densiflorae (Vainio) G. Schneider, Biblioth. Lich. 13: 175. 1979. Type: Japan. Kozuke, 25 Feb 1918, Yasuda 350 (holotype, TUR-VAIN 22632, no lichen substances).

Distribution: Pantropical.

Variety corallina has a variable morphology and no detectable lichen substances. The type specimen has well developed squamules 0.1-0.5 mm diam., a type 1 cortex 30 um thick, and both laminal and marginal cylindrical isidia. Isidia are also formed from very tiny squamules. Additional specimens may have only this latter form so the thallus is completely dominated by isidia. The ascospores are 7.5-11.5 x 2-3 um (LENGTH: X=9.46, SD=1.87, L. min. 6.5, L. max. 13.0; WIDTH: X=2.56, SD=0.54, W. min. 2, W. max. 3; n=50).

Variety corallina is distinguished from all other varieties of P. corallina by its lack of lichen substances. In morphology it is closest to P. isidiotyla. Phyllopsora isidiotyla is distinguished

by its finely branched isidia and the abundant pale hyphae extending from the exciple.

Specimens examined: MEXICO. Michoacán: Cerro Azul, Morelia, 10 Mar 1890, Arsène 3802 (COLO, H, S, UPS). Nuevo León: Sierra de la Silla, Monterrey, 10 Jun 1889, Pringle 40 (FH=4x). Veracruz: Cordoba, 1876, Duby s.n. (G); Veracruz, 520 m, 17 Mar 1960, Hale & Soderstrom 19841 (US).

CUBA. Oriente: El Yunque, Mt. Baracoa, Mar 1908, Underwood & Earle 1004 (NY). Santiago de Cuba: Arroyo Negro, ca. 4 km SE of La Gran Piedra, ca. 1000 m, 5 Apr 1982, Harris 14400 (HAC, NY).

ST. EUSTATIUS. On the rim of the Quill Vulcano, 500 m, 2 Aug 1980, Sipman 14953 (B).

VENEZUELA. Lara: Sierra Portuguesa, Parque Nacional "Yacambú", 1400-1900, 20-21 May 1978, López-Figueiras 15974 (MERF). Mérida: Valley of the Río Chama, 1600 m, 21 Jan 1979, Sipman 10984 (B, MERF). Miranda: El Vulcán, above Baruta, 1200-1300, 1 May 1986, Brako 8659, 8671, 8672 (NY); along road from Hoya de la Puerta to San José de los Altos, 1100-1250, 9 May 1986, Brako 8694 (NY).

GUYANA. Rupununi: Savanna between Takutu River and Kanuku Mts., Smith 3340 (FH, U).

FRENCH GUIANA. 1859, Leprieur 509 (G).

PERU. Huanuco: Ca. 18 km NNE of Tingo Maria, Puente Pumahuasi, 20 Feb 1981, R. Santesson & Moberg P38:11 (S). San Martín: Tarapoto, NE of Hotel de Turistas, 350 m, 12 Mar 1981, R. Santesson & Thor P71:53, P71:92 (S).

BRAZIL. Bahia: Serra das Mangabeiras, ca. 8 km before Seabra,

1050 m, 17 Jul 1980, Kalb 290 (Hb. Kalb); ca. 10 km N of Rui Barbosa, 400 m, 18 Jul 1980, Kalb 293 (Hb. Kalb); Chapada Diamantina, between Mundo Novo and Morro do Chapeú, 800 m, 20 Jul 1980, Kalb 295 (Hb. Kalb). Mato Grosso: Ca. 35 km SE of Cuiabá, 120 m, 3-4 Jul 1980, Kalb 269A (Hb. Kalb); Santo Antônio de Leverger, ca. 40 km S of Cuiabá, 100 m, 5 Jul 1980, Kalb 275 (Hb. Kalb); Serra dos Coroados, 6 km SW of Buritî, 600 m, 8 Jul 1980, Kalb 280 (Hb. Kalb); ca. 10 km NE of Chapada dos Guimarães, 680 m, 9 Jul 1980, Kalb 282 (Hb. Kalb); between Santo Antônio and Coxipós, 22 Dec 1893, Malme, Lich. Regnell. 2170C, 2178C (S). Mato Grosso do Sul: Estrada do Pantanal, E of Coxim, 300 m, 26 Jun 1980, Kalb 259 (Hb. Kalb); ca. 30 km S of Campo Grande, 550 m, 14 Nov 1979, Kalb & Plöbst 266, Lich. Neotropici 343 (M, US). Minas Gerais: 1885, Glaziou s.n. (G, PC); Serra do Caraça, 8 Jul 1978, Kalb & Plöbst s.n. (Hb. Kalb). Rio de Janeiro: 1878, Glaziou s.n. (G), 1885, Vainio, Lich. Bras. Exs. 145 (BM, M, TUR-VAIN-22606). Rio Grande do Sul: Santo Angelo, 7 Feb 1893, Malme, Lich. Regnell. 1013 (BM, G, H, US, W); Colonia Ijui, 30 Mar 1893, Malme, Lich. Regnell. 1227B (S). Santa Catarina: 13 km above Timbé do Sul on road to Serra Rochina, 650 m, 11 Jan 1987, Falkenberg 3655B (NY). São Paulo: Fazenda São João near the Rio Claro, 600 m, 16 Aug 1980, Kalb 302B (Hb. Kalb); Apiahy (Apiaí), 21 Sep 1878, Puiggari s.n. (G); Caverna do Diablo, 200 m, 29 Sep 1984, Vital & Buck 12495 (NY, SP).

ARGENTINA. Misiones: Cataracts of Iguazú, 150 m, 29 Apr 1979, Kalb 143 (Hb. Kalb).

UNITED STATES. Alabama: Monroe Co., Brooklyn, 1853, Beaumont

94, 104, 149, 188 (FH-TUCK 2828), Peters s.n. (NY). Florida: Alachua Co., Gainesville, Ravenel 11 (BM); Duval Co., near Jacksonville, Calkins 447 (NY), Faxon 310 (NY), s.n. (FH); St. Johns Co., 6 Mile Creek, Calkins 47 (G), 93 (G, NY=2x); Sine loc., 1878, Austin 1, 24 (FH-TUCK 2828), s.n. (US); Southwest Florida, Mar 1878, Austin & Smith 48 (US), Calkins 27 (FLAS). Georgia: De Kalb Co., Stone Mt., Ravenel s.n. (BM, FH-TUCK 2821). Illinois: Menard Co., Athens, 10 Feb 1880, Hall s.n. (BM, FH-TUCK 2821); 1877, Wolf s.n. (US). Louisiana: 1853, Hale s.n. (FH-TUCK 2828); East Baton Rouge Parish, Burden Research Plantation, W of Essen Lane, SE Baton Rouge, 19 Mar 1974, Tucker 12019A (M); East Feliciana Parish, Idlewild Research Station, 5.6 km SE of Clinton, 17 Nov 1978, Tucker 18104 (COLO, NY); Iberia Parish, Bois Olivier, 9 Jul 1890, Langlois 846 (US); St. Landry Parish, St. Leo, 22 Mar 1895, Langlois s.n. (US); St. Martin Parish, Grand Bois, 15 Jan 1894, Langlois 848 p.p. (US), Bayou Cupucin, 22 Oct 1894, Langlois bd (BM, NY, US=2x), St. Martinville, 2 Aug 1982, Langlois s.n. (US), 1894, Langlois s.n. (MIN), Duchamps, 26 Sep 1894, Langlois az (S, US=2x). Missouri: Butler Co., Nedyville, Nov 1898, Russell 90 (NY). New Jersey?: 1866, Austin 310 (FH-TUCK 2821). North Carolina: Polk Co., Tryon, 20 Jan 1928, Evans 412 (UPS). South Carolina: Aiken Co., Aiken, Jan 1885, Ravenel s.n. (BM=2x), s.n. (BM, H, NY); Berkeley Co., Santee Canal, Ravenel s.n. (BM, UPS, US). Texas: Jasper Co., E bank of Neches River on highway 190, 26 Dec 1949, Whitehouse 22632 (US); Liberty Co., 14 m E of Cleveland, 9 Jan 1976, Egan EL-7762 (O); sine loc., Hall & Ravenel 16 (US). Virginia: Sussex Co., Tower Hill, Jun 1854, Tuckerman s.n. (FH-TUCK 2821).

SOUTH AFRICA. Cape Prov.: Div. Albany (near Grahamstown), Fern Kloof, 25 Nov 1953, Almborn 10814 (LD).

Phyllopsora corallina var. **glaucella** (Vainio) Brako, comb. et stat. nov.

Lecidea breviuscula var. glaucella Vainio, Dansk Bot. Arkiv 4(11): 21. 1926. Phyllopsora breviuscula var. glaucella (Vainio) Zahlbr., Cat. Lich. Univ. 10: 426. 1939 "fo. glaucina". Type: Mexico. Veracruz: Mirador, Liebmann, Pl. Mex. 7381a (holotype, TUR-VAIN 34026, trace argopsin?, trace unknown A?, unknown G1, G2). Fig. 22B.

Distribution: Southern North America, Mexico, West Indies and South America.

This variety differs from other varieties of P. corallina by its chemistry of unknown compounds G1 and G2, that occur together with faint traces of argopsin and unknown A. The squamules are 0.1-0.3 mm diam. with a type 2 cortex, 25 um thick. The isidia are cylindrical. The ascospores are 7.5-9.5 x 2.5-3 um (LENGTH: X=8.57, SD=0.97, L. min. 7.0, L. max. 11.0; WIDTH: X: 2.73, SD=0.41, L. min. 2.5, L. max. 3; n=50).

The original description says "non isidiosis", but the type collection is clearly isidiate. Misquoted in Zahlbruckner's catalogue (1926-1927) as f. glaucina Vainio, it is closest to var. santensis in morphology.

Specimens examined: DOMINICAN REPUBLIC. Pedernales: Las

Abejas, S slope of Sierra de Baoruca, ca. 40 km N of Caba Rojo, 1750 m, 26 Jan 1987, Buck 14757 (NY).

PUERTO RICO. Indiera Fria, near Maricao, 430-800 m, 19-22 Feb 1915, Britton et al. 4398 (NY).

BRAZIL. Espirito Santo: 20 km E of Linhares, 30 m, 25 Jul 1980, Kalb s.n. (Hb. Kalb). Goiás: Between Jataí and Estância, 510 m, 11 Jul 1980, Kalb 283B (Hb. Kalb). São Paulo: Fazenda São João on the Rio Claro, 600 m, 16 Aug 1980, Kalb 302 (Hb. Kalb).

PARAGUAY. Alto Paraná: Centro Florestal Alto Paraná, 4.5 km W of Pto. Pte. Stroessner on Ruta 7, ca. 250 m, 15 Oct 1984, Buck 12360 (NY).

ARGENTINA. Corrientes: Pase de la Patria, Arroyo San Juan, 9 Sep 1985, Ferraro & Nash 3220 (CTES).

UNITED STATES. Florida: Dade Co., Cocoanut Grove, 1897, Thaxter 177 (FH); Seminole Co., Oviedo, Mena s.n. (FH=2x).

Phyllopsora corallina var. **ochroxantha** (Nyl.) Brako, comb. et stat. nov.

Lecidea ochroxantha Nyl., Ann. Sci. Nat. Bot., sér. 4, 11: 223. 1859. Phyllopsora ochroxantha (Nyl.) Zahlbr., Cat. Lich. Univ. 10: 377. 1939. Type: Bolivia. Camplolicans, [1847,] Weddell s.n. (lectotype designated by Swinscow & Krog, 1981, H-NYL 20489, argopsin, unknowns A, O1, O2; isolectotypes, H, PC). Fig. 23B.

Lecidea subvirescens Nyl., Ann. Sci. Nat. Bot., sér. 5, 7: 321. 1867. Phyllopsora subvirescens (Nyl.) G. Schneider, Biblioth.

Lich. 13: 179. 1979. Type: Venezuela. Río Negro, 1200 m, 1863, Lindig s.n. (holotype, H-NYL 20492, unknown O1, O2).

Lecidea ernstiana Müll. Arg., Flora 60: 473. 1877. Psora ernstiana (Müll. Arg.) Müll. Arg., Flora 70: 320. 1887. Phyllopsora ernstiana (Müll. Arg.) Müll. Arg., Bot. Jahrb. Syst. 20: 265. 1894. Type: Venezuela. Distrito Federal: Caracas, Ernst 190 (holotype, G, unknown O1, O2).

Psora polydactyla Müll. Arg., Flora 70: 320. 1887. Phyllopsora polydactyla (Müll. Arg.) Zahlbr., Cat. Lich. Univ. 4: 400. 1926. Type: Brazil. São Paulo: Apiahy (Apiaí), Apr 1882, Puiggari 2156 (holotype, G, argopsin, unknowns A, O1). Fig. 24.

Lecidea spinulosa Vainio, Acta Soc. Fauna Fl. Fenn. 2: 46. 1890. Phyllopsora spinulosa Zahlbr., Cat. Lich. Univ. 4: 401. 1926. Type: Brazil. Minas Gerais: Sitio, 1885, Vainio, Lich. Bras. Exs. 993 (holotype, TUR-VAIN 22627; isotypes, BM=2x, argopsin, unknowns A, O1, O2, M, TUR-VAIN 22626, ZT).

Lecidea glabriuscula Nyl., Ser. lich. trop. 40. 1891. Phyllopsora glabriuscula (Nyl.) Swinscow & Krog, Lichenologist 13: 241. 1981. Type: Cuba. Wright, Lich. Cub. ser. 2, 105 (holotype, H-NYL 20534, unknowns A, O3).

Phyllopsora cinerella Zahlbr. in H. Magn. & Zahlbr., Ark. Bot. 3IA(6): 18. 1944. Type: U.S.A. Hawaii: Kauai, near Robinson's summerhouse, 1000 m, Feb 1910, Faurie 308 (lectotype here designated, PC; syntypes, Faurie 307, UPS,

argopsin, unknown O2, Maui, 350 m, Faurie 539, n.v.).

Phyllopsora cinerella f. virescens Zahlbr. in H. Magn. & Zahlbr., Ark. Bot. 31A(6): 19. 1944. Type: U.S.A. Hawaii: Oahu, near Honolulu, 400 m, Faurie 413 (lectotype here designated, PC, argopsin, unknown O2; isolectotype, BM).

Phyllopsora martinii Swinscow & Krog, Lichenologist 13: 232. 1981. Type: Kenya. Coast Prov.: Kwale District, Shimba Hills, Kivumoni Forest, 350 m, 1972, Krog & Swinscow K 42/3 (holotype BM, argopsin, unknowns A, O1, O2,; isotypes, BM, O, UPS). Figs. 22A, 25A.

Distribution: Southern North America, Central America, West Indies, South America, Hawaii, Australia and Africa.

Variety ochroxantha is distinguished by the constant presence of unknown compounds O1, O2 or O3. The squamules are 0.3-1.0 mm diam. The ascospores are 7-10 x 2.5-3.5 um (LENGTH: x=8.44, SD=1.59, L. min. 6.5, L. max. 11.7; WIDTH: X=2.94, SD=0.68, W. min. 2, W. max. 3.5; n=50).

Chemical strains: Chem. strain I: atranorin, argopsin, unknowns A, O1, O2 and +/- zeorin. Chem. strain II: unknowns O1, O2 and +/- zeorin. Chem. strain III: unknown A, unknown O3.

The type specimen has Chem. strain I. The thallus morphology is variable. The isidia are especially variable in occurrence and morphology. The type specimen has small lobes with only few cylindrical isidia. It is identical in morphology and chemistry with the type of L. spinulosa. The type specimen of L. polydactyla has

long lobes with abundant marginal, elongate isidia. This seems to be an extreme form. The type of P. martinii has a type 2 cortex. Thallus morphology may be similar to var. santensis, but var. ochroxantha has slightly smaller ascospores than var. santensis.

Chemical Strain I:

Specimens examined: MEXICO. Morelos: Cuernavaca, 6500 ft, 31 Oct 1908, Pringle 10742 (COLO). San Luis Potosí: Tamasopo, 15 Jun 1892, Pringle 36A (FH=2x).

GUATEMALA. Petén: Near Tikal, 300 m, 9-10 Jan 1979, Kalb & Plöbst 73 (Hb. Kalb).

COSTA RICA. Puntarenas: Monteverde, 1450, 4 Jan 1979, Sipman 12098 (B).

PANAMA: Coclé: Near El Valle de Anton, 550 m, 25-26 Nov 1985, Brako 8428 (NY). Darién: W ridge of Cerro Tacarcuna massif, 4100-4180 ft, 26 Jan 1975, Mori & Gentry 4420 (US).

CUBA. Santiago de Cuba: La Gran Piedra, 1.5 km SE of Peak, ca. 1000 m, 4 Apr 1982, Buck 7620 (HAC, NY), 2 Apr 1982, Harris 14181 (HAC, NY), 3 Apr 1982, Harris 14282, 14285, 14290 (HAC, NY), 4 Apr 1982, Harris 14350, 14351, 14359 (HAC, NY), 4 Apr 1982, ca. 1 km W of peak, 1000 m, 6 Apr 1982, Harris 14523 (HAC, NY), NE slope, 1100 m, 7 Apr 1982, Harris 14644 (HAC, NY); "Monte Kentucky", ca. 5 km SE of La Gran Piedra, 1000 m, 5 Apr 1982, Buck 7684 (HAC, NY), Harris 14410 (HAC, NY); Arroyo Negra, ca. 4 km SE of La Gran Piedra, 1000 m, 5 Apr 1982, Harris 14445 (HAC, NY). Without prov.: La Prenda, Dec 1921, Hioram 5306 (US); Wright, Lich. Cub. ser. 2, 727 (FH-TUCK 2919, G, H-NYL 20532).

DOMINICAN REPUBLIC. Pedernales: Las Abejas, S slope of Sierra de Baoruco, ca. 40 km N of Cabo Rojo, 1750 m, 26 Jan 1987, Harris 20794 (NY).

COLOMBIA. 1869, Lindig s.n. (PC).

VENEZUELA. Aragua: 6.5 km from Colonia Tovar along the La Victoria-Tovar road, 6 Apr 1986, Brako 8607 (NY). Bolivar: Parque Nacional Canaima, on road from Aeropuerto Luepa to Kavanayen, 10 Apr 1985, Brako 8176 (NY), 11 Apr 1985, Brako 8181 (NY). Distrito Federal: Parque Nacional El Avila, Boca de Tigre, Jun 1985, Brako 8189 (NY); Caracas, 1900 m, 13 Jan 1979, Sipman 10687 (B, MERF). Mérida: Road from Estanquez to Canaguá, 2200 m, 13 Dec 1984, Brako 7934A (NY); La Carbonera, 2100-2200 m, 17 Dec 1984, Brako 8124, 8129, 8131, 8132, 8160 (MERF, NY); along the El Morro road, 2000 m, 18 Feb 1976, López-Figueiras & Keogh 12362 (MERF); Mount Zerpa, near La Hechicera, 2000 m, 3 Mar 1978, López-Figueiras & Keogh 15495 (MERF). Miranda: Above El Hatillo, 27 May 1986, Berry s.n. (NY); El Vulcán, above Baruta, 1200-1400 m, 4 May 1986, Brako 8691 (NY).

PERU. San Martín: Lamas, Cerro Blanco (ca. 63 km W-WNW of Tarapoto), 1200 m, 17 Mar 1981, R. Santesson & Thor P77:18 (S).

BRAZIL. Bahia: Itanagra, 8 km W of Itanagra along road to Subaúma, 50 m, 27 May 1981, Boom & Mori 978 (NY). Goiás: Between Jataí and Estância, 510 m, 11 Jul 1980, Kalb 283B (Hb. Kalb). Minas Gerais: Tiradentes near São João del Rei, 900 m, 6 Jul 1978, Kalb & Plöbst 29 (Hb. Kalb); Vila Monte Verde, 30 km E of Camanducaia, 1500 m, 7-11 Sep 1978, Kalb & Plöbst 44 (Hb. Kalb); Lafayette, 1885, Vainio, Lich. Bras. Exs. 275 (TUR-VAIN 22600), 338 (BM, TUR-VAIN

22601); Caraça, 1885, Vainio, Lich. Bras. Exs. 1356 (TUR-VAIN 22628), 1443 (TUR-VAIN 22629), s.n. (TUR-VAIN 22630). Pará: Serra do Cachimbo, 842 km N of Cuiabá, ca. 350-500 m, 5 May 1983, Brako & Dibben 6758 (INPA, NY); Rio Jamanxím, 974-1024 km N of Cuiabá, 300 m, 10-15 May 1983, Brako & Dibben 7006A (INPA, NY); Serra Maze, 1208-1229 km N of Cuiabá, 100-200 m, 18-22 May 1983, Brako & Dibben 7331 (INPA, NY). Rio de Janeiro: Glaziou 1938B (M). São Paulo: Apiahy (Apiaí), 1890, Puiggari 1721 (G); Campos do Jordão, 1700 m, 25 May 1978, Kalb & Plöbst 20 (Hb. Kalb); near Cachoeira de Emas, 15 km NE of Piraçununga, 550 m, 14 Jun 1979, Kalb & Plöbst 145 (Hb. Kalb); Serra do Itapeti, between Mogi das Cruzes and Arujá, 500 m, 20 Apr 1980, Kalb 232 (Hb. Kalb); Morro Grande near Cotia, 25 km W of São Paulo, 850 m, 27 Sep 1980, Kalb 309 (Hb. Kalb).

PARAGUAY. Paraguarí: Parque Nacional Ybycuí, trail along Arroyo Mina, ca. 200 m, 5-6 Oct 1984, Buck 11935 (NY).

ARGENTINA. Corrientes: San Cosme, Paso de la Patria, Arroyo San Juan, 9 Sep 1985, Ferraro & Nash 3220 (CTES).

UNITED STATES. Florida: Faxon s.n. (FH).

Chemical Strain II:

Specimens examined: PANAMA. Darién: W ridge of Cerro Tacarcuna massif, 4100-4800 ft, 26 Jan 1975, Mori & Gentry 4420 (US).

CUBA. Santiago de Cuba: La Gran Piedra, NE slope, 1100 m, 7 Apr 1982, Harris 14564 (HAC, NY). Without prov.: Wright, Lich. Cub. ser. 2, 726 (H-NYL 20533).

JAMAICA. Feb-Mar 1905, Cummings 44 (FH=2x); 1884, Hart 104 (FH-TUCK 2923).

DOMINICAN REPUBLIC. Independencia: Sierra de Baoruco, 25.5 km S of Puerto Escondito at intersection of road to Charco Colorado, 1750 m, 14 Jan 1987, Buck 14509 (NY).

VENEZUELA. Mérida: Finca "Buenos Aires", near Aricagua, 1700 m, 8 Mar 1976, López-Figueiras 12649 (MERF). Miranda: El Vulcán, above Baruta, 1200-1400 m, 1 May 1986, Brako 8663 (NY).

ECUADOR. Pastaza: Mera, at cemetery, 1100 m, 26 Nov 1972, Arvidsson & Nilson 414 (GB).

BRAZIL. Pará: Serra do Cachimbo, 774 km N of Cuiabá, 400 m, 22 Apr 1983, Brako & Dibben 5523 (INPA, NY); Aeroporto Cachimbo, 20 km N of the border with Mato Grosso, 430-480 m, 27 Apr 1983, Brako & Dibben 6141, 6168, 6170 (INPA, NY); 842 km N of Cuiabá, 350-500 m, 5 May 1983, Brako & Dibben 6748 (INPA, NY); cataracts on the Rio Curuá, 877 km N of Cuiabá, 350-500 m, 2 May 1983, Brako & Dibben 6527 (INPA, NY), 7 May 1983, Brako & Dibben 6909 (INPA, NY). Paraná: Reserva Ecológica Sapitanduva, between Morretes and Antonina, 100 m, 17-18 Jan 1987, Hatschbach & Brako 8873 (NY). Rio Grande do Sul: Hamburgerberg, near São Leopoldo, 18 Nov 1892, Malme, Lich. Regnell. 599 (S, UPS).

Chemical Strain III:

Specimens examined: MEXICO. Oaxaca: In hills between Arroyo Humaca and Río Verde, 300 m, 20 Apr 1985, Thomas et al. 3574 (NY).

COSTA RICA. Puntarenas: Near La Cruzes Garden, ca. 4 km SSE of San Vito, 1330 m, 1 Jan 1979, Sipman 11989 (B).

PANAMA. Boca del Toro: Fortuna Dam region, 1000 m, 8 Dec 1985, McPherson 7847 (NY). Coclé: Near El Valle de Anton, 550 m, 25-26 Nov

1985, Brako 8417, 8421, 8430 (NY). Panamá: Along trail to Cerro Brewster, 670 m, 18-21 Nov 1985, Brako 8256 (NY); along El Llano-Carti road, 400 m, 24 Nov 1985, Brako 8386 (NY); along the Cerro Jefe-Alto Pacoura road, 28 Nov 1985, Brako 8499 (NY).

BAHAMAS. Andros: Nicholl's Town and vicinity, 13-15 Mar 1907, Brace 6881 (NY).

CUBA. Isle of Pines: San Juan, 15,17 Mar 1916, Britton et al. 15586 (FH, NY). Oriente: Bayate, Ekman 37 (S, TUR-VAIN 22611); Nogueras Hill, 27 Oct 1921, Hioram 5690 (US).

DOMINICAN REPUBLIC. Pedernales: Las Abejas, 55 km N of port of Cabo Rojo on Alcoa road, 3600 ft, 5 May 1982, Harris 15383 (NY).

VENEZUELA. Amazonas: Río Negro, Cerro de La Neblina, along the Río Mawarinuma, just outside Cañon Grande, 140 m, 5 Feb 1985, Buck 12827 (NY, VEN). Miranda: El Vulcán, above Baruta, 1200-1400 m, 4 May 1976, Brako 8682 (NY).

TRINIDAD. Río Grande Forest, S of Tamana, 5 May 1957, Fleming s.n. (NY).

SURINAM. Surinam: Paramaribo, 50 m, Narain 144 (B).

ECUADOR. Napo: Santa Rosa, km 5 North, 400 m, 20 Aug 1982, Aptroot & Hensen 10650 (U); Auca Oil Fields, 56 km S of Coca, 17 Jun 1983, Brako 7459, 7460, 7463A (NY, QCA). Pichincha: Ca. 18 km NW of San Miguel de los Bancos, 800 m, 27-29 Dec 1983, Buck 10334 (NY).

PERU. San Martín: Lamas, Cerro Blanco (ca. 63 km W-WNW of Tarapoto), 1200 m, 17 Mar 1981, R. Santesson & Thor P77:23 (S).

BRAZIL. Pará: Serra do Cachimbo, Aeroporto Cachimbo, 20 km N of the Mato Grosso border, 430-480, 27 Apr 1983, Brako & Dibben 6169

(INPA, NY); 842 km N of Cuiabá, 350-500 m, 5 May 1983, Brako & Dibben 6752 (INPA, NY); Rio Jamanxím, 974-1024 km N of Cuiabá, 300 m, 10-15 May 1983, Brako & Dibben 7080 (INPA, NY); Serra Maze and vicinity, 1208-1229 km N of Cuiabá, 100-200 m, 18-22 May 1983, Brako & Dibben 7267 (INPA, NY). Paraná: Prainhas, near Porto de Cima, 100 m, 16 Jan 1987, Hatschbach & Brako 8839 (NY); Reserva Ecológica Sapitanduva, between Morretes and Antonina, 100 m, 17-18 Jan 1987, Hatschbach & Brako 8856 (NY). São Paulo: Ilha de São Sebastião, 200 m, 6 Jul 1979, Kalb 155, 157 (Hb. Kalb); Praia Grande, S of São Paulo, 2 m, 18 Dec 1978, Kalb & Hannack 59 (Hb. Kalb). Roraima: Alto Alegre, Ilha de Maracá, 9 Jun 1986, Rodrigues et al. 847 (INPA, NY), 12 Jun 1986, Rodrigues et al. 933 (INPA, NY).

UNITED STATES. Florida: 27 Dec 1898, Pattillo 165 (FLAS).

AUSTRALIA. Queensland: Trinity Bay, 1886, Müller s.n. (G).

Phyllopsora corallina var. **phaeobyssina** (Vainio) Brako, comb. nov.

Lecidea breviuscula var. phaeobyssina Vainio, Ann. Acad. Sci. Fenn., ser. A, 6(7): 127. 1915. Phyllopsora breviuscula var. phaeobyssina (Vainio) Zahlbr., Cat. Lich. Univ. 4: 396. 1926. Type: Guadeloupe. Houelmont, [1897,] Duss 481 (holotype, TUR-VAIN 22602, atranorin; isotype, NY). Figs. 25B, 26.

Distribution: Guadeloupe, St. Vincent, Brazil and Venezuela.

This species is distinguished by its medium-size squamules with abundant, flattened isidia, its unusual chemistry of only argopsin

and its orange hymenium. The spores are 7-10 x 2.5-3 um (LENGTH: X=7.32, SD=0.95, L. min. 6.0, L. max. 9.9; WIDTH: X=2.88, SD=0.24, W. min. 2.5, W. max. 3.5; n=15). It most closely resembles P. corallina var. ochroxantha which has cylindrical isidia.

Specimens examined: ST. VINCENT: Richmand Peak, 1000-2000 m, Elliott 261 (TUR-VAIN 22612A).

VENEZUELA: Amazonas: San Carlos, Spruce, Lich. Amaz. And. 225 (BM).

BRAZIL. São Paulo: Serra de Boissocanga, above Maresias, 330 m, 18 Feb 1980, Kalb 212 (Hb. Kalb); Fazenda São João near the Rio Claro, 600 m, 16 Aug 1980, Kalb 302 (Hb. Kalb).

Phyllopsora corallina var. **rappiana** Brako, var. nov.

P. corallinae var. santensi similis sed atranorino et C ignoto diversa.

Type. United States. Florida: Sarasota Co., Myakka River State Park, 16 Aug 1985, Brako 8229 (holotype, NY).

This variety is distinguished by its chemistry of atranorin and unknown C. It is closest to var. santensis in morphology. The ascospores are 6-11 x 2-3.5 um (LENGTH: X=8.12, SD=0.70, L. min. 6.3, L. max. 10.0; WIDTH: X=2.95, SD=.15, W. min. 2.5, W. max. 3; n=20).

Distribution: Central America, South America and southern North America.

Specimens examined: MEXICO. Veracruz: Cordoba, 1876 , Duby s.n. (US).

GUATEMALA. Izabál: Quiriguá, Jul 1976, Hale 50881, 50974

(US=2x).

HONDURAS. Copán: Copán, Jul 1976, Hale 50964 (US). Morazán: Suyatillo, north of El Zamorano, 800-850 m, 18 Jul 1949, Standley 21360 (F). Olancho: Between Juticalpa and El Asilo, 380-400 m, 10 Mar 1949, Standley 17763 (F); between Juticalpa and La Concepcíon, 400 m, 12 Mar 1949, Standley 17916 (F).

COSTA RICA. Puntarenas: Near bridge on Río Brujo, 450 m, 2 Jan 1979, Sipman 12061 (B).

GUYANA. Rupununi: Savanna between Takutu River and the Kanuku Mts, 12-22 Mar 1938, Smith 3340 (NY).

BRAZIL. Mato Grosso: Ca. 35 km SE of Cuiabá, 120 m, 3-4 Jul 1980, Kalb 269 (Hb. Kalb).

UNITED STATES. Florida: Sarasota Co., Myakka River State Park, 16 Aug 1985, Brako 8223 (NY); Seminole Co., Sanford, 9 Apr 1923, Rapp s.n. (FLAS).

Phyllopsora corallina var. santensis (Tuck.) Brako, comb. et stat. nov.

Lecidea santensis Tuck., Amer. J. Sci. Arts, ser. 2, 25: 428. 1858. Phyllopsora santensis (Tuck.) Swinscow & Krog, Lichenologist 13: 236. 1981. Type: U.S.A. South Carolina: Berkeley Co., Santee Canal, 1849, Ravenel 182 (holotype, FH-TUCK 2822, argopsin, unknown A). Fig. 27.

Phyllopsora albicans Müll. Arg., Bull. Soc. Roy. Bot. Belgique 32: 132. 1893. Type: Costa Rica. Cartago: Terraba (Turrialba), 1893, Tonduz s.n. (holotype, G; isotypes, US=2x, argopsin, unknown A, as Pittier & Durand, Pl. Costar. Exs. 5474).

Lecidea porphyromelaena Vainio, Ann. Acad. Sci. Fenn., ser. A, 15(6): 113. 1921. Phyllopsora porphyromelaena (Vainio) Zahlbr., Cat. Lich. Univ. 4: 401. 1926. Type: Philippines. Luzon: Bataan Prov., Mount Marivales, Dec 1908, Merrill, Bur. Sci. 6273 (lectotype designated by Swinscow & Krog, 1981, TUR-VAIN 22619; syntype, Bur. Sci. 6256, TUR-VAIN 22620, argopsin, unknown A; isosyntypes, BM, US).

Lecidea miradorensis Vainio, Dansk Bot. Ark. 4(11): 22. 1926. Phyllopsora miradorensis (Vainio) G. Schneider, Biblioth. Lich. 13: 177. 1979. Type: Mexico. Veracruz: Mirador, 18 Mar 1842, Liebmann, Pl. Mex. 7373 (lectotype designated by Swinscow & Krog, 1981, TUR-VAIN 34034; isolectotype, FH; syntype, Liebmann, Pl. Mex. 7372a, TUR-VAIN 34035, argopsin, unknown A reported by Swinscow & Krog, 1981).

Phyllopsora formosana Zahlbr., Repert. Spec. Nov. Regni Veg. 33: 43. 1933. Type: Taiwan. Raisha, 5 Jan 1925, Asahina s.n. (holotype, W, argopsin, unknown A, reported by Swinscow & Krog, 1981).

Lecidea corallina f. saxicola Malme, Ark. Bot. 28A(7): 47. 1936. Type: Brazil. Mato Grosso: Santo Antônio near Cuiabá, Morrinho, 24 Apr 1894, Malme, Lich. Regnell. 2607B (holotype, S, argopsin, unknown A).

Distribution: Pantropical.

This variety differs from var. corallina by its chemistry of atranorin, argopsin, +/- unknown A and zeorin. Variety santensis

generally has well developed squamules with numerous globose to cylindrical, erect, isidia. The apothecial margin is usually darker than the disc. The ascospores are 8.5-12 x 2.5-3 um (LENGTH: X=10.27, SD=1.55, L. min. 7.0, L. max. 13.0; WIDTH: X=2.9, SD=0.25, W. min. 2.5, W. max. 3; n=50). Distinguished by their chemistries, var. santensis and var. ochroxantha are often similar in morphology. Variety santensis usually has abundant laminal, globose isidia where var. ochroxantha usually has mostly marginal, elongate-cylindrical isidia. The spores in var. santensis tend to be slightly longer than those of var. ochroxantha.

Chemical strains: Chem. strain I: +/-atranorin, argopsin, unknown A, and +/- zeorin. Chem. strain II: argopsin.

Chemical Strain I:

Specimens examined: COSTA RICA. Puntarenas: Restaurant Río Brujo, ca. 10 km from Río Grande de Térraba, 350 m, 2 Jan 1979, Kalb & Plöbst 71 (Hb. Kalb); Monteverde, 1450 m, 4 Jan 1979, Sipman 12088 (B, NY).

BAHAMAS. New Providence: Waterloo, 12-24 Mar 1907, E. Britton 6633 (NY, US).

DOMINICAN REPUBLIC. Pedernales: Las Abejas, S slope of Sierra de Baoruco, 40 km N of Cabo Rojo, 1750 m, 26 Jan 1987, Harris 20779 (NY).

COLOMBIA. Vaupes: Río Apaporis, Mar 1951, Schultes 11753 (FH), s.n. (NY).

SURINAM. Surinam: Paramaribo, 50 m, 1976, Narain 55 (B).

ECUADOR. Napo: Añangu, 70 km E of Coca on the Río Napo, 1 Mar

1983, Brako 5311 (NY, QCA).

PERU. San Martín: Tarapoto, NE of Hotel Turistas, 350-500 m, 11 Mar 1981, R. Santesson & Thor P70:47 (S), 16 Mar 1981, R. Santesson & Thor P76:14, P76:18, P76:19 (S).

BRAZIL. Amazonas: 0.5 km E of Borba, 22 Jun 1983, Nelson et al. 1311 (INPA, NY). Mato Grosso: Serra Cobrinha, ca. 10 km W of BR-158 and 17 km N of junction of BR-158 and MT-413, 14 Oct 1985, Thomas et al. 4392 (INPA, NY); San Antônio do Leverger, 40 km S of Cuiabá, 100 m, 5 Jul 1980, Kalb 274 (Hb. Kalb); Chapada dos Guimarães, 800 m, 6 Jul 1980, Kalb 277 (Hb. Kalb); Serra dos Coroados, Burití, 600 m, 8 Jul 1980, Kalb 280 (Hb. Kalb); Santa Anna da Chapada, 2 Mar 1894, Malme, Lich. Regnell. 2481 (S). Mato Grosso do Sul: Estrada do Pantanal, E of Coxim, 270 m, 29 Jun 1980, Kalb 256 (Hb. Kalb), 300 m, Kalb 259 (Hb. Kalb). Pará: Serra do Cachimbo, Base Aérea do Cachimbo, 430-480 m, 26 Apr 1983, Brako & Dibben 6036 (INPA, NY). Paraná: Guaíra, 200 m, 9 Aug 1980, Kalb 301 (Hb. Kalb). São Paulo: Serra de Paranapiacaba, 40 km SW of São Paulo, 800 m, 19 Mar 1978, Kalb & Plöbst 1 (Hb. Kalb); Praia de Peruibe near Itanhaém, 1 m, 23 Aug 1978, Kalb & Plöbst 47, 132 (Hb. Kalb); Ilha da Cananéia, 16 Jul 1979, Kalb 168 (Hb. Kalb); Ilha Comprida, sealevel, 15-16 Jul 1979, Sipman 14088 (B).

PARAGUAY. Central: Villa Elisa, ca. 20 km S of Asunción, 15 Oct-10 Nov 1947, Olrog s.n. (UPS).

UNITED STATES. Alabama: Baldwin Co., Fish River, 29 Nov 1924, Evans 133 (FH, NY, US), Yupon Point, 1 Mar 1925, Evans 202 (FH, NY, US), Battles, 29 Mar 1925, Evans 382 (FH, NY, US). Florida: Alachua

Co., Gainesville, 14 Mar 1938, Murrill s.n. (NY), Ravenel 11 (BM); Clay Co., Goldhead Branch State Park, 120 ft, 24 Jun 1973, Buck s.n. (NY); Dade Co., Cocoanut Grove, 1897, Thaxter 179 (FH), Matheson Hammock State Park, 10 km S of Miami, 6 Oct 1985, Thor 4452 (S); Duval Co., Jacksonville, Calkins 52 (FH), 96 (NY), 134 (US), 153, 154 (FH), Moncrief, Calkins 106, 107 (MIN), 140, 141 (S), 1898, Calkins s.n. (FLAS=2x), Calkins s.n. (MIN, NY), Curtis s.n. (FH), 1888, Eckfeldt 396E (US); Highlands Co., Highlands Hammock State Park, Wild Orange Grove Trail, 11 Aug 1985, Buck 13207 (NY), Harris 18113, 18114, 18151 (NY); Marion Co., Juniper Springs National Recreation Area, 10 Aug 1985, Harris 18088 (NY), Ocala, 1897, Thaxter 215 (FH); Orange Co., 1929, Rapp s.n. (FLAS); St. Johns Co., 6 Mile Creek, Calkins 51 (NY); Sarasota Co., Myakka River State Park, 7 May 1967, Harris 2614 (MIN), 16 Aug 1985, Brako 8220, 8222, 8224, 8225, 8226, 8227, 8228, 8230, 8231 (NY), 26 Feb 1981, Thor 2143 (S); Seminole Co., Oviedo, 29 May 1925, Rapp s.n. (FLAS), Sanford, Jun 1905, Rapp s.n. (FH), Jun 1906, Rapp s.n. (FH=2x), Feb 1908, Rapp s.n. (FH, US), Mar 1908, Rapp s.n. (FH), May 1911, Rapp s.n. (FH=2x, US), Jun 1911, Rapp s.n. (FH=3x), Mar 1914, Rapp s.n. (FH), Feb 1918, Rapp 38 (FH), Mar 1918, Rapp s.n. (UPS), Feb 1921, Rapp s.n. (FLAS), Oct 1922, Rapp s.n. (FLAS), Dec 1922, Rapp s.n. (FLAS), 1923, Rapp s.n. (FLAS), Jan 1925, Rapp s.n. (FLAS), Apr 1928, Rapp s.n. (FLAS), 20 Nov 1928, Rapp s.n. (FLAS), 22 Nov 1928, Rapp s.n. (FLAS), Apr 1929, Rapp s.n. (UPS), Rapp s.n. (FLAS). Georgia: Camden Co., ca. 5 mi S of Woodbine along US Route 17, 28 Feb 1975, Egan EL-6751 (O); McIntosh Co., Darien, Mar 1881, Ravenel 674 (FH). Illinois: Menard

Co., Athens, 1878, Hall s.n. (S). Louisiana: St. Tammany Parish, Abita, 27 Nov 1891, Langlois 847 (US). South Carolina: Ravenel s.n. (BM, US), Tuckerman s.n. (UPS). Texas: Jasper Co., 6 mi S of Everdale, 19 Apr 1951, Whitehouse 25059 (US).

PHILIPPINES. Luzon: Bontoc Prov., Nov-Dec 1910, Vanoverbergh, Bur. Sci. 1023 (TUR-VAIN 22621).

Chemical Strain II:

Specimens examined: JAMAICA. Mandeville, 28 Jan 1909, Wight 10 (FH).

PERU. Loreto: Iquitos, Explorama Lodge, Lake Trail, 100 m, 23 Jan 1981, R. Santesson P7:19 (S).

UNITED STATES. Florida: Lake Co., Lake Norris, 6 May 1921, Kelly s.n. (US); Seminole Co., Sanford, Nov 1910, Rapp 89 (FH=2x).

Phyllopsora cuyabensis (Malme) Zahlbr., Cat. Lich. Univ. 10: 377. 1939. Lecidea cuyabensis Malme, Ark. Bot. 28A(7): 48. 1936. Type: Brazil. Mato Grosso: Serra da Chapada, Buritĺ, 26 Jun 1894, Malme, Lich. Regnell. s.n. (holotype, S, no lichen substances; possible isotypes, S, UPS). Figs. 28A, 29.

Thallus squamulose, squamules round to irregular or elongate, lobes deeply incised, 0.3-1.0 mm wide, thick and convex, adjoined and overlapping, adnate to ascending, Pd-. Upper surface rough and fibrillose; margin with dense fine white fibrils. Isidia common, globose or branched. Cortex type 2, with an irregular upper surface, 15-25 um thick. Prothallus pale, thick. Lichen substances: none detected.

Apothecia common. Disc convex, tan. Margin slightly raised, tan. Exciple and hypothecium yellowish, KOH+ slightly brighter. Hymenium colorless, 40-50 um thick. Epihymenium colorless. Ascospores simple, ellipsoid to short fusiform, 7-10 x 2.5-3 um (LENGTH: X=8.30, SD=1.45, L. min. 6.5, L. max. 13.0; WIDTH: X=2.76, SD=0.42, W. min. 2.5, W. max. 3; n=50).

Pycnidia abundant, tan, ostiole darker, partly immersed in the thallus. Pycnospores rod-shaped, straight, 7-9 x 1 um.

Distribution: Guatemala and Brazil.

The large squamules remind one of the P. parvifolia group, but the species is distinguished by its rough surface, deeply incised lobes, abundant isidia, and chemistry. All herbarium specimens have white squamules. Malme (1936) confused small squamule forms of P. cuyabensis with P. furfuracea, which is distinguished by its chemistry of unknown H.

Specimens examined: GUATEMALA. Alta Verapaz: Chama-Chichoob, 1000 ft, 23 Jul 1920, Johnson 355 (US). Petén: Near Tikal, 300 m, 9-10 Jan 1979, Kalb & Plöbst 73 (Hb. Kalb).

BRAZIL. Amazonas: Along road to Balbina Hydroelectric Dam Project from Manaus-Caracarai Road, 8 & 11 Aug 1979, Buck 2709A (INPA, NY). Mato Grosso: São Vicente, 20 Oct 1974, Freire 46 (INPA, NY); ca. 35 km SE of Cuiabá, 120 m, 3-4 Jul 1980, Kalb 269 (Hb. Kalb). Roraima: Alto Alegre, Ilha de Maracá, 11 Jun 1986, Rodrigues 908 (INPA, NY). São Paulo: Salto Grande de Paranapanema, Jul 1901, Wettstein & Schiffner s.n. (W).

Phyllopsora fendleri (Tuck. & Mont.) Müll. Arg., Bot. Jahrb. Syst. 20: 264. 1894. Biatora fendleri Tuck. & Mont. in Mont., Ann. Sci. Nat. Bot., sér. 4, 8: 296. 1857. Lecidea fendleri (Tuck. & Mont.) Nyl., Ann. Sci. Nat. Bot., sér. 4, 19: 339. 1863, sér. 4, 20: 262. 1863. Type: Venezuela. Fendler s.n. (holotype, FH-TUCK 2923, no lichen substances; isotype, H-NYL 20523). Fig. 28B.

Thallus squamulose to small foliose, squamules short-lobed, 0.5-1.0 mm wide, strongly convex, adjoined and overlapping, adnate, Pd-. Upper surface glabrous, pubescent and fibrillose at the margin. Isidia lacking. Cortex type 1-2, 50-60 um thick. Prothallus abundant, pale. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan to golden-brown. Margin slightly raised, paler than the disc with white fibrils. Exciple tan, KOH-. Hypothecium golden-brown, KOH-. Hymenium tan, 55 um tall. Epihymenium not obvious. Ascospores simple, ellipsoid to short fusiform, 9.5-13 x 3-4 um (LENGTH: X=11.24, SD=1.52, L. min. 9.0, L. max. 15.0; WIDTH: X=3.56, SD=0.51, W. min. 3.0, W. max. 5.0; n=50).

Pycnidia common, tan to golden-brown, ostiole darker, partially immersed in the thallus. Pycnospores rod-shaped, straight, 15-16 x 1 um.

Distribution: Venezuela and Brazil, above 1200 m.

This species is closest to P. parvifolia var. breviuscula, but is distinguished by its shorter lobes, golden-brown hypothecium and

larger ascospores and pycnospores.

Specimens examined: VENEZUELA. Distrito Federal: Caracas, Ernst s.n. (US); track from Altamira to La Silla, 1900 m, 13 Jan 1979, Sipman 10688 (B, MERF). Mérida: La Carbonera, 2400 m, 22 Jan 1979, López-Figueiras & Sipman 18483 (MERF); Morro Negro, near Pico de Horma, 2400 m, 12 Apr 1980, López-Figueiras & Rodrigues 22887, 22951 (MERF). Trujillo: Páramo de Cendé, 2800-3100 m, 30 Mar 1976, López-Figueiras 13036 (MERF); Páramo de La Nariz, near the T.V. tower, 2500 m, 28 Mar 1979, López-Figueiras & Hale 19474 (MERF), 2400 m, 24 Jan 1980, López-Figueiras 22026 (MERF); Las Palmas, 2300 m, 20 Aug 1981, López-Figueiras 26280 (MERF).

BRAZIL. Amazonas: Pico Rondon, 1250 m, 4 Feb 1984, Samuels et al. 185 (INPA, NY). São Paulo: Campos do Jordão, 1700 m, 25 May 1978, Kalb & Plöbst 20 (Hb. Kalb).

Phyllopsora furfuracea (Pers.) Zahlbr. in Engler & Prantl, Nat. Pflanzenfam. 1(1*): 138. 1905. Lecidea furfuracea Pers. in Gaud., Voy. Uran. 192. 1827. Type: "Marianna Island". Gaudichaud s.n (lectotype here designated, PC; frag. H-NYL 20507). Fig. 30A.

Lecidea haemophaea Nyl., Flora 52: 122. 1869. Phyllopsora haemophaea (Nyl.) Müll. Arg., Hedwigia 34: 141. 1895. Type: Peru. Loreto: Yurimaguas, Spruce, Lich. Amaz. And. 185 (holotype, H-NYL 20520; isotypes, BM, unknowns H1, H2, G=2x).

Lecidea schizophylla var. isidiata Malme, Ark. Bot. 28A(7): 44.

1936. Type: Brazil Rio Grande do Sul: Colonia Ijuhy, 30 Mar 1893, Malme, Lich. Regnell. 1226B p.max.p. (holotype, S).

Lecidea hypochrysea Vainio, Ann. Acad. Sci. Fenn., ser. A., 15(6): 114. 1921. Phyllopsora hypochrysea (Vainio) G. Schneider, Biblioth. Lich. 13: 176. 1979. Type: Philippines. Mindanao: Subprov. Butuan, 320 m, Mar-Jul 1911, Weber 1393 (holotype, TUR-VAIN 22622, unknown H1).

Thallus squamulose or dominated by isidia, squamules round to irregular, ca. 0.1 mm diam., mostly slightly convex, closely adjoined and sometimes appearing as a continuous crust, adnate, Pd-. Upper surface glabrose, fibrillose at the margin. Isidia cylindrical to coralloid. Cortex type 2, 10 um thick. Prothallus sparse to abundant, reddish. Lichen substances: unknown H1, +/- H2, +/- H3.

Apothecia common. Disc plane to convex, tan to red-brown. Margin slightly raised with abundant pale fibrils, paler than the disc. Exciple pale tan to tinged red KOH- or KOH+ scarlet. Hypothecium gold to golden-brown, KOH - or KOH+ scarlet. Hymenium gold, 50 um. Epihymenium gold, 5 um thick. Ascospores simple or uniseptate, cylindrical to short fusiform, 8-10 x 2-2.5 um (LENGTH: X=8.97, SD=1.11, L. min. 6.0, L. max. 12.0; WIDTH: X=2.31, SD=0.23, W. min. 1.8, W. max. 2.5; n=50).

Pycnidia common, tan to golden-brown, ostiole darker. Pycnospores rod-shaped, straight, 9 x 1 um.

Distribution: Pantropical.

This species is distinguished by its small isidiate squamules, apothecia with an orange pigment commonly KOH+ scarlet, medium size ascospores and unknowns H1, +/- H2, +/- H3. It is closest to P. corallina, but differs by its thallus morphology and chemistry.

The thallus morphology varies with age. In young thalli, the squamules are small, round to irregular, shiny and adnate to the substrate (Fig. 1A). The prothallus is pale and web-like, apothecia and pycnidia are common. The squamules expand and produce isidia which are globose at onset and become cylindrical with age (Fig. 1B-C). When young the surface of each isidium is smooth and shiny, as they elongate, the isidia may become swollen. With age, the isidia deflate, appearing irregular in shape and with a rough surface (Fig. 1D); the prothallus darkens and appears carbonized. The apothecia found on the darkened prothallus are old, often growing from the hymenia of expired apothecia. The young, healthy apothecia contain an orange pigment which readily reacts KOH+ and diffuses a scarlet substance. Older apothecia may have orange pigmentation, but only brighten slightly with KOH, or a gold substance diffuses.

Specimens examined: MEXICO. Veracruz: Mirador, Aug 1841, Liebmann, Pl. Mex. 7381B (TUR-VAIN 34030).

HONDURAS. El Cayo: Valentin, 27 Jun 1936, Mains 3653 (US).

PANAMA. Colón: Near Fort Davis, 1 m, 23 Nov 1985, Brako 8355 (NY).

CUBA. Isle of Pines: La Cunagua, 19 Feb 1918, Britton et al. 14596 (FH, NY, US=2x). Santiago de Cuba: Arroyo Negro, ca. 4 km SE of La Gran Piedra, 1000 m, 5 Apr 1982, Harris 14453 (HAC, NY); La

Gran Piedra, ca. 1 km W of peak, 1000 m, 6 Apr 1982, Harris 14547, 14548 (HAC, NY), NE slope, 1100 m, 7 Apr 1982, Harris 14647 (HAC, NY). Without prov.: La Prenda, Dec 1921, Hioram 5335 (NY, S), 5345, 5407 p.p. (US); Wright, Lich. Cub. ser. 2, 119 (FH-TUCK 2922, H-NYL 20579, US).

JAMAICA. Portland Parish: 7 mi NW of Muirton on road to Ecclesdown, along trail into John Crow Mts., 11 Apr 1981, Buck 5646 (NY). Without parish: 3 Mar 1905, Cummings 37 (COLO=2x, O, NY=2x, US=2x), Feb & Mar 1905, Cummings 49 (FH=2x, NY); Hart s.n. (NY).

DOMINICAN REPUBLIC. Independencia: Sierra de Baoruco, 25.5 km S of Puerto Escondito, 1750 m, 24 Jan 1987, Buck 14493 (NY), Harris 20471, 20481 (NY); Charco de La Paloma, 48.4 km S of Puerto Escondito, 1800 m, 25 Jan 1987, Buck 14688 (NY), Harris 20677 (NY). El Seibo: 19 km E of Sabana de La Mar on the road to Miches, sealevel, 28 Mar 1981, Buck 5003 (NY). La Vega: La Sal, 13.3 km N of El Río then 10 km E of Paso Bajito on road to Casabito, 3500-3600 ft, 29 Apr 1982, Harris 15009 (NY); Arroyo Piedrosa, 1.2 km from Monabao on road to Jarabacoa, 11 May 1982, Harris 15679 (NY); km 17 on Jarabacoa-La Vega road, 11 May 1982, Harris 15754 (NY); "La Cotorra" along trail to Pico Duarte, 5000 ft, 16 Jan 1987, Harris 20079, 20109 (NY). La Vega/Santiago: Parque Nacional J. Armando Bermudez, along trail along Río Los Guanos near La Ciénaga, 3500-4000 ft, 12 Jan 1987, Harris 19751 (NY). Pedernales: Las Abejas, 55 km N of port of Cabo Rojo on Alcoa road, 3600 ft, 5 May 1982, Harris 15345 (NY).

COLOMBIA: Cundinamarca: Between San José and Lago Pedro Paulo (ca. 32 km from Mosquera, on the Mosquera-La Mesa road), 2000-2250 m,

1 Aug 1976, Dumont CO-5433, CO-5441 (NY); Villeta, 2100 m, 186?, Lindig 840 (H-NYL 20506, H-NYL P.M. 4116), 2696 (H-NYL 20509, H-NYL P.M. 4107, UPS).

VENEZUELA. Aragua: Rancho Grande, Parque Nacional Henri Pittier, 1200 m, Dec 1986, Brako 8507A (NY); La Mora, W of Colonia Tovar, 1200 m, Dec 1986, Brako 8517 (NY); 6.5 km from Colonia Tovar along the La Victoria-Tovar, 6 Apr 1986, Brako 8608, 8612 (NY). Bolivar: Parque Nacional Canaima, on road from Aeropuerto Luepa to Kavanayen, 10 Apr 1985, Brako 8165 (NY). Carabobo: Along the Río San Gián between the top of the electrical plant and 2 km below the plant, 350-550 m, 2 Apr 1966, Steyermark & Steyermark 95589 (NY). Distrito Federal: Caracas, Ernst 143 (G); track from Altamira to La Silla, 1900 m, 13 Jan 1979, Sipman 10690 (B, MERF). Mérida: Road from Estánquez to Canaguá, 2200 m, 13 Dec 1984, Brako 7943 (NY); La Carbonera, 2100-2200 m, 14 Dec 1984, Brako 8111, 8117, 8158 (NY), 2300 m, 22 Jan 1979, Sipman & López-Figueiras 11029 (B, MERF); El Maciegal, near Mérida, 1800-2100 m, 10 Jul 1975, López-Figueiras & R. Terán 9931 (MERF); Mount Zerpa, near La Hechicera, 2000 m, 3 Mar 1978, López-Figueiras & Keogh 15464, 15481, 15498, 15502 (MERF), 28 Dec 1978, López-Figueiras 17289, 17290 (MERF), 4 Dec 1980, López-Figueiras 25003 (MERF). Miranda: El Vulcán, above Baruta, 1200-1400 m, 1 May 1986, Brako 8655, 8657, 8664, 8665B, 8666 (NY), 4 May 1986, Brako 8677 (NY). Nueva Esparta: Isla Margarita, Cerro Matasiete, 11 Apr 1986, Brako 8622, 8628, 8630, 8631A (NY).

ECUADOR. Morona-Santiago: Palora, 900 m, 13 Aug 1982, Aptroot & Hensen 10362 (U). Pichincha: Ca. 18 km NW of San Miguel de Los Bancos, 800m, 27-29 Dec 1983, Harris 17928 (NY).

PERU. San Martín: Tarapoto, NE of Hotel de Turistas, 350 m, 11 Mar 1981, R. Santesson & Thor P70:82 (S), 12 Mar 1981, R. Santesson & Thor P71:15, P71:42 (S). Cuzco: Paucartambo, ca. 3 km S of Pillcopata, 750 m, 28 Mar 1981, R. Santesson et al. P101:29 (S); ca. 11 km S of Pillcopata, 850 m, 28 Mar 1981, R. Santesson et al. P102:22 (S).

BRAZIL. Acre: Along the Rio Iaco, a few km above Sena Madureira, 4 Oct 1980, Nelson 572 (INPA). Mato Grosso: Sierra dos Coroados, 6 km SW of Buritĺ, 600 m, 8 Jul 1980, Kalb 280B (Hb. Kalb); Buritĺ, 19 Jan 1894, Malme, Lich. Regnell. 2268B (S), 20 Jun 1894, Malme, Lich. Regnell. s.n. (S), 21 Jun 1894, Malme, Lich. Regnell. s.n. (S). Minas Gerais: Serra do Caraça, 1200 m, 8 Jul 1978, Kalb & Plöbst 31 (Hb. Kalb), 1500 m, 12 Jul 1978, Kalb & Plöbst 34 (Hb. Kalb); Vila Monte Verde, ca. 30 km E of Camanducaia, 1500 m, 7-11 Sep 1978, Kalb & Plöbst 44 (Hb. Kalb), 2 Jul 1979, Kalb & Plöbst 150 (Hb. Kalb), 1600 m, 2 Jul 1979, Sipman 12959 (B); Fazenda São Mateus E of Camanducaia, 1800 m, 30 Nov 1980, Kalb 315 (Hb. Kalb); Sitio, 1885, Vainio, Lich. Bras. Exs. 719 (BM=2x, TUR-VAIN 22658); Caraça, 1895, Vainio, Lich. Bras. Exs. 1451 (BM, TUR-VAIN 22607, ZT), 1469 (TUR-VAIN 22639). Pará: Serra do Cachimbo, 780 km N of Cuiabá, 430-480 m, 29 Apr 1983, Brako & Dibben 6428 (INPA, NY). Paraná: Reserva Ecológia Sapitanduva between Morretes and Antonina, 100 m, 17-18 Jan 1987, Hatschbach & Brako 8862, 8865, 8892 (NY). Rio de Janeiro: 1878, Glaziou 1938 (G, NY); Itatiáia, 22 Jul 1978, Kalb & Plöbst 53, Lich. Neotropici 341 (M, US); Corcovado, 15 Aug 1892, Malme, Lich. Regnell. 82, 83 (S). Rio Grande do Sul: S of Torres on

the road to Camping Itapeba, 10 m, 9 Jan 1987, Falkenberg 3603 (NY); Pirating near Pelatas, 19 Dec 1892, Malme, Lich. Regnell. 851 (S). Rondônia: 120 km SW of Porto Velho, 20 km NW of Mibrasa, 25 May 1982, McFarland 266 (INPA, NY). Santa Catarina: Serra Rio do Rastro, ca. 12 km W of Bom Jardim da Serra, 1470 m, 27 Sep 1984, Vital & Buck 12361 (NY, SP); between Uribiçi and Capivara Alta on road to Braço do Norte, 1040 m, 12 Jan 1987, Falkenberg 3722 (NY). São Paulo: Campos do Jordão, 1700 m, 25 May 1978, Kalb & Plöbst 20, 22 (Hb. Kalb), 1520 m, 25 Jan 1987, Brako 8933 (NY); Serra de Paranapiacaba, 80 km SW of São Paulo, 700 m, 24 Mar 1978, Kalb & Plöbst 5 (Hb. Kalb); 60 km SW of São Paulo above Juquitiba, 660-800m, 13-14 May 1978, Kalb & Plöbst 18 (Hb. Kalb), 550 m, 27 Apr 1980, Kalb 233 (Hb. Kalb); Serra do Peruibe near Ana Dias, 120 km SW of São Paulo, 50 m, 2 Apr 1978, Kalb & Plöbst 9, 58 (Hb. Kalb); between Taubaté and Ubatubá, 800 m, 18 Jun 1978, Kalb & Plöbst 26 (Hb. Kalb); Serra da Cantareira, ca. 30 km N of São Paulo, 950 m, 5 Aug 1978, Kalb & Hannack 42 (Hb. Kalb); Serra do Garrãozinho, between Moji das Cruzes and Bertioga, 850 m, 30 Jun 1979, Kalb 148 (Hb. Kalb), Sipman 12675, 12721 (B), 29 Mar 1980, Kalb 227 (Hb. Kalb); Ilha da Cananéia, 5 m, 16 Jul 1979, Kalb 166 (Hb. Kalb); 3 km E of Botukatu, 850 m, 11 Nov 1979, Kalb & Plöbst 197 (Hb. Kalb); Serra de Botucatu, Pardinho, 800 m, Kalb & Plöbst 198 (Hb. Kalb); Serra de Boissocanga above Maresias, 30 km W of São Sebastião, 330 m, 18 Feb 1980, Kalb 212 (Hb. Kalb); Morro Grande near Cotia, 850 m, 27 Sep 1980, Kalb 309 (Hb. Kalb); Ilha Comprida, 2 m, 1 Nov 1980, Kalb 313A (Hb. Kalb); Eldorado Paulista, Caverna do Diablo, 200 m, 29 Sep 1984, Vital & Buck 12505 (NY, SP).

UNITED STATES. Florida: Dade Co., Hattie Bauer Hammock,

Everglade Keys, 12 Jul 1915, Small et al. 6235 (NY); Seminole Co., Sanford, Mar 1926, Rapp s.n. (FLAS).

IVORY COAST. Nanane: N'zo (near N'Zérékoré, base of Mt. Nimba), 550 m, 1951, Des Abbayes s.n. (UPS).

KENYA. Coast Prov.: Kwale District, Shima Hills, 350 m, 1-2 Sep 1985, Kalb & Schrögl 13235 (Hb. Kalb).

TANZANIA. Arusha Prov.: Mt. Meru, E slope, road to crater, 2100-2200 m, 7 Jan 1971, R. Santesson 23030 (S).

NEW CALEDONIA. Jun 1886, Savès 21 (M).

Phyllopsora glabella (Nyl.) G. Schneider, Biblioth. Lich. 13: 176. 1979. Lecidea glabella Nyl., Sert. lich. trop. 37. 1891. Type: Cuba. Wright, Lich. Cub. ser. 2, 142 (holotype, H-NYL 20534, no lichen substances; isotype, FH-TUCK 2922).

Phyllopsora microsperma Müll. Arg., Bull. Herb. Boissier 2: 89. 1894. Type: Mexico. Jalisco, 1890, sine coll. [misit] Eckfeldt 190 (holotype, G).

Lecidea subglabella Malme, Ark. Bot. 28A(7): 41. 1936. Phyllopsora subglabella (Malme) G. Schneider, Biblioth. Lich. 13: 179. 1979. Type: Brazil. Mato Grosso: "Guia pr. Cuyabá", 14 May 1894, Malme, Lich. Regnell. 2547 (holotype, S, no lichen substances; isotype, UPS).

Thallus squamulose, squamules round to irregularly lobed, 0.2-0.35 mm diam., convex, adjoined and overlapping, adnate, Pd-. Upper surface glabrous, short fine pale fibrils at the margin. Isidia lacking. Cortex type 1-2, 60 um thick, containing granules.

Prothallus scant, pale to reddish. Lichen substances: none detected.

Apothecia common. Disc convex, golden-brown. Margin slightly raised, darker than the disc. Exciple golden-brown, tinged red in patches, KOH-. Hypothecium golden-brown, KOH-. Hymenium colorless, 50 um. Epihymenium not obvious. Ascospores simple, ovoid, 5.5-6.5 x 2.5-3 um (LENGTH: X=5.92, SD=0.64, L. min. 4.5, L. max. 7.2; WIDTH: X=2.85, SD=0.38, W. min. 2.5, W. max. 3.6; n=25).

Pycnidia common, golden-brown, immersed in the thallus. Pycnospores rod-shaped, straight, 6-9 x 1 um.

Distribution: Mexico, Honduras, Cuba and Brazil.

This species is distinguished by its large thick squamules, small ovoid ascospores and lack of lichen substances. It is closest to P. parvifoliella which differs in having larger ascospores and argopsin.

Specimens examined: MEXICO. San Luis Potosí: Las Palmas, 300 ft, 6 Jun 1890, Pringle s.n. (COLO, FH=3x, UPS, US).

HONDURAS. Olanco: Vicinity of Juticalpa, 380-480 m, 5-16 Mar 1949, Standley 17941 (F).

CUBA. Pinar del Río: San Cristobal, Wright, Lich. Cub. ser. 2, 102 (FH-TUCK 2922).

Phyllopsora halei (Tuck.) Zahlbr., Cat. Lich. Univ. 4: 398. 1926.

Pannaria halei Tuck., Amer. J. Sci. Arts, ser. 2, 25: 424. 1858. Lecidea halei Nyl., Mém. Soc. Sci. Nat. Cherbourg 5: 337. 1857, nom. nud. Lecidea halei (Tuck.) Tuck., Proc. Amer. Acad. Arts Sci. 6: 274. 1866. Type: U.S.A. Louisiana:

1853, Hale 58 (holotype, FH-TUCK 2828, atranorin; isotypes H-NYL 20521, 20522). Fig. 30B.

Phyllopsora pannosa Müll. Arg., Bot. Jahrb. Syst. 20: 265. 1894. Lecidea pannosa (Müll. Arg.) Stiz., Ber. Tätigk. St. Gallischen Naturw. Ges. 1893-94: 246. 1895. Type: Tanzania. [Tanga Prov:] Usambara, "Kwambugu-Hochwälder in D.O. Africa", Holst 1432 (lectotype designated by Swinscow & Krog, 1981, G, atranorin; isolectotype, BM).

Thallus at center more or less crustose, with discrete to ajoined squamules at margin, squamules round to elongate, 0.5-1 mm wide, complanate, adnate. Upper surface in part ecorticate and fibrillose or pubescent, fibrillose at the margin, Pd+ bright yellow. Isidia rare to common (lacking in type of P. halei). Cortex type 2, 25 um thick, containing granules. Prothallus abundant, red. Lichen substances: atranorin.

Apothecia common. Disc plane to convex, golden-brown to dark reddish-brown. Margin slightly raised, darker than the disc. Exciple and hypothecium reddish-brown, KOH-. Hymenium reddish-brown, 45 um tall. Epihymenium not obvious. Ascospores simple, cylindrical to short fusiform, 9-12 x 2.5-3 um (LENGTH: X=10.63, SD=1.38, L. min. 8.1, L. max. 13.5; WIDTH: X=3.06, SD=0.41, W. min. 2.25, W. max. 4.0: n=25).

Pycnidia not seen.

Distribution: Southern North America and Africa.

This species is distinguished by its unusual thallus type. It

has been confused with Crocynia pyxinoides Nyl. which lacks a cortex and has a greenish-black pigmentation in the apothecia and prothallus. Crocynia pyxinoides may also contain norstictic and stictic acid aggregates.

Specimens examined: KENYA. Central Prov.: Nanyuki District, between Naro Moru and Nanyuki, 2050 m, 17-18 Aug 1985, Kalb & Schrögl 13488, 13532, 13540, 13542, 13543 (Hb. Kalb); between Naro Moru and Mt. Kenya, 2300 m, 14 Aug 1985, Kalb & Schrögl 13619 (Hb. Kalb); Nyeri District, Mt. Kenya, 2200 m, Jan 1972, Swinscow K 32/14, K 32/30 (BM). Rift Valley Prov.: Trans Nzoia District, Cherangany Mts, 2500-2700, 22 May 1949, Maas Gessteranus 11489 (NY); Mt. Elgon, 8000 ft, 31 May 1957, Burnett L14 (BM); Elgeyo Marakwet District, forest 2 km N of Kapcherop, 2200 m, Feb 1973, Swinscow 2K 13/1; Sogotio Forest 8 km N of Chebiemit, 2300 m, Feb 1973, Swinscow 2K 10/1, 2K 10/5 (BM). Rift Valley/Central Prov.: Aberdare National Park, Ruhuruini Park gate, 2400 m, 19 Feb 1979, Moberg 4427 (UPS). Western Prov.: Kakamega District, Kakamega Forest, near Yala River, 5-7 km S of Forest Station, 1500-1700 m, 21 Jan 1970, R. Santesson 21837 (UPS).

TANZANIA. Arusha Prov.: Ngurdoto National Park, NW of Lake Longil, 1500 m, 16 Jan 1970, R. Santesson 21329 (UPS=2x).

UGANDA. Ankole District: Kantsyore Island, 8 km E of Kikagati, 4200 ft, 11 Sep 1967, Burnet s.n. (BM).

Phyllopsora intermediella (Nyl.) Zahlbr., Cat. Lich. Univ. 4: 398. 1926. Lecidea intermediella Nyl., Ann. Sci. Nat. Bot., sér. 4, 19: 339. 1863. Psora intermediella (Nyl.) Müll. Arg.,

Flora 71: 528. 1888. Type: Cuba. Oriente: Lomo del Gato, Wright s.n. (holotype, H-NYL 20558; isotypes, as Wright, Lich. Cub. 183, BM=2x, FH-TUCK 2921, G, L=2x, M, UPS, no lichen substances, W). Fig. 31A.

Thallus squamulose, squamules round or elongate-flabellate, 0.1-0.3 mm diam., discrete, adjoined or overlapping, adnate to ascending, complanate to convex, Pd-. Upper surface glabrous, short fibrillose at the margin. Isidia irregular and somewhat flattened or less commonly globose to cylindrical, sometimes swollen at the base and often branched, to 1 mm long, erect. Cortex a thin gelatinous layer, 20 um thick, extending to the lower side of the squamules. Prothallus abundant, reddish. Lichen substances: none detected.

Apothecia common. Disc plane to slightly convex, golden-brown. Margin slightly raised, darker than the disc, with abundant red fibrils. Exciple reddish-brown, KOH-. Hypothecium golden-brown to tinged red, KOH-. Hymenium tan, 50 um tall. Epihymenium not obvious. Ascospores simple, ovoid or fusiform, 7-9 x 2.5-3.5 um (type only).

Pycnidia common, mostly superficial, tan with a darker ostiole. Pycnospores rod-shaped, straight, 12-15 x 1 um.

Distribution: Central America, West Indies and South America.

This species is closest to P. longiuscula from which it differs by its globose or elongate, often swollen isidia, darker margined apothecia and shorter ascospores. It is treated in the broad sense.

The type material of P. intermediella has elongate, flattened isidia and ascospores 7-9 x 2-3 um. Only a few of the specimens cited below are fertile. Buck 24720 differs from type material by having more erect isidia and ascospores 10-15 x 3-4 um. Specimens from the Galapagos Islands, have larger, more regular squamules than other collections, and have isidia that are swollen at the base and conical at the tip, and ascospores from 11-15 x 2.5-3.5 um. Sterile collections from Venezuela are close in thallus morphology to the Galapagos specimens. Other sterile specimens including Brako 8694b, 8696, López-Figueiras 10014 and Ekman s.n., have very long cylindrical, sometimes branched isidia. The isidia on Berry 4566-4570 are very small and crowded. This species has been found growing on bark and rock.

Specimens examined: COSTA RICA. Cartago: Turrialba, 650 m, 21-22 Feb 1986, Berry 4566, 4567, 4568, 4569, 4570 (NY).

CUBA. Oriente: Bayate, 4 Apr 1917, Ekman s.n. (S).

JAMAICA. Trelawny Parish: Cockpit Country, 500 m, 18 Apr 1981, Buck 5883 (NY).

DOMINICAN REPUBLIC. Pedernales: 6 km N of Los Arroyos, 5200 ft, 6 May 1982, Buck 8305 (NY); Las Abejas, S slope of Sierra de Baoruco, ca. 40 km N of Cabo Rojo, 1750 m, 26 Jan 1987, Buck 24720, 24728 (NY).

VENEZUELA. Amazonas: Río Negro, base of Cerro de la Neblina, 140 m, 25-28 Nov 1984, Brako 7531 (NY, VEN), 23 Feb 1984, Buck 11104 (NY, VEN). Mérida: La Carbonera, 2100-2200 m, 17 Dec 1984, Brako 8100, 8123 (NY, MERF), 28 Jun 1978, López-Figueiras 16238 (MERF).

Miranda: Along road from Hoya de la Puerta to San José de los Altos, 1100-1250 m, 9 May 1986, Brako 8694b, 8696 (NY). Tachira: Near Betania, 2400 m, 30 Jul 1975, López-Figueiras 10014 (MERF).

ECUADOR. Galapagos Islands: Santa Cruz Island, vicinity of Academy Bay, 21 Jan-9 Mar 1964, Weber L-40262 (COLO, FH, UPS, US); Floreana Island, trail from Black Beach to Highlands, 25 Apr 1976, Weber & Lanier L-62909 (COLO).

PERU. Loreto: Iquitos, Explorama Lodge, ca. 50 km NE of Iquitos, 100 m, 24 Jan 1981, R. Santesson P9:8 (UPS).

BRAZIL. Pará. Serra do Cachimbo, cataracts on the Rio Curuá, 877 km N of Cuiabá, 350-500 m, 2 May 1983, Brako & Dibben 6614a (INPA, NY). São Paulo: Eldorado Paulista, Caverna do Diablo, ca. 200 m, 29 Sep 1984, Vital & Buck 12497 (NY, SP).

Phyllopsora isidiotyla (Vainio) Riddle, Mycologia 15: 81. 1923.

Lecidea isidiotyla Vainio, Étud. class. lich. Brésil 2: 49. 1890. Type: Brazil. Minas Gerais: Lafayette, 1885, 1000 m Vainio, Lich. Bras. Exs. 222 (holotype, TUR-VAIN 22634, atranorin, zeorin; isotypes, BM=2x, M, UPS, ZT). Fig. 31B.

Thallus squamulose or dominated by isidia, squamules granular to elongate, ca. 0.1 mm wide, Pd-. Upper surface dull to delicately fibrillose. Isidia irregular-shaped, cylindrical. Upper cortex heavily gelatinized, 10 um thick. Prothallus abundant, pale. Lichen substances: atranorin and zeorin.

Apothecia common. Disc concave to slightly convex,

golden-brown. Margin raised, pale with abundant pale projecting fibrils. Exciple golden brown to pale at the margin, KOH- or KOH+ red. Hypothecium golden-brown to red-brown, KOH- or KOH+ red. Hymenium golden-brown, 45 um tall. Epihymenium golden-brown to red-brown. Ascospores ellipsoid to short fusiform, 9-11.5 x 2-3.5 um (LENGTH: X=10.18, SD=1.38, L. min. 7.5, L. max. 12.5; WIDTH: X=2.76, SD=0.57, W. min. 2.0, W. max. 3.5; n=50).

Pycnidia not common, tan to golden brown, superficial. Pycnospores rod-shaped, straight, 11-12 x 1 um.

Distribution: Costa Rica and South America.

This species is distinguished by its granular, isidiate thallus and the abundant pale fibrils on the margin of the apothecia.

Specimens examined: COSTA RICA. Tonduz s.n. (G).

VENEZUELA. Mérida: Páramo de Mariño, near Tovar, 3000 m, 25 Nov 1980, López-Figueiras 24739 (MERF).

BRAZIL. Minas Gerais: Vila Monte Verde, 30 km E of Camanducaia, 1800 m, 7-11 Sep 1978, Kalb & Plöbst 44 (Hb. Kalb). Rio Grande do Sul: Santo Angelo, near cachoeira, 6 Jan 1893, Malme, Lich. Regnell. 861X (S), 10 Jan 1893, Malme, Lich. Regnell. 887B (S), 7 Feb 1893, Malme, Lich. Regnell. 1013 (S); Silveire Martins, 20 Mar 1893, Malme, Lich. Regnell. 1208B (S).

Phyllopsora kalbii Brako, sp. nov.

Squamulis mediocribus convexis proxime adnatis, isidiis globoso-moniliformibus, necnon apotheciis brunneis distincta.

Type: Brazil. Mato Grosso do Sul: Estrada do Pantanal, some km E of Coxim, 270 m, 29 Jun 1980, Kalb 256 (holotype, NY; isotypes, Hb. Kalb, M). Fig. 32A.

Thallus squamulose, squamules round to elongate, 0.1-0.3 mm diam., discrete to adjoined and overlapping, convex, closely adnate, Pd-. Upper surface glabrous, fibrillose at the margin. Isidia globose, elongating by budding. Cortex type 2, 20 um thick. Prothallus thin, pale. Lichen substances: none detected.

Apothecia common. Disc plane to slightly convex, golden-brown to dark brown. Margin slightly raised, darker than the disc. Exciple golden-brown, KOH-. Hypothecium golden-brown, KOH-. Hymenium tan, 40 um tall. Epihymenium not obvious. Ascospores simple or uniseptate, ellipsoid to short fusiform, 7.5-10 x 2.5-3 um (LENGTH: X=8.86, SD=1.33, L. min. 6.5, L. max. 12.0; WIDTH: X=2.94, SD=0.22, W. min. 2.5, W. max. 3.5, n=50).

Pycnidia common, tan, ostiole orange or brown, immersed in the thallus. Pycnospores rod-shaped, straight, 9 x 1 um.

Distribution: Pantropical.

This species is distinguished by its medium-sized, convex, closely adnate squamules, globose-moniliform isidia and brown pigmented apothecia.

Specimens examined: DOMINICAN REPUBLIC. Distrito National: Santo Domingo, Jardín Botánico Nacional "Dr. Rafael M. Moscoso", 19 Mar 1981, Buck 4631, 4634 (NY), Reese 15195 A (NY).

BRAZIL. Mato Grosso: Cuiabá, 2 Dec 1893, Malme, Lich. Regnell. 2056A, Lich. Austroamericani 235a (BM, UPS), 11 Dec 1893, Malme, Lich. Regnell. 2097C (S), 3 Jan 1894, Malme, Lich. Regnell. 2208 (S), 9 Jan 1894, Malme, Lich. Regnell. 2231 (BM, FH, S), 2233C, 2234B (S), 25 May 1894, Malme, Lich. Regnell. s.n. (S); Coxipó, near Cuiabá, 27 Dec 1893, Malme, Lich. Regnell. 2187B, Lich. Austroamericani 235b (BM, S, UPS), 9 Feb 1894, Malme, Lich. Regnell. 2349 (S, UPS), 2349B (S); Serra da Chapada, Buritĺ, 19 Jan 1894, Malme, Lich. Regnell. 2271 (S); Santa Anna de Chapada, 4 Feb 1894, Malme, Lich. Regnell. 2339B (S). Mato Grosso do Sul: Estrada do Pantanal, E of Coxim, 300 m, 29 Jun 1980, Kalb 258 (Hb. Kalb).

KENYA. Central Prov.: Nanyuki District, between Naro Moru and Nanyuki, 2050 m, 17-18 Aug 1985, Kalb & Schrögl 13520, 13551, 13562 (Hb. Kalb).

TANZANIA. Arusha Prov.: Mt. Meru, E slope, 2100-2200 m, 16 Jan 1970, R. Santesson 21525 (UPS). Kilimanjaro Prov.: Mt. Kilimanjaro, W slope, Shima Farm, 1700 m, 12 Jan 1970, R. Santesson 21001A (UPS); E of Lemosho Glades, ca. 2400 m, 13 Jan 1970, R. Santesson 21050 (UPS).

Phyllopsora longiuscula (Nyl.) Zahlbr., Cat. Lich. Univ. 4: 398. 1926. Lecidea longiuscula Nyl., Ann. Sci. Nat. Bot., sér. 4, 19: 339. 1863. Psora longiuscula (Nyl.) Müll. Arg., Flora 65: 483. 1882. Type: Cuba. Oriente: Monte Verde, Wright s.n. (holotype, H-NYL 20537; isotypes, as Lich. Cub. 179, often mixed with or replaced by Squamacidia janeirensis, FH-TUCK

2919, G=2x, H-NYL 20535, L=2x, M, no lichen substances, UPS, W).

Thallus squamulose, squamules round or elongate-flabellate, 0.1-0.3 mm diam., discrete, adjoined or overlapping, adnate to ascending, complanate to convex, Pd-. Upper surface glabrous, short fibrillose at the margin. Isidia flattened, incised and often branched. Cortex a thin gelatinous layer, 20 um thick, extending to the lower side of the squamules. Prothallus abundant, reddish. Lichen substances: none detected.

Apothecia common. Disc plane to slightly convex, golden-brown. Margin slightly raised, paler than the disc, with abundant red fibrils. Exciple tan, KOH-. Hypothecium golden-brown, KOH-. Hymenium tan, 50 um tall. Epihymenium not obvious. Ascospores simple, ovoid or fusiform, 14-18 x 3.0-4.0 um (LENGTH: X=15.87, SD=1.97, L. min. 12.5, L. max. 19; WIDTH: X=3.42, SD=0.50, W. min. 2.7, W. max. 4; n=15).

Pycnidia not seen.

This species is closest to P. intermediella from which it differs by its isidial morphology, pale-margined apothecia and by its longer ascospores. Only the type material and the Wright collection from the Krempelhuber hb. are fertile.

Distribution: Cuba, Puerto Rico and Venezuela.

Specimens examined: CUBA. Oriente: Bayate, 4 Apr 1917, Ekman s.n. (S); Monte Verde, 14 Sep, Wright s.n. (M-KREMPELHUBER). Sine

loc., Wright s.n. (M, UPS).

PUERTO RICO. Indiera Fria, near Maricao, 430-800 m, 19-22 Mar 1915, N. Britton et al. 4509 (NY).

VENEZUELA. Nueva Esparta: Isla Margarita, Cerro Matasiete, 11 Apr 1986, Brako 8631 (NY, VEN), 8632, 8635, 8636, 8637 (NY).

Phyllopsora minor Brako, nom. nov.

Lecidea corallina var. schizophylloides Vainio, J. Bot. 34: 106. 1896. Phyllopsora corallina var. schizophylloides (Vainio) Zahlbr., Cat. Lich. Univ. 4: 397. 1926 (non Phyllopsora schizophylloides (Malme) Schneider = Phyllopsora buettneri var. munda (Malme) Brako). Type: St. Vincent. Richmond Peak, 1000-2000 m, Elliott 261 (lectotype designated by Swinscow & Krog, 1981, TUR-VAIN 22612A, no lichen substances; isolectotype, BM). Fig. 32B.

Thallus squamulose, squamules round to irregular or elongate, lobes 0.1 mm wide, discrete to adjoined and overlapping, complanate to convex, adnate, Pd-. Upper surface glabrous, fibrillose at the margin. Isidia lacking. Cortex type 2, 10 um thick, in part extending to the lower surface. Prothallus abundant, red. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan to golden-brown. Margin plane, dark red to brown. Exciple gold, tinged red in patches, KOH-. Hypothecium gold, KOH-. Hymenium pale gold, 45 um thick. Epihymenium golden-brown. Ascospores simple, short

ellipsoid, 8.5-11 x 2.5-3 um (LENGTH: X=9.72, SD=1.33, L. min. 7.0, L. max. 12.0; WIDTH: X=2.62, SD=0.28, W. min. 2.5, W. max. 3; n=25).

Pycnidia not seen.

Distribution: Costa Rica and St. Vincent.

This species is distinguished by is tiny, elongate and closely adnate squamules, its medium-size ascospores, and the lack of lichen substances. The type specimen includes 2 species. The piece designated "a" is closest to the original description and has been selected by Swinscow and Krog (1981) as the lectotype. It is closest to P. canoumbrina which has smaller squamules and ascospores, and P. confusa which has thicker, ascending squamules. Specimen "b" is P. corallina var. phaeobyssina.

Specimens examined: COSTA RICA. San José: La División, 25 Feb 1986, Berry 4575 (NY).

Phyllopsora parvifolia (Pers.) Müll. Arg., Bull. Herb. Boissier 2 (Appendix 1): 90. 1894. Lecidea parvifolia Pers. in Gaud., Voy. Uran. 192. 1827. Biatora parvifolia (Pers.) Mont., Ann. Sci. Nat. Bot., sér. 2, 4: 92. 1835. Parmelia parvifolia (Pers.) Mont. in Sagra, Hist. fis. Cuba, Bot. 214, tab. 10, fig. 3. 1838. Psora parvifolia (Pers.) Massal., Framm. Lich. 25. 1855. Zeora parvifolia (Pers.) C. Müll., Bot. Zeitung (Regensburg) 15: 386. 1857. Type: Brazil. Rio de Janeiro, Gaudichaud s.n. (holotype, PC; fragment, BG). Fig. 33.

Thallus squamulose to small foliose, squamules elongate, often divided, often densely microphylline-lobulate, lobes 0.5-1.0 mm wide, complanate to convex, adnate to slightly ascending, Pd-. Upper surface glabrous, pubescent and long fibrillose at the margin. Isidia lacking. Cortex type 1, 1-2 or 2, 40-50 um thick. Prothallus abundant, pale to reddish. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan to dark reddish-brown. Margin slightly raised, concolorous with the disc or darker, smooth or with abundant white projecting fibrils. Exciple tan, KOH-. Hypothecium tan, KOH-. Hymenium colorless to tan, 55 um tall. Epihymenium not obvious. Ascospores simple to uniseptate, ovoid, ellipsoid or short fusiform, (7)8-16 x 2.5-5 um.

Pycnidia common, tan, partially immersed in the thallus. Pycnospores rod-shaped, straight, 9 x 1 um.

Distribution: Pantropical.

This species is distinguished by its large, elongate, +/- lobulate squamules lacking in lichen substances. It is closest to P. fendleri which has smaller squamules with short lobes, a brown hypothecium and longer pycnospores. Two varieties are distinguished by different cortex types and by differences in spore dimensions.

Key to the varieties of Phyllopsora parvifolia:

1. Thallus upper cortex type 1-2, greater than 50 um thick; ascospores ovoid

P. parvifolia var. breviuscula

1. Thallus upper cortex type 2, less than 50 um; ascospores ellipsoid to short fusiform

P. parvifolia var. parvifolia

Phyllopsora parvifolia var. parvifolia

Lecidea subbreviuscula Nyl., Sert. lich. trop. 40. 1891. Phyllopsora subbreviuscula (Nyl.) Zahlbr., Cat. Lich. Univ. 4: 401. 1926. Type: Cuba. Wright, Lich. Cub. ser. 2, 120 (holotype, H-NYL 20524; isotype, FH-TUCK 2922).

Lecidea parvifolia var. concrescens Malme, Ark. Bot. 28A(7): 51. 1936. Phyllopsora parvifolia var. concrescens (Malme) Zahlbr., Cat. Lich. Univ. 10: 377. 1939. Type: Brazil. Rio Grande do Sul: Col. Ijuhy near Cruz Alta, 30 Mar 1893, Malme, Lich. Regnell. 1227 (lectotype designated by Swinscow & Krog, 1981, S, no lichen substances; syntype, Malme, Lich. Regnell. 1235, S). Fig. 33.

Phyllopsora weberi Ferraro, Bol. Soc. Argent. Bot. 24: 179. 1985. Type: Argentina. Misiones: Dept. San Ignacio, 8 Dec 1981, Ferraro et al. 2231 (holotype, CTES; isotype, COLO, no lichen substances).

Distribution: Pantropical.

-Variety parvifolia has a type 2 cortex and ellipsoid to short fusiform ascospores, 9.5-12.5 x 2.5-3 um (LENGTH: X=10.89, SD=1.57, L. min. 8.0, L. max. 18.0; WIDTH: X=2.69, SD=0.28, W. min. 2, W. max. 3; N=50). The squamule lobes are thinner than in var. breviuscula. Lobules may completely dominate the thallus.

Specimens examined: MEXICO. Tamaulipas: Las Palmas, Pringle 20 (FH), 6 Jun 1890, Pringle 219 (FH).

COSTA RICA. Puntarenas: Monteverde, 1450 m, 4 Jan 1979, Sipman 12099, 12201 (B).

PANAMA. Panamá: Along trail to Cerro Brewster from Río Pacora valley, 670 m, 18-21 Nov 1985, Brako 8270 (NY).

CUBA. Santiago de Cuba: "Monte Kentucky", ca. 5 km SE of La Gran Piedra, 1000 m, 5 Apr 1982, Harris 14410A (HAC, NY). Without prov.: Wright, Lich. Cub. ser. 2, 105 (UPS).

DOMINICAN REPUBLIC. Independencia: Sierra de Baoruca, 30.5 km S of Puerto Escondito, 1940 m, 25 Jan 1987, Buck 14655 (NY), Harris 20587 (NY); 23.5 km S of Puerto Escondito at intersection of road to Charco Colorado, 1750 m, 24 Jan 1987, Harris 20496 (NY). La Vega: East part of La Cienaga, 6 km W of Monabao, 11 May 1982, Harris 15677 (NY); Arroyo Piedrosa, 1.2 km from Monabao on road to Jarabacoa, 11 May 1982, Harris 15683 (NY); Piedra Blanca, 4 km from Jarabacoa then 5.7 km on road to Piedra Blanca, 12 May 1982, Harris 15774 (NY); Salto de Jimenoa, 7.5 km from Jarabacoa on road to El Río de Constanza from Pueblo Salto de Jimenoa, 12 May 1982, Harris 15861, 15870 (NY); Loma del Puerto, 400 m, 18 Jan 1969, Liogier 15725 (NY).

PUERTO RICO. 3 m E of Santurce, 1899, Heller 448 (NY).

COLOMBIA. Choachi, 2000 m, Lindig 803 (H-NYL P.M. 4112).

VENEZUELA. Aragua: Agua Fria, 17 Apr 1987, Brako 8949 (NY). Bolivar: Parque Nacional Canaima, on road from Aeropuerto Luepa to Kavanayen, 10 Apr 1985, Brako 8168 (NY). Distrito Federal: Caracas, 1887, Ernst 34, 84 (G), 1895, Ernst 188 (G), s.n. (US). Mérida: El

Paramito, near El Morro, 2650 m, 21 Dec 1977, López-Figueiras 14699 (MERF); at the lake of the Páramo de los Granates, 2600-2800 m, 28 Dec 1977, López-Figueiras 15160 (MERF). Miranda: El Vulcán, above Baruta, 1200-1400 m, 1 May 1986, Brako 8656, 8660, 8665 (NY), 4 May 1986, Brako 8692 (NY); along road from Hoya de la Puerta to San José de los Altos, 1100-1250 m, 9 May 1986, Brako 8695 (NY). Trujillo: Hoya del Carruzo, between El Páramo de Tur al and El Páramo de Cendé, 2800-2900 m, 1 Apr 1976, López-Figueiras 13211 (MERF); La Cava, between La Hoya del Carruzo and El Páramo de Cendé, 3000 m, 1 Apr 1976, López-Figueiras 13240 (MERF).

ECUADOR. Morona-Santiago: Pachicutza at "Escuela Fiscomisional Cardinal Döpfner", km 140 on road Loja-Gualaquiza, 900-1000 m, 26-27 Apr 1973, Holm-Nielson et al. 4559D (AAU).

BRAZIL. Bahia: Ca. 10 km N of Rui Barbosa, 400 m, 18 Jul 1980, Kalb s.n. (Hb. Kalb). Goiás: Between Jataí and Estância, 510 m, 11 Jul 1980, Kalb 283B (Hb. Kalb). Mato Grosso: Ca. 35 km SE of Cuiabá, 120 m, 4 Jul 1980, Kalb 273 (Hb. Kalb); Serra dos Coroados, between Cuiabá and Burití, 500 m, 6 Jul 1980, Kalb 276 (Hb. Kalb); Burití, 600 m, 8 Jul 1980, Kalb 280 (Hb. Kalb), 20 Jan 1894, Malme, Lich. Regnell. 2261 (S, UPS); Chapada dos Guimarães, 800 m, 6 Jul 1980, Kalb 277 (Hb. Kalb); 20 km NE of Chapada dos Guimarães, 670 m, 9 Jul 1980, Kalb 281 (Hb. Kalb); 10 km NE of Chapada dos Guimarães, 680 m, 9 Jul 1980, Kalb 282 (Hb. Kalb). Mato Grosso do Sul: Ca. 30 km S of Campo Grande, 550 m, 14 Nov 1979, Kalb 199 (Hb. Kalb). Minas Gerais: Mountain slope above Tiradentes near São João del Rei, 900 m, 6 Jul 1978, Kalb & Plöbst 29 (Hb. Kalb); Serra do Caraça, 8 Jul 1978, 1200

m, Kalb & Plöbst 31 (Hb. Kalb); above Vila Monte Verde, ca. 30 km E of Camanducaia, 1800 m, 3 Jul 1979, Kalb 151 (Hb. Kalb); between Vila Monte Verde and Camanducaia, 1300 m, 28-29 Nov 1980, Kalb 314 (Hb. Kalb); Lafayette, 1885, Vainio, Lich. Bras. Exs. 337 (BM); Lagoa Santa, Warming 133 (M=2x), s.n. (NY, UPS). Pará: Rio Jamanxím, 974-1024 km N of Cuiabá, 300 m, 10-15 May 1983, Brako & Dibben 6990 (INPA, NY). Paraná: Prainhas, near Port de Cima, 100 m, 16 Jan 1987, Hatschbach & Brako 8838, 8850 (NY); Reserva Ecológica Sapitanduva between Morretes and Antonina, 100 m, 17-18 Jan 1987, Hatschbach & Brako 8858, 8861, 8872, 8874, 8882, 8884, 8894, 8895 (NY); near Bateias, W of Curitiba, 19 Jan 1987, Hatschbach & Brako 8910 (NY); Guaíra, 200 m, 9 Aug 1980, Kalb 301 (Hb. Kalb); Foz do Iguaçu, 100-200 m, 22-23 Sep 1984, Vital & Buck 11955 (NY, SP). Rio de Janeiro: Itatiáia, between Registro do Picú and Agulhas Negras, 23 Jul 1979, Kalb 161 (Hb. Kalb); between Paratí and Cunha, 2 Nov 1979, Kalb & Plöbst s.n. (Hb. Kalb); Corcovado, 15 Aug 1892, Malme, Lich. Regnell. 56, 68 (S); Rio de Janeiro, 1885, Vainio, Lich. Bras. Exs. 101 (TUR-VAIN 22610). Rio Grande do Sul: Porto Alegre, 29 Sep 1892, Malme, Lich. Regnell. 503 (S, US), 3 Oct 1892, Malme, Lich. Regnell. 526 (S); Hambergerberg, near São Leopoldo, 18 Oct 1892, Malme, Lich. Regnell. 617B (S); Santo Angelo near cachoeira, 8 Feb 1893, Malme, Lich. Regnell. 1021 (S); Silveira Martins, 28 Feb 1893, Malme, Lich. Regnell. 1092 (S), 8 Feb 1893, Malme 309, Lich. Regnell. 1021A (W); Colonia Ijuhy, 2 Apr 1893, Malme, Lich. Regnell. 1229 (S), 6 Apr 1893, Malme, Lich. Regnell. 1235B (S), Malme 309, Lich. Regnell. 1235 (W); South of Torres, on road to Camping Itapeba, 9 Jan 1987, Falkenberg 3603, 3612 (NY); 10 km E of Tainhas, on road from Terra de

Areia to Tainhas, 850 m, 10 Jan 1987, Falkenberg 3633 (NY); Itaimbezinho, 10 Jan 1987, Falkenberg 3645 (NY), 1100 m, Grüninger 3018 (BG). Santa Catarina: 13 km above Timbé do Sul, on road to Serra da Rochina, 650 m, 11 Jan 1987, Falkenberg 3653, 3657 (NY); between Uribiçi and Capivara Alta on road to Braço do Norte, 1040 m, 12 Jan 1987, Falkenberg 3706, 3720 (NY). São Paulo: São Paulo, 6 Oct 1922, Hoehne s.n. (H); Serra de Paranapiacaba, 40 km SW of São Paulo, 800 m, 19 Mar 1978, Kalb & Plöbst 1 (Hb. Kalb); 80 km SW of São Paulo, on the Rio Juquiá, 700 m, 24 Mar 1978, Kalb & Plöbst 5 (Hb. Kalb); ca. 60 km SW of São Paulo above Juquitiba, 550 m, 14 May 1978, Kalb & Plöbst 29, Lich. Neotropici 293 (COLO, H, M, US); Ilha de São Sebastião, 400 m, 22 Apr 1978, Kalb & Plöbst 12 (Hb. Kalb), 500 m, 22 Apr 1978, Kalb & Plöbst 13 (Hb. Kalb), 400 m, 2 Apr 1979, Kalb & Plöbst 137 (Hb. Kalb), 500 m, 6 Jul 1979, Kalb & Plöbst 157 (Hb. Kalb); Campos do Jordão, Pico de Itapeva, 1850 m, 28 May 1978, Kalb & Plöbst 23 (Hb. Kalb), 14 Oct 1978, Kalb & Plöbst 50 (Hb. Kalb); between Taubaté and Ubatuba, 800 m, 18 Jun 1978, Kalb 26 (Hb. Kalb); Serra de São Lourenço, NW of São Lourenço da Serra, 850 m, 3 Sep 1978, Kalb & Plöbst 45 (Hb. Kalb); above Campos do Jordão, ca. 45 km N of Taubaté, 14 Oct 1978, 1950 m, Kalb & Plöbst 49 (Hb. Kalb); Ilha Comprida, 2 m, 18 Mar 1979, Kalb & Plöbst 136 (Hb. Kalb), 3 m, 15 Jul 1979, Kalb & Plöbst 163 (Hb. Kalb); near Cachoeiras de Emas, ca. 15 km NE of Piraçununga, 550 m, 14 Jun 1979, Kalb & Plöbst 145 (Hb. Kalb); Anhemi District, Fazenda Barrenco Rico, 450 m, 10 Nov 1979, Kalb 192 (Hb. Kalb); 3 km E of Botukatu, 850 m, 11 Nov 1979, Kalb & Plöbst 197 (Hb. Kalb); Serra de Botukatu, Pardinho, 800 m, 11 Nov

1979, Kalb & Plöbst 198 (Hb. Kalb); above Maresias, ca. 30 km W of São Sebastião, 330 m, 18 Feb 1980, Kalb 212 (Hb. Kalb); between Moji das Cruzes and Arujá, 500 m, 20 Apr 1980, Kalb 232 (Hb. Kalb); Fazenda São João near Rio Claro, 600 m, 16 Aug 1980, Kalb 302 (Hb. Kalb); Morro Grande near Cotia, 850 m, 27 Sep 1980, Kalb 309 (Hb. Kalb).

PARAGUAY. Alto Paraná: Centro Forestal Alto Paraná, 4.5 km W of Pto. Pte. Stroessner on Ruta 7, 250 m, 15 Oct 1984, Buck 12361 (NY). Amambay: Parque Nacional Cerra Corá, along trail up Cerro Muralla, 300 m, 19 Oct 1984, Buck 12530 (NY). Central: Asunción, 1878, Balansa 16 (G), 18 Aug 1893, Malme, Lich. Regnell. 1612B (S); Villa Morra, 14 Aug 1893, Malme, Lich. Regnell. s.n. (S). Paraguarí: Parque Nacional Ybycuí, along trail to Mirador, 200 m, 4 Oct 1984, Buck 11769 (NY), along trail to Salto Mbocaruzú on Río Corrientes, ca. 200 m, 6 Oct 1984, Buck 12093 (NY). Guarapi, Apr 1881, Balansa 4201 (BM, G=3x, H-NYL P.M. 4111, L, M, W), 30 Jul 1881, Balansa 4202 (BM, G=3x, M, W). Cerro Curupatiti, Apr 1879, Balansa 4199 (BM, G=2x), 1887, Balansa s.n. (G); 1878-84, Balansa s.n. (G, H-NYL P.M. 4110). Cerro León, 23 Jul 1881, Balansa 4207 (G=2x). Cerro Yaguaron, 1887, Balansa 4150 (G).

ARGENTINA. Chaco: Lero. de Mayo, Colonia Benitez, Reserva del INTA, 16 May 1979, Ferraro et al. 1820 (CTES); Gran Chaco, 15 Sep 1893, Malme s.n. (S). Corrientes: Espedrado, El Sombrerito, Estación Experimental INTA, Costa del Río Paraná, 26 Nov 1978, Ferraro et al. 1410 (BG, CTES); Saladas, Ruta 12, 27 Dec 1983, Ferraro 2830 (CTES); Ituzaingó, Rincón de Santa María, 22 Nov 1977, Neiff s.n. (CTES).

Itapúa: Cantera, 19 Jul 1957, Montes 12042F (NY); Colonia Fram, 25 Jul 1957, Montes 12051F, 12052D (NY). Misiones: Candelaria, Arroyo Yabebiry and Ruta 12, 18 Dec 1981, Ferraro et al. 2316 (CTES); Puerto do Iguazú, 200 m, 31 Aug 1980, Kalb 306 (Hb. Kalb). San Pedro: Rosario, 13 Sep 1893, Malme, Lich. Regnell. s.n. (S); Colonia Risso, 23 Sep 1893, Malme, Lich. Regnell. 1817B (S), 28 Sep 1893, Malme, Lich. Regnell. 1862A (S=3x), 1864C (S), 7 Oct 1893, Malme, Lich. Regnell. 1897A & B (S), 8 Oct 1893, Malme, Lich. Regnell. 1911A (S), 8 Oct 1893, Malme, Lich. Regnell. 1912C (S, UPS); 1882, Spegazzini s.n. (H-NYL 20544, W=2x).

UNITED STATES. Alabama: Mobile Co., Mobile, 1901, Mohr s.n. (US). Florida: Duval Co., Jacksonville, Calkins 433 (NY); Highlands Co., Lake Placid, Archibald Biological Station, 9 Oct 1985, Thor 4516 (S); St. Johns Co., 6 Mile Creek, Calkins 108 (NY), s.n. (S). Hawaii: Hawaii Volcanos National Park, Kipuka Pua'ulu on Mauna Loa strip road, 4000 m, 2 Apr 1983, Weber & Bujakiewicz s.n (COLO). Louisiana: Livingston Parish: Livingston, 26 Sep 1968, Tucker 7637 (LSU); St. Martin Parish: Grand Bois, 15 Jan 1894, Langlois 848 af (US). Texas: Harris Co., Houston, 1872, Hall s.n. (FH-TUCK 2828), 1869, Ravenel 52 (BM, FH-TUCK 2828), s.n. (BUF).

TANZANIA. Tanga Prov.: Usambara, Holst 3330 p.p. (G).

Phyllopsora parvifolia var. breviuscula (Nyl.) Brako, comb. et stat. nov.

Phyllopsora breviuscula (Nyl.) Müll. Arg., Bull. Herb. Boissier 2(Appendix 1): 45. 1894. Lecidea breviuscula Nyl.,

Ann. Sci. Nat. Bot., sér. 4, 19: 339. 1863. Lecidea parvifolia* breviuscula (Nyl.) Nyl., Ann. Sci. Nat. Bot., sér. 5, 7: 321. 1867. Psora breviuscula (Nyl.) Müll. Arg., Flora 65: 483. 1882. Type: Cuba. [Oriente:] Monte Verde, Wright s.n. (holotype, H-NYL 20557, no lichen substances; isotypes as Wright, Lich. Cub. 181, B, BM, G=3x, L=2x, UPS). Figs. 34, 35.

Phyllopsora brachyspora Müll. Arg., Bot. Jahrb. Syst. 20: 264. 1894. Type: Tanzania. "Hochwald ob Kwa Mstufa in Usambara, D.O. Afr.", 1894, Holst 9181 p.p. (holotype, G; isotypes, BM, M, W).

Distribution: Pantropical.

This variety differs from var. parvifolia by its type 1-2 cortex that is over 50 um thick, and by its ovoid ascospores, 7.5-9.5 x 3.5-4 um (LENGTH: X=8.38, SD=0.87, L. min. 7.0, L. max. 10.5; WIDTH: X=3.85, SD=0.39, W. min. 2.7, W. max. 4; n=50). The thicker cortex gives the thallus lobes a convex appearance. The thallus is rarely lobulate. It is closest to P. fendleri which has shorter thallus lobes, a golden-brown hypothecium and longer ascospores. Some specimens of Wright, Lich. Cub. 181 are labeled Lecidea parvifolia var. fuscescens, apparently a herbarium name used by Tuckerman, but never published.

Specimens examined: VENEZUELA. Amazonas: San Carlos, Río Negro, Spruce, Lich. Amaz. And. 142 (G=x3, H-NYL 20526, 20527, PC=2x, W=2x). Distrito Federal: Caracas, Ernst 5 (US), 95, 139, 723 s.n. (G).

BRAZIL. Mato Grosso: Chapada dos Guimarães, 800 m, 6 Jul 1980, Kalb 277 (Hb. Kalb); ca. 20 km NE of Chapada dos Guimarães, 670 m, 9 Sep 1980, Kalb 281 (Hb. Kalb); Santa Anna de Chapada, 2 Mar 1894, Malme, Lich. Regnell. 2585, Lich. Austroamericani 233 (G, H, S, US=2x, W). Minas Gerais: Caldas, Malme, Lich. Regnell. s.n. (COLO, S); 5 km W of Monte Verde, 1400 m, 2 Jul 1979, Sipman 12821 (B); Monte Verde, 1600 m, 2 Jul 1979, Sipman 12909 (B). São Paulo: Itapira, 16 May 1927, Hoehne s.n. (W); Apiahí, Puiggari s.n. (G).

ARGENTINA: Misiones: Iguazú, road to Garganta del Diablo, 2 Mar 1982, Ferraro 2579 (CTES).

UNITED STATES. Alabama: Baldwin Co., Yupon Point, 1 Mar 1925, Evans 202 (NY).

AUSTRALIA. Queensland: Brisbane, 1887, Bailey s.n. (G); Rosewood Margins, Bailey s.n. (B), 13 (G); Toowoomba, Hartman s.n. (FH=2x, FH-TAYLOR 684, G=5x, M, UPS=3x).

Phyllopsora parvifoliella (Nyl.) Müll. Arg., Bull. Soc. Roy. Bot. Belgique 32: 131. 1893. Lecidea parvifoliella Nyl., Ann. Sci. Nat. Bot., sér. 4, 19: 339. 1863. Type: Cuba. Wright, Lich. Cub. 182 (holotype, H-NYL 20545, no lichen substances; isotypes, BM, BUF, trace of argopsin?, FH-TUCK 2919, G=3x, L=2x, M, UPS, W=2x). Fig. 36.

Thallus squamulose, squamules elongate and lobed, lobes 0.1-0.3 mm diam., complanate to slightly convex, mostly discrete, loosely adnate to ascending, Pd-. Upper surface glabrous, slightly pubescent

or fibrillose at the margin. Isidia common, cylindrical. Cortex type 1, 40 um thick. Prothallus abundant, red. Lichen substances: trace argopsin?

Apothecia common. Disc plane to convex, golden-brown to dark red. Margin slightly raised, concolorous or darker than the disc. Exciple and hypothecium red, KOH-. Hymenium colorless, 40 um tall. Epihymenium red. Ascospores simple, ovoid, 5-6.5 x 2-3 um (LENGTH: X=5.63, SD=0.84, L. min. 4.0, L. max. 8.0; WIDTH: X=2.32, SD=0.35, W. min. 1.8, W. max. 3; n=25).

Pycnidia not seen.

Distribution: Central America, West Indies, South America and southern North America.

This species is distinguished by the combination of its medium-size, elongate, isidiate squamules, red apothecial pigment and small ovoid ascospores. Phyllopsora chlorophaea has a similar red pigmentation in the apothecia, but it has smaller squamules, lacks lichen substances, and has larger spores.

Specimens examined: COSTA RICA. 1893, Tonduz s.n. (G).

ST. EUSTATIUS. Vulcano Quill, 450-500 m, 30 Jul 1980, Sipman 14819, 14820 (B), 14833 (B, NY), 14852 (B), 540 m, 6 Aug 1980, Sipman 15069 (B).

VENEZUELA. Amazonas: Río Negro, at base of Cerro de la Neblina, 140 m, 23 Feb 1894, Buck 11118 (NY, VEN); San Carlos, Spruce, Lich. Amaz. And. 221 (BM). Nueva Esparta: Isla Margarita, Cerro Matasiete, 11 Apr 1986, Brako 8624, 8625 (NY).

PERU. Loreto: Iquitos, Explorama Lodge, 100 m, 23 Jan 1981, R. Santesson P7:3 (UPS).

BRAZIL. Amazonas: Rio Uatumã, 8 & 11 Aug 1979, Buck 2737C (INPA, NY). Minas Gerais: 1885, Glaziou s.n. (G). Rondônia: Vicinity of first rapids on the Rio Pacaás Novos, sealevel-2 m, 24-28 Mar 1978, Reese 13570 (INPA, NY).

UNITED STATES. Florida: Lake Co., Lake Norris, 5 Jun 1921, Kelly s.n. (NY, US).

Phyllopsora subcrustacea (Malme) Brako, comb. et stat. nov.

Lecidea corallina Eschw. var. subcrustacea Malme, Ark. Bot. 28A(7): 47. 1936. Phyllopsora corallina var. subcrustacea (Malme) Zahlbr., Cat. Lich. Univ. 10: 377. 1939. Type: Paraguay. Asunción, 18 Aug 1893, Malme, Lich. Regnell. 1612b (holotype, S, no lichen substances; isotype, UPS). Fig. 37A.

Thallus squamulose, squamules granular to elongate, 0.1 mm wide, closely adjoined to form an almost continuous crust, adnate to ascending, Pd-. Upper surface glabrous, slightly fibrillose at the margin. Isidia cylindrical. Cortex type 2, 20 um thick, in part extending over the entire squamule. Prothallus abundant, pale. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan. Margin slightly raised and wavy, bright red, with abundant white projecting fibrils. Exciple tan or tinged red, KOH-. Hypothecium tan, KOH-. Hymenium tan, 40 um tall. Epihymenium colorless. Ascospores simple,

ellipsoid to short fusiform, 11.5-14 x 2.5-3 um (LENGTH: X=12.87, SD=1.3, L. min. 11.0, L. max. 15.3; WIDTH: X=2.73, SD=0.35, W. min. 1.8, W. max. 3,; n=25).

Pycnidia not seen.

Distribution: Paraguay.

This species is only known from type material. It is distinguished by its closely adjoined squamules, its bright red-marginate apothecia and long ascospores.

SUMMARY

This study reassesses the delimitation and relationships of the lichen genus Phyllopsora while providing the first systematic treatment of the neotropical species of the genus.

In the past, Phyllopsora was placed in the Lecideaceae along with most crustose and squamulose lichens with lecideine apothecia and green algae. Recent studies have shown this to be an artificial assemblage of genera. Investigations of ascal structure, apothecial anatomy and chemistry have provided a wealth of characters that are now used to delimit more natural taxa.

Among the modern revisions of the Lecideaceae, Anderson (1964) pioneered with studies of North American species of Lecidea. Hertel and Leuckert (1969) were the first to use a combination of apothecial, chemical and conidial characters to define segregate genera from Lecidea. In addition, Hertel (1967, 1970, 1975, 1977) published valuable studies on European, Asian and Subantarctic

species of Lecidea and related genera, some of which he segregated to new families. Utilizing this new approach, Kilias (1981) monographed the saxicolous species of Catillaria. Schneider (1981) published a preliminary monograph of Psora and Timdal (1984a) studied Hypocenomyce and presented a revised treatment of Psora (Timdal, 1984b). Coppins (1983) published a monograph of the European species of the genus Micarea including detailed chemical studies and reports of anamorphs. Sipman (1983), in his study of the Megalosporaceae, was the first to use detailed chemistry in monographing a group of primarily tropical lecideoid lichens.

Recently, Hafellner (1984) recognized 35 segregate families from the Lecideaceae s. lat. He recognized these families primarily using ascal structure and apothecial anatomy. Using these characters it is clear that Phyllopsora cannot be maintained in the Lecideaceae. Hafellner placed Phyllopsora in its own family the Phyllopsoraceae. More recently, Phyllopsora has been included in the Bacidiaceae (Eriksson & Hawksworth, 1986) based on its squamulose to small foliose thallus form, its apothecia with radiate exciple, true paraphyses and thick-walled asci with an amyloid hemispheric dome containing a narrow conical non-amyloid masse axiale. My studies have confirmed this.

In the current treatment the concept of the genus is refined. Type studies have been made for nearly all described species of Phyllopsora. The species concept is reassessed for the genus. Two or more independent characters are required for separation of taxa at the species level, while the rank of variety is used for taxa which

differ from each other by only one character and which are not fully separated geographically. Prior to this study, 51 taxa were described from the neotropics. Using these criteria, the number has been reduced to nineteen species and nine varieties. Twenty-five names are reduced to synonymy and nine species are reduced to variety status necessitating new combinations. Fifteen species are excluded from the genus. Psorellopsis and Squamacidia are described for four species which could not be placed in previously recognized genera. Keys to the species and varieties are presented.

Phyllopsora is distinguished from other genera by the combined characters of its ascal type, its apothecial type, and by its small, thin-walled, rarely septate ascospores. The genera Bacidia, Biatora, Eschatogonia, Physcidia, Psorellopsis and Squamacidia share characters with Phyllopsora and the relationship of these genera to Phyllopsora is shown in Table 3.

Most species of Phyllopsora have a squamulose to small foliose thallus with an obvious prothallus. Isidia and lobules are common in the genus. A distinct upper cortex is always present. The photobiont, where identified, is Pseudochlorella. The hyphae of the medulla and lower surface are loosely woven. The apothecia are biatorine and uniform in anatomy as described above. Pycnidia are globose and partially immersed in the thallus. The inner wall is lined with irregularly shaped conidiophores that may be branched. The conidia are rod-shaped, straight or bent, 9-16 x 1 um.

Five of the nineteen neotropical species of Phyllopsora have detectable lichen substances. The occurrence and distribution of

substances is shown in Table 2. The only substances of known structure are atranorin, argopsin, pannarin and zeorin. Twelve substances of unknown structure were detected.

Most species of Phyllopsora are corticolous on a broad range of woody angiosperms and are most common in humid, shaded habitats. The altitudinal range of the genus is from sealevel to 3000 m. Phyllopsora has a largely pantropical distribution. There is no clear distribution pattern to the chemical varieties detected in the genus. The widespread distribution of most species in the genus could be an indication of historic, geologically related distribution or recent long distance dispersal.

The data presented provide a Flora Neotropica monograph of Phyllopsora as a contribution to a worldwide monograph of this genus.

APPENDIX I

SYNOPSIS OF OLD WORLD PHYLLOPSORA TAXA

Phyllopsora foliata (Stirton) Zahlbr., Cat. Lich. Univ. 4: 397. 1926. Lecidea foliata Stirton, Trans. Proc. Roy. Soc. Victoria 17: 71. 1881. Psora foliata (Stirton) Müll. Arg., Flora 65: 483. 1882. Type: Australia. Queensland: Brisbane, Bailey 156 (holotype, GLAM; isotype BM, no lichen substances).

Thallus squamulose, squamules irregular, deeply incised, lobes ca. 0.1 mm diam., convex, adjoined and overlapping, adnate, Pd-. Upper surface glabrous to rough with some fine pale fibrils. Isidia lacking. Cortex type 2, 30 um thick. Prothallus web-like, pale. Lichen substances: none detected.

Apothecia common. Disc plane to convex, orange-brown. Margin slightly raised, concolorous with the disc. Exciple golden-brown, KOH-. Hypothecium golden-brown, KOH-. Hymenium tan, 45 um tall. Epihymenium not obvious. Ascospores simple, short fusiform, 8.5-16 x 2.5-3 um.

Pycnidia not seen.

Distribution: Queensland, Australia.

The type collection is in poor condition. This species may be synonymous with P. corallina var. corallina.

Phyllopsora griseocastanea (Vainio) G. Schneider, Biblioth. Lich. 13: 176. 1979. Lecidea griseocastanea Vainio, Ann. Acad. Sci. Fenn., ser. A, 15(6): 144. 1921. Type: Philippines. Luzon: Benguet Prov., Pauai, May 1909,

Merrill 6651 (holotype, TUR-VAIN 22625, no lichen substances detected; isotypes, BM, US).

Thallus squamulose, squamules round to irregular, incised or lobulate, lobes ca. 0.1 mm diam., adjoined and overlapping, convex, adnate, Pd-. Upper surface glabrous, shiny, fibrillose at the margin. Isidia lacking. Cortex type 2, heavily gelatinized, 10 um thick. Prothallus abundant, pale. Lichen substances: none detected.

Apothecia common. Disc plane to convex, golden-brown. Margin plane, concolorous with the disc. Exciple tan, KOH-. Hypothecium golden brown, KOH+ diffusing a brown crystalline solution. Hymenium golden-brown, 35-40 um tall. Epihymenium not obvious. Ascospores simple, short-fusiform, (10)12-15 x 2.5-3 um.

Pycnidia not seen.

Distribution: Known only from the type collection.

This species seems closest to P. furfuracea which differs by its red-tinged exciple and chemistry.

Phyllopsora kiiensis (Vainio) G. Schneider, Biblioth. Lich. 13: 177. 1979. Lecidea kiiensis Vainio, Bot. Mag. (Tokyo) 35: 67. 1921. Type: Japan. Prov. Kii: 30 Dec 1911, Yasuda 268 (holotype, TUR-VAIN 22651, atranorin?, unknown H1).

Thallus squamulose, squamules round to irregular, 0.3-0.5 mm diam., adjoined and overlapping, complanate to slightly convex, adnate. Upper surface glabrous, fibrillose at the margin, Pd-. Cortex type 2, 25 um thick. Isidia common, globose to cylindrical,

laminal and marginal. Prothallus abundant, red. Lichen substances: trace atranorin?, unknown H.

Apothecia common. Disc plane to convex, orange-brown. Margin slightly raised and paler than the disc, with pale projecting fibrils. Exciple tan to tinged red, KOH- or KOH+ scarlet. Hypothecium golden-brown, KOH- or KOH+ scarlet. Hymenium gold, 50 um tall. Epihymenium gold. Ascospores simple, short fusiform 7-11 x 2-3 um.

Pycnidia not seen.

Distribution: Africa, Japan.

This species is closest to P. furfuracea, which also has unknown H, but P. kiiensis has much larger squamules.

Phyllopsora manipurensis (Müll. Arg.) G. Schneider, Biblioth. Lich. 13: 177. 1979. Psora manipurensis Müll. Arg., J. Linn. Soc., Bot. 29: 219. 1892. Type: India (holotype, G, n.v.; isotype, BM).

Thallus squamulose, squamules incised, 0.25 mm diam., complanate to convex, adjoined and overlapping, adnate. Upper surface glabrous, fibrillose at the margin, Pd+ faint yellow. Cortex type 2. Isidia lacking. Prothallus sparse, pale to reddish. Lichen substances: TLC not done due to paucity of material.

Apothecia common. Disc plane to convex, reddish-brown. Margin slightly raised and darker than the disc, with abundant pale projecting fibrils. Exciple reddish-brown, KOH-. Hypothecium pale

golden-brown, KOH-. Hymenium pale, 40 um tall. Epihymenium not obvious. Ascospores ellipsoid, 7-9 x 2.5-3 um.

Pycnidia common, golden-brown, immersed in the thallus. Pycnospores rod-shaped, straight, 9-10 x 1 um.

Distribution: India.

The holotype collection was not found in G. The isotype collection was examined in an early stage of my study, but then had to be returned to the BM as it was requested by another worker. The isotype must be re-examined for comparison of characters not previously studied.

Phyllopsora mauritiana (Tayl.) G. Schneider, Biblioth. Lich. 13: 177. 1979. Lecidea mauritiana Tayl., London J. Bot. 6: 151. 1847. Type: Africa. Mauritius (lectotype designated by Swinscow & Krog, 1981, FH-TAYLOR, no lichen substances; isolectotypes, BM, H-NYL P.M. 4427).

Lecidea compacta Nyl., Ann. Sci. Nat. Bot., sér. 4, 11: 259. 1859. Phyllopsora compacta (Nyl.) G. Schneider, Biblioth. Lich. 13: 175. 1979. Type: Mauritius (holotype, H-NYL 20654).

Thallus squamulose at the margin, more or less crustose at the center, squamules round to irregular, 0.5-1.0 mm diam., complanate, adnate. Upper surface glabrous, fibrillose at the margin, Pd-. Cortex type 1-2, 40 um thick. Prothallus abundant, red. Lichen substances: none detected.

Apothecia common. Disc plane to convex, golden-brown. Margin slightly raised, concolorous or darker than the disc. Exciple tinged red, KOH-. Hypothecium tan, KOH-. Hymenium tan, KOH-, 60 um tall. Epihymenium not obvious. Ascospores simple, short fusiform, 8-10 x 2.5-3 um.

Pycnidia tan, partially immersed in the thallus. Pycnospores rod-shaped, straight, 5-7 x 1 um.

Distribution: Mauritius, Reunion.

The material from Nylander's herbarium bears the unpublished name Lecidea flavorufa, but this name is crossed out and replaced by L. mauritiana. The thallus form approaches L. thaleriza, but P. mauritiana differs in apothecial form and by its smaller pycnospores.

Phyllopsora mediocris Swinscow & Krog, Lichenologist 13: 234. 1981.

Type: Tanzania. Tanga Prov.: Usambara Mountains, Amani, near Forestry House, c. 900 m, 9 Jan 1971, Moberg 1381a-1 (holotype, UPS, no lichen substances reported by Swinscow & Krog, 1981).

Thallus squamulose, squamules irregular and elongate, 0.3-0.5 mm wide, adjoined and overlapping, complanate, loosely adnate to ascending. Upper surface glabrous, fibrillose at the margin. Isidia cylindrical. Cortex type 1-2, 30 um thick. Prothallus abundant, red. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan to reddish-brown. Margin not raised, concolorous with the disc. Exciple tan, KOH-. Hypothecium tan, KOH-. Hymenium colorless, 35 um tall. Epihymenium lacking. Ascospores simple, ellipsoid to short fusiform, 8-12 x

2.5-3 um.

Pycnidia common, orange-brown, immersed in the thallus. Pycnospores rod-shaped, straight, 6-9 x 1 um.

Distribution: Tanzania

Swinscow and Krog (1981) distinguish this species by the moderate sized squamules, absence of isidia, the thick, red prothallus, and the lack of lichen substances. It is known only from the type locality. It differs from P. confusa only in having slightly larger squamules.

Phyllopsora microdactyla (Knight) D. Galloway, New Zealand J. Bot. 21: 196. 1983. Lecidea microdactyla Knight, Trans. & Proc. New Zealand Inst. 12: 375. 1880. Type: New Zealand. Knight s.n. (lectotype designated by Galloway, 1983, BM, no lichen substances).

Psora foliata var. subcorallina Müll. Arg., Flora 65: 483. 1882. Lecidea foliata var. subcorallina (Müll. Arg.) Shirley, Proc. Roy. Soc. Queensland 6: 166. 1889. Phyllopsora foliata var. subcorallina (Müll. Arg.) Zahlbr., Cat. Lich. Univ. 4: 397. 1926. Type: Australia. Queensland: Near Toowoomba, Hartman s.n. (holotype, G, no lichen substances).

Lecidea carpodeti Zahlbr., Akad. Wiss. Wien Math.-Naturwiss. Kl., Denkschr. 104: 308. 1941. Type: New Zealand. Otago: Boyd's Bush near Dunedin, J. S. Thomson (T492) ZA 566 (lectotype designated by Galloway, 1983, BM ex CHR 347017).

Thallus squamulose, squamules granular to irregular and incised, ca. 0.1 mm diam., adjoined and overlapping, convex, adnate to ascending. Upper surface glabrous, fibrillose at the margin, Pd-. Isidia cylindrical. Cortex type 2, 10 um thick, extending to the lower surface of the squamules. Prothallus abundant, pale. Lichen substances: none detected.

Apothecia common. Disc plane to convex, orange-brown. Margin not raised, concolorous with the disc. Exciple tan, KOH-. Hypothecium tan containing granules, KOH-. Hymenium tan, 45 um tall. Epihymenium not obvious. Ascospores simple or uniseptate, ellipsoid to fusiform, (10)16-22 x 2-4 um.

Pycnidia common, orange-brown, ostiole slightly darker, immersed in the thallus. Pycnospores rod-shaped, straight, 10-14 x 1 um.

Distribution: Australia and New Zealand.

This species is distinguished by its squamule form and long spores. Galloway (1983) reported that the ascospores are "biseriate cylindrical-ellipsoid", but I found them to be ellipsoid to fusiform. Phyllopsora microdactyla may be synonymous with P. foliata.

Phyllopsora parvifolia var. javanica (Schaerer) Brako, comb. nov.

Lecidea javanica Schaerer in Moritz, Syst. Verz. 128. 1846. Biatora javanica (Schaerer) Mont. & v.d. Bosch in Jungh., Plant. Jungh. 4: 460. 1855. Psora breviuscula var. javanica (Schaerer) Müll. Arg., Hedwigia 31: 280. 1892.

Phyllopsora breviuscula var. javanica (Schaerer) Zahlbr., Cat. Lich. Univ. 4: 386. 1926. Type: Java. Zollinger 838* (holotype, G, no lichen substances; isotypes, G=3x, H-NYL 20497, PC, ZT).

Thallus squamulose, squamules elongate-incised, 0.1-0.5 mm diam., complanate to convex, adjoined and overlapping, adnate to ascending, Pd-. Upper surface glabrous, margin slightly fibrillose. Isidia cylindrical, abundant, marginal and laminal, in part coralloid. Cortex type 2, 40 um thick. Prothallus pale to reddish. Lichen substances: +/- zeorin.

Apothecia common. Disc plane to soon convex, tan. Margin with abundant pale projecting fibrils. Exciple pale tan, KOH-. Hypothecium pale tan, KOH-. Hymenium colorless, 30 um tall. Epihymenium not obvious. Ascospores simple, short fusiform, 8-10 x 2 um.

Pycnidia not seen.

Distribution: Java.

Known from type material and one other collection, this species has a P. parvifolia-like thallus, but is distinguished by its often coralloid isidia and the occasional occurrence of zeorin.

Phyllopsora parvifolia var. pulvinata Steiner, Bull. Herb. Boissier, sér. 2, 7: 644. 1907. Type: South Africa. Sanatorium, 1000 m, Jan 1900, Junod. 999 (lectotype designated by Swinscow & Krog 1981, W 1907/16022, no lichen substances detected;

isolectotypes, G, B, W1920/799).

Thallus squamulose, squamules round to elongate, 0.1-0.3 mm diam., mostly convex, adnate, Pd-. Upper surface glabrous, fibrillose at the margin. Isidia lacking. Cortex type 2, 25 um thick, often extending to the underside of the squamules. Prothallus thin, pale to reddish. Lichen substances: none detected.

Apothecia common. Disc plane to slightly convex, tan, orange or golden-brown. Margin slightly raised, concolorous, paler than the disc, with fine projecting fibrils. Exciple tan, KOH-. Hypothecium tan to golden-brown, containing crystals which dissolve in KOH. Hymenium tan to golden-brown, 35 um tall. Epihymenium not obvious. Ascospores simple, ellipsoid to short fusiform, 9-13 x 2-3 um.

Pycnidia common, orange-tan, ostiole darker, partially immersed in the thallus. Pycnospores rod-shaped, straight, 9 x 1 um.

Distribution: South Africa.

This variety may be synonymous with P. foliata.

Lecidea phaeoglauca Vainio, Ann. Acad. Sci. Fenn., ser. A, 15(6): 112. 1921. Type: Philippines. Luzon: Bataan Prov., Limay, 31 Dec 1909, Robinson, Bur. Sci. 963 (lectotype designated by Swinscow & Krog, 1981, TUR-VAIN 22617; syntype: Philippines. Balabac Island, Mar-Apr 1906, Mangubat, Bur. Sci. 527, TUR-VAIN 22616, no lichen substances detected; isosyntypes, BM, US).

Thallus squamulose, squamules round to irregular or elongate,

lobes 0.2-0.3 mm wide, discrete to adjoined and overlapping, mostly complanate, loosely adnate, Pd-. Upper surface glabrous, fibrillose at the margin. Isidia cylindrical, marginal. Cortex type 2, 20 um thick. Prothallus abundant, red. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan to golden-brown. Margin not raised, dark red to brown, with abundant projecting fibrils. Exciple gold, tinged red in patches, KOH-. Hypothecium tan, KOH-. Hymenium tan, 35 um thick. Epihymenium not obvious. Ascospores simple, ellipsoid, 9-10 x 2-3 um.

Pycnidia not seen.

Distribution: Philippine Islands.

This species is known only from type material and may prove to be synonymous with P. corallina.

Phyllopsora rosei Coppins & James, Lichenologist 11: 166. 1979.

Type: Great Britain. V.C. 48., Merioneth: Dolgellau, Apr 1960, James s.n. (holotype, BM, atranorin, argopsin). Fig. 37B, 38.

Thallus leprose to squamulose, individual elements spherical to irregular, 0.1-0.3 mm diam., adnate. Upper surface dull, margin with fine pale projecting fibrils, Pd+ orange. Isidia lacking. Cortex type 1, 5 um thick. Prothallus web-like, pale. Lichen substances: atranorin and argopsin.

Apothecia common. Disc plane to convex, tan to golden-brown. Margin not raised, concolorous with the disc. Exciple tan, KOH-. Hypothecium tan, KOH-. Hymenium tan, 35 um tall. Epihymenium

golden-brown. Ascospores simple to biseptate, ellipsoid to fusiform, 7-15 x 2-6 um.

Pycnidia not seen.

Distribution: British Isles and France.

This species is distinguished by its leprose-squamulose thallus, the presence of argopsin and its variable ascospores. Phyllopsora rosei is a temperate species which differs from other Phyllopsora species in its apothecial morphology, and its tendency to form variable, multiseptate ascospores. These characters make its placement in Phyllopsora uncertain.

Phyllopsora societatis (Vainio) Zahlbr., Cat. Lich. Univ. 4: 401. 1926. Lecidea societatis Vain., Univ. Calif. Publ. Bot. 12(1): 10. 1924. Type: Tahiti. Papehue River, 7 Jun 1922, Setchell & Parks 5349 (holotype, TUR-VAIN 22614, fatty acids reported by Swinscow & Krog, 1981; isotypes, BM, FH, NY, US).

Lecidea purpurescens Vainio, Univ. Calif. Publ. Bot. 12(1): 10. 1924. Phyllopsora purpurescens (Vainio) Zahlbr., Lich. Cat. Univ. 4: 401. 1926. Type: Tahiti. Punaruu Valley, 19 Jun 1922, Setchell & Parks 5380 p.p. (holotype, TUR-VAIN 22618 - fatty acids reported by Swinscow & Krog, 1981; isotypes, BM, FH, NY, US).

Thallus squamulose, squamules round to elongate, 0.1-0.3 um wide, discrete to overlapping, complanate, adnate. Upper surface glabrous, fibrillose at the margin, Pd-. Isidia cylindrical. Cortex

type 1-2, 20 um thick. Prothallus abundant, pale to red. Lichen substances: none detected.

Apothecia common. Disc orange-brown, plane to convex. Margin slightly raised and paler than the disc. Exciple golden-brown, pale at the margin, KOH-. Hypothecium golden-brown, KOH-. Hymenium tan, 60 um tall. Epihymenium not obvious. Ascospores simple, ellipsoid to short fusiform, 6-10 x 2-3 um.

Pycnidia common, orange-brown to dark brown, ostiole darker, partly immersed in the thallus. Pycnospores rod-shaped, slightly bent, 11-17 x 1 um.

Distribution: Tahiti.

Lecidea societatis is only known from type material. It is similar to P. corallina var. corallina but the apothecia of L. societatis have a pale exciple and the pycnospores are longer and bent.

EXCLUDED SPECIES

The following taxa, previously assigned to Phyllopsora, do not belong to the genus as currently delimited and can be placed in other genera:

Lecidea aleuroides Stirton, J. Linn. Soc., Bot. 14: 469. 1875.

Phyllopsora aleuroides (Stirton) Müll. Arg., Bull. Herb. Boissier 2(Appendix 1): 45. 1894. Type. New Zealand. Near Wellington, Buchanan s.n. (lectotype designated by Galloway,

1983, GLAM; isolectotypes, BM, WELT).

=**Psoromidium aleuroides** (Stirton) D. Galloway.

Lecidea congregans Zahlbr., Akad. Wiss. Wien, Math.-Naturwiss. Kl., Denkschr. 104: 305. 1941. Phyllopsora congregans (Zahlbr.) D. Galloway, New Zealand J. Bot. 21: 196. 1983. Type: New Zealand. Otago, Mt. Cargill near Dunedin, 400 m, May 1935, J.S. Thomson A96 (lectotype designated by Swinscow & Krog, 1981, W3424).

=**Trapeliopsis congregans** (Zahlbr.) Brako, comb. nov.

Lecidea coroniformis Krempelh., Verh. Zool.-Bot. Ges. Wien 18: 327. 1868. Phyllopsora coroniformis (Krempelh.) Zahlbr. in Engler & Prantl, Nat. Pflanzenfam. 1(1*): 139. 1905. Biatora coroniformis (Krempelh.) Jatta, Flora Ital. Cryptog. 3: 520. 1911. Type. United States. Texas: ex. hb. Endlicher (holotype, M).

=**Psora crenata** (Tayl.) Reinke

Phyllopsora cryptocarpa Riddle, Mycologia 15: 80. 1923. Type: Cuba. Isle of Pines: San Juan, 15,17 Mar 1916, Britton et al. 15588 (holotype, FH; isotypes, FH, NY).

=**Fellhanera cryptocarpa** (Riddle) Brako, comb. nov.

Phyllopsora leprosa W. Riedl, Österr. Bot. Z. 121: 145. 1973.

Type: Surinam. 1827, Weigel s.n. (holotype, W).

=**Crocynia gossypina** (Sw.) Massal.

Phyllopsora melanocarpa Müll. Arg., Hedwigia 34: 28. 1895. Type: Australia. Victoria, Wilson 150 (holotype, G; isotype, W).

=**Neophyllis pachyphylla** (Müll. Arg.) G. Schneider

Phyllopsora subcorallina Zahlbr., Ann. Mycol. 33: 43. 1935. Type: U.S.A. Florida: Sanford, Mar 1928, Rapp 70 (lectotype here designated, W; syntype, Rapp 69, FH).

=**Kiliasia subcorallina** (Zahlbr.) Brako, comb. nov.

Phyllopsora subfilamentosa Zahlbr., Ann. Mycol. 33: 44. 1935. Type: U.S.A. Florida: Sanford, Rapp 62 (holotype, W).

=**Fuscidea subfilamentosa** (Zahlbr.) Brako

Psoromidium wellingtonii Stirton, Proc. Phil. Soc. Glasgow 10: 304. 1877. Phyllopsora wellingtonii (Stirton) Müll. Arg., Bull. Herb. Boissier 2(Appendix 1): 45. 1894. Type: New Zealand. Near Wellington, J. Buchanan s.n. (lectotype designated by D. Galloway, 1983, BM).

=**Psoromidium aleuroides** (Stirton) D. Galloway.

NOMINA DUBIA

Phyllopsora byssiseda (Nyl. ex Hue) Zahlbr., Cat. Lich. Univ. 4: 396. 1926. Lecidea byssiseda Nyl., Flora 41: 380. 1859, nom. nud.

Lecidea byssiseda Nyl. ex Hue, Nouv. Arch. Mus. Hist. Nat., Paris, sér. 3, 3: 103. 1891. Type: Mexico. Müller s.n. (holotype, H-NYL 20517).

The type collection is sterile and in poor condition.

Phyllopsora parvifolia var. fibrillifera (Nyl.) Müll. Arg., Bull. Soc. Roy. Bot. Belgique 32: 131. 1893, Bull. Herb. Boissier 2(Appendix 1): 45. 1894. Lecidea parvifolia var. fibrillifera Nyl., Ann. Sci. Nat. Bot., sér. 4, 15: 47. 1861. Psora parvifolia var. fibrillifera (Nyl.) Müll. Arg., J. Bot. (Morot) 7: 55. 1893. Type: New Caledonia. Vieillard 1790 (holotype, H-NYL 20528).

The type is only a small fragment, which cannot be identified.

Phyllopsora parvifolia var. granulosa (Müll. Arg.) Müll. Arg., Bot. Jahrb. Syst. 20: 264. 1894. Psora parvifolia var. granulosa Müll. Arg., Flora 65: 327. 1882. Lecidea parvifolia var. granulosa (Müll. Arg.) Shirley, Proc. Roy. Soc. Queensland 6: 166. 1889. Type: Java. Junghuhn s.n. (holotype, G; isotype, L).

The type material is in poor condition and cannot be identified.

Phyllopsora parvifolia var. hirtella B. de Lesd., Rev. Bryol. Lichénol. 7: 60. 1934. Type: Cuba. Armenia: 700 m, Hioram s.n. (lectotype HAC, designated by Vězda, 1969, in hb.; frag. NY).

I have only seen the NY fragment which is sterile and cannot be identified.

Phyllopsora subhyalina (Stirton) Zahlbr., Cat. Lich. Univ. 4: 401. 1926. Lecidea subhyalina Stirton, Trans. Proc. Roy. Soc. Victoria 17: 77. 1881. Type: Australia. Victoria: Gippsland, Waterloo, Stirton 8662 (holotype, BM).

The type collection is a small fragment, too scrappy for full description. The apothecia are highly gelatinized, but not typical of Phyllopsora. The ascospores are simple and ovate, 13-15 x 7-9 um.

Phyllopsora subparvifolia var. dactyligera Müll. Arg., Hedwigia 34: 141. 1895. Type: Venezuela. Distrito. Federal: Caracas, Ernst 43 (holotype, G).

The type is squamulose with coralloid isidia to 1 mm long, lacking lichen substances and sterile.

Phyllopsora viridis Paulson, J. Siam Soc. (Nat. Hist.) 8: 101. 1930. Type: Thailand. Kaw Tao, 22 Sep 1918, ca. 100 m, Paulson 29 (holotype, BM).

The type is a small scrap on rock and is too small for full study.

TYPES NOT SEEN

Type material for the following taxa were requested from, but not located in the herbaria listed in the methods section. Type material may exist in other herbaria and will be searched for during

preparation of a worldwide study of the genus.

Phyllopsora foliata var. atrovirens (Knight) Zahlbr., Cat. Lich. Univ. 4: 397. 1926. Lecidea foliata var. atrovirens Knight in Shirley, Proc. Roy. Soc. Queensland 6: 166. 1889. Type: Australia. Queensland: Fassifern & Milora.

Lecidea furfuracea var. biatorina Vainio, Ann. Acad. Sci. Fenn., ser. A, 6(7): 127. 1915. Type: West Indies. Guadeloupe, Duss 1498.

Lecidea glaucoprasina Spreng., Mant. prim. fl. hal. 57. 1807. Phyllopsora glaucoprasina (Spreng.) Schneider, Biblioth. Lich. 13: 176. 1979. Type: not mentioned in protologue.

Phyllopsora parvifolia var. coralloides (Mont.) Zahlbr., Cat. Lich. Univ. 4: 399. 1926. Parmelia parvifolia var. coralloides Mont. in Gay, Fl. chil. 8: 145. 1852. Type: not mentioned in protologue.

TAXA OF UNCERTAIN PLACEMENT:

The following taxa, which also must be excluded from Phyllopsora, do not belong to any currently recognized genera. When sufficient material of these taxa has been examined, they will be described as new genera.

Psorellopsis Brako, gen. nov.

A Phyllopsora excipuli et hypothecii textura, paraphysibus tenuioribus necnon ascosporis filiformibus septatis diversum; a Bacidia apotheciorum anatomia et ascosporarum muris tenuioribus diversum.

Type species: Psorellopsis pertexta (Nyl.) Brako

Thallus squamulose, squamules granular to irregular, 0.1-.5 mm diam., convex. Upper surface glabrous, fibrillose at the margin. Isidia lacking. Upper cortex 10-40 um thick, consisting of anticlinally oriented, thick walled-hyphae with round to narrowly cylindrical lumina. Photobiont layer continuous, photobiont green, unicellular, 10-15 um diam. Medulla poorly developed, composed of loosely woven and non-amyloid hyphae. Lower cortex absent. Prothallus web-like to abundant, pale to red. Lichen substances: none detected.

Apothecia to 1.5 mm diam., simple or aggregated, attached laminally to the squamules or developed directly from the prothallus. Disc plane to convex, tan to dark reddish-brown. Margin generally raised, concolorous with the disc or darker red. Exciple

cup-shaped, composed of radiating hyphae, pale to red, KOH- or KOH+ yellow, containing small crystals which dissolve in KOH. Hypothecium cellular, pale to red, KOH-, containing crystals and oil droplets. Hymenium 40-50 um tall, amyloid. Epihymenium indistinct or a thin gelatinous layer with some pigmentation, KOH-. Paraphyses cellular, straight, sparingly branched and anastomosing, apical cell slightly swollen, length to width ratio 12:1. Asci elongate-clavate, +/- or a well developed tholus and lightened, narrow, conical masse axiale (type "C" of Hafellner, 1984). Ascospores eight in the ascus, uni- to multiseptate, colorless, filiform, smooth-walled (16)20-40 x 1.5-3 um.

Pycnidia spherical, partially immersed in the thallus, tan, ostiole brown pigmented. Conidiophores lining the pycnidial cavity. Pycnospores rod-shaped, bent, 10-15 x 1 um.

Distribution: Pantropical.

This group of species, formerly placed in Psorella, is distinguished by its squamulose thallus, obvious prothallus, characteristic apothecial anatomy, and long filiform, thin-walled ascospores. It differs from Phyllopsora by the different texture in the exciple and hypothecium, its thinner paraphyses and its long, septate, filiform ascospores. The apothecial anatomy and and thinner walled ascospores distinguish this genus from Bacidia. The asci need more detailed study as there appears to be much variation in development of the tholus and masse axiale.

Key to the species of Psorellopsis

1. Squamules elongate, lobes 0.1-0.5 mm broad, ascending at the margin; upper cortex type 1-2, 35 um thick P. microphyllina

1. Squamules round to irregular, ca. 0.1 mm broad, closely adnate; upper cortex type 2, 10 um thick

   2. Exciple golden-brown, containing small granular crystals; hypothecium containing oil droplets P. cognata

   2. Exciple commonly tinged red, lacking granules; hypothecium lacking oil droplets P. pertexta

Psorellopsis cognata (Nyl.) Brako, comb. nov.

Lecidea cognata Nyl., Ann. Sci. Nat. Bot., sér. 4, 19: 347. 1863. Thalloidima cognatum (Nyl.) Müll. Arg., Rev. Mycol. 10: 60. 1888. Patellaria cognata (Nyl.) Müll. Arg., Hedwigia 34: 150. 1895. Psorella cognata (Nyl.) Zahlbr., Cat. Lich. Univ. 4: 402. 1926. Type: Cuba. Wright, Lich. Cub 218 (lectotype here designated, FH-TUCK 3019, isolectotypes, BM=2x, BUF, FH-TUCK 3019, F, G=2x, L=2x). Figs. 45A, 46.

Thallus squamulose, squamules granular to irregular, ca. 0.1 mm diam., convex, discrete to adjoined, adnate. Upper surface glabrous, fibrillose at the margin, Pd-. Isidia lacking. Cortex type 2, 10 um thick. Prothallus web-like, pale to reddish. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan to orange-brown.

Margin raised, concolorous with the disc. Exciple pale golden browr, containing small granular crystals and oil droplets, KOH+ yellow. Hypothecium golden brown, KOH+ yellow. Hymenium pale, 45 um thick. Epihymenium not obvious. Ascospores uniseptate, filiform, 20-35 x 1.5-2 um.

Pycnidia not seen

Distribution: Cuba.

This species is distinguished by its small, closely adnate squamules containing small granular crystals and abundant oil droplets in the hypothecium.

Specimens examined: CUBA. Oriente: Monte Verde, 23 May, Wright, Lich. Cub. 217 (BM=2x, FH-TUCK 3019, G, L, UPS).

Psorellopsis microphyllina (Tuck. ex Nyl.) Brako, comb. nov.

Lecidea microphyllina Tuck. ex Nyl., Ann. Sci. Nat. Bot., sér. 4, 19: 347. 1863. Psorella microphyllina (Tuck. ex Nyl.) Zahlbr., Cat. Lich. Univ. 4: 403. 1926. Phyllopsora microphyllina (Tuck. ex Nyl.) Swinscow & Krog, Lichenologist 13: 243. 1981. Type: Cuba. Wright s.n. (holotype, H-NYL 17345a).

Thallus squamulose, squamules flabellate to irregular, 0.1-0.5 mm diam., complanate to convex, discrete to adjoined and overlapping, adnate to ascending at the margin. Upper surface glabrous,

fibrillose at the margin, Pd-. Isidia lacking. Cortex type 1-2, 35 um thick. Prothallus web-like to abundant, pale to red. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan. Margin raised, tan. Exciple tan, KOH-. Hypothecium tan, KOH-. Hymenium colorless, 50 um thick. Epihymenium not obvious. Ascospores uni- to multi-septate, filiform, 25-40 x 1.5-2 um.

Pycnidia not seen.

Distribution: Cuba, Brazil and Argentina.

This species is distinguished by its elongate, ascending squamules and thick cortex.

Specimens examined: CUBA. Oriente: Monte Verde, 31 Mar, Wright, Lich. Cub. 211 (BM=2x, BUF, FH, FH-TUCK 3018, G=3x, L=2x).

BRAZIL. Roraima: Ca. 204 km N of Boa Vista, on the Boa Vista-Santa Elena, Venezuela road, 29 Nov 1977, Dumont et al. 715 (INPA, NY).

ARGENTINA. Corrientes: Ituzaingó, Rincón Santa María, 22 Nov 1977, Nieff s.n. (CTES).

Psorellopsis pertexta (Nyl.) Brako, comb. nov.

Lecidea pertexta Nyl., Ann. Sci. Nat. Bot., sér. 4, 19: 347. 1863. Thalloidima pertextum (Nyl.) Müll. Arg., Rev. Mycol. 10: 60. 1888. Psorella pertexta (Nyl.) Müll. Arg., Bot. Jahrb. Syst. 23: 297. 1896. Phyllopsora pertexta (Nyl.) Swinscow &

Krog, Lichenologist 13: 244. 1981. Type: Cuba. Wright s.n. holotype, H-NYL 17344, no lichen substances reported by Swinscow & Krog, 1981). Fig. 47.

Lecidea microphyllina var. subgranulosa Tuck., Proc. Amer. Acad. Arts Sci. 6: 278. 1866. Biatora subgranulosa (Tuck.) Tuck., Synops. N. Amer. Lich. 2: 40. 1888. Bacidia subgranulosa (Tuck.) Riddle, Mycologia 4: 131. 1912. Type: Cuba. Wright, Lich. Cub. 214. (lectotype here designated, FH-TUCK 3019; isolectotypes, BM=2x, BUF, FH, G=2x, L=2x, UPS).

Bacidia hiorami B. de Lesd., Bull. Soc. Bot. France 83: 6. 1936. Type: Cuba. Oriente: La Victoria, 800 m, Hioram s.n. (lectotype, HAC, designated by Vezda, 1969, in hb.; frag. NY).

Thallus squamulose, squamules granular to irregular, ca. 0.1 mm diam., convex, discrete to adjoined, adnate. Upper surface glabrous, fibrillose at the margin, Pd-. Isidia lacking. Cortex type 2, 10 um thick. Prothallus web-like to abundant, pale to red. Lichen substances: none detected.

Apothecia common. Disc plane to convex, tan to reddish-brown. Margin raised, tinged red. Exciple tan to tinged red, KOH-. Hypothecium tan to tinged red, KOH-. Hymenium pale, 50 um thick. Epihymenium not obvious. Ascus type C. Ascospores uni- to multi-septate filiform, 20-40 x 1.5-2 um.

Pycnidia common, tan, ostiole dark red, partially immersed in the thallus. Pycnospores rod-shaped, bent, 10-15 x 1 um.

Distribution: West Indies, South America and Samoa

This species is distinguished by its small closely, adnate squamules, its commonly red tinged exciple lacking granules and hymenium without oil droplets. Chiodecton fuscocinctum Vainio may be synonymous with this species, but the type is sterile.

Specimens examined: CUBA. Oriente: Sierra Nipe, near Woodfield, 400-550 m, Dec 1909, Shafer 3359 (NY). Santiago de Cuba: La Gran Piedra, ca. 1 km W of peak, 1000 m, 6 Apr 1982, Harris 14514 (NY), NE slope, 1100 m, 7 Apr 1982, Harris 14632 (NY). Without prov.: La Prenda, Jul 1922, Hioram 6139 (NY); Wright, Lich. Cub. 215 (BM=2x, BUF, FH, FH-TUCK 3019=2x, G=2x, L=2x, UPS), 216 (BM, BUF, FH, FH-TUCK 3019=2x, G=2x, L, UPS).

JAMAICA. St. Andrew Parish: Hardwar Gap, along "Shelter Trail", 4000 ft, 12 Apr 1981, Buck 5697 (NY). Sine loc., Feb-Mar 1905, Cummings 118 (NY).

PUERTO RICO. Caribbean National Forest, Luquillo Division, along trail up Mt. Britton, 941 m, 24 Feb 1981, Buck 3516 (NY).

VENEZUELA. Amazonas: Río Negro, Cerro de la Neblina, along the Río Mawarinuma, just outside Cañon Grande, 140 m, Feb-Mar 1984, Buck 10969 (NY, VEN), 12 Mar 1984, Buck 11522 (NY, VEN).

FRENCH GUIANA. Sine loc., Leprieur 505 (PC-MONTAGNE).

BRAZIL. Amazonas: Along the Río Negro, 100 and 200 km from Manaus, 40 m, 14-18 Oct 1980, Kalb 310 (Hb. Kalb). Bahia: Serra das Mangabeiras, ca. 30 km from Seabra, 1000 m, 17 Jul 1980, Kalb 164

(Hb. Kalb). Pará: Serra do Cachimbo, 774 km N of Cuiabá, ca. 400 m, 22 Apr 1983, Brako & Dibben 5555 (INPA, NY); Base Aérea do Cachimbo, ca. 20 km N of the border with Mato Grosso, 430-480 m, 30 Apr 1983, Brako & Dibben 6451 (INPA, NY); cataracts on the Rio Curuá, 877 km N of Cuiabá, ca. 350-500 m, 2 May 1983, Brako & Dibben 6507; at the mouth of the Amazon River, Belém, 10 m, 19-20 Oct 1980, Kalb 311 (Hb. Kalb). São Paulo: Serra do Peruibe near Ana Dias, 50 m, 2 Apr 1978, Kalb & Plöbst 9 (Hb. Kalb); Ilha Comprida, 3 m, 15 Jul 1979, Kalb 163 (Hb. Kalb), 2 m, 1 Nov 1980, Kalb s.n. (Hb. Kalb).

SAMOA. Manua, Dec 1894, Reinecke 58 p.p. (G). Ins. Samoa, 1895, Reinecke s.n. (G).

Squamacidia Brako, gen. nov.

A Phyllopsora acidis lobarico et fumarprotocetrarico, excipulo crasso pallido granula refractiles continenti, necnon ascosporis elongatis fusiformibus septatis diversum.

Type species: Squamacidia janeirensis (Müll. Arg.) Brako.

Thallus squamulose, squamules elongate and incised, 0.3-0.5 mm diam., convex. Upper surface glabrous, fibrillose at the margin. Isidia cylindrical. Upper cortex type 1, 60 um thick. Photobiont layer continuous, photobiont green, unicellular, 10-15 um diam. Medulla poorly developed, composed of loosely woven and non-amyloid hyphae. Lower cortex absent. Prothallus abundant, pale. Lichen substances: lobaric acid, +/- fumarprotocetraric acid and pigments.

Apothecia to 1.5 mm diam., simple or aggregated, attached laminally to the squamules. Disc plane to convex, tan to dark reddish-brown. Margin generally raised, paler than the disc. Exciple cup-shaped, composed of hyphae with broad lumina at the margin, containing refractile granules, KOH-. Hypothecium tan, KOH-. Hymenium tan, 80 um tall, amyloid. Epihymenium not obvious. Paraphyses cellular, straight, sparingly branched and anastomosing, apical cell slightly swollen. Asci elongate-clavate, with a well developed tholus and lightened, narrow, conical masse axiale (type "C" of Hafellner, 1984). Ascospores eight in the ascus, uni- to multiseptate, colorless, fusiform, smooth-walled, 24-40 x 2-2.5 um.

Pycnidia not seen.

Distribution: Pantropical.

This monotypic genus is distinguished by its squamulose thallus, obvious prothallus, distinctive chemistry, characteristic apothecial arrangement, and long fusiform ascospores. It differs from Phyllopsora by its chemistry, its thick pale exciple containing refractile granules, and by its septate, long fusiform ascospores

Squamacidia janierensis (Müll. Arg.) Brako, comb. nov.

Thalloidima janeirensis Müll. Arg., Hedwigia 31: 280. 1892. Psorella janeirensis (Müll. Arg.) Zahlbr., Cat. Lich. Univ. 4: 402. 1926. Phyllopsora janeirensis (Müll. Arg.) Swinscow & Krog, Lichenologist 3: 242. 1981. Type: Brazil. Rio de

Janeiro: Portella s.n. (holotype, BM, fumarprotocetraric acid, lobaric acid; isotype, G).

Phyllopsora stenospora Zahlbr., Repert. Spec. Nov. Regni Veg. 33: 44. 1933. Type: Taiwan. Mt. Arisan, Toroyen, Asahina 170 (holotype, W, lobaric acid; isotype, NY).

Thallus squamulose, squamules incised, 0.3-0.5 mm diam., complanate, adjoined and overlapping, adnate to ascending. Upper surface glabrous, fibrillose at the margin, Pd+ orange. Cortex type 1, 60 um thick. Isidia cylindrical to coralloid. Prothallus abundant, pale. Lichen substances: Lobaric acid, +/- fumarprotocetraric acid and pigments.

Apothecia common. Disc plane, orange-brown to brown. Margin raised, paler than the disc. Exciple pale tan, containing refractile granules, KOH-. Hypothecium pale tan, KOH-. Hymenium tan, 80 um tall. Epihymenium not obvious. Ascospores simple to once septate, fusiform, 24-40 x 2-2.5 um.

Pycnidia not seen.

Distribution: West Indies, South America, Taiwan and the Philippine Islands.

Specimens examined: JAMAICA. 21 Mar 1905, Cummings 48 (FH=2x, NY); 1885, Hart s.n. (FH-TUCK 3018), Hart 32D (NY).

VENEZUELA. Bolivar: Parque Nacional Canima, La Gran Sabana, on road from Aeropuerto Luepa to Kavanayen, 10 Apr 1985, Brako 8172 (NY).

BRAZIL. Acre: Slopes of Serra da Moa, 19 Apr 1971, Prance et al. 12132 (INPA, NY). Amazonas: Platô da Serra do Aracá (Serra Norte), 1100 m, 14 Feb 1984, Cisneros et al. 30, 50 (INPA, NY); Reserva Biologia de Campina INPA-SUFRAMA on the Manaus-Caracarai road at point 45 km from intersection of the Manaus-Itacoatiara road, 6 Nov 1977, Dumont et al. 117 (INPA, NY); Reserva Experimental do INPA, Manaus-Caracarai km 61, 3 Aug 1973, Prance et al. 18717 p.p. (INPA, NY). Minas Gerais: Serra do Espinhaço, Serra do Caraça, 8 Jul 1978, Kalb & Plöbst 31 (Hb. Kalb), 1300 m, 12 Jul 1978, Kalb & Plöbst 34 (Hb. Kalb). Pará: Serra do Cachimbo, 774 km N of Cuiabá, ca. 400 m, 22 Apr 1983, Brako & Dibben 5531, 5556 (INPA, NY), 5605, 5612 (INPA); 763 km N of Cuiabá, ca. 400 m, 22 Apr 1983, Brako & Dibben 5887 (INPA, NY); Aeroporto Cachimbo, ca. 20 km N of the border with Mato Grosso, ca. 430-480 m, 27 Apr 1983, Brako & Dibben 6172 (INPA, NY); cataracts on the Rio Curuá, 877 km N of Cuiabá, ca. 350-500 m, 2 May 1983, Brako & Dibben 6621 (INPA, NY), 7 May 1983, Brako & Dibben 6914 (INPA, NY); 780 km N of Cuiabá, ca. 430-480 m, 29 Apr 1983, Brako & Dibben 6394 (INPA, NY).

PHILIPPINE ISLANDS. North Luzon: Prov. Baguio, 1400 m, 10 Aug 1983, Kalb & Schrögl s.n. (Hb. Kalb).

Squamacidia janeirensis var. endococcinea (Zahlbr.) Brako, comb. et stat. nov.

Physcidia endococcinea Zahlbr., Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss., Kl. 83: 159. 1909. Type: Brazil. São Paulo: Itapecirica, near Barra Mansa, ca. 1000 m,

9 Jun 1901, Schiffner s.n. (holotype, W).

Distribution: Panama, Venezuela and Brazil.

Variety endococcinea is distinguished by the straw colored or scarlet colored pigment in the medulla.

Specimens examined: PANAMA. Panamá: Cerro Jefe, 900 m, 28 Nov 1985, Brako 8494 (NY).

VENEZUELA. Miranda: El Vulcán, above Baruta, 1200-1400 m, 1 May 1986, Brako 8667 (NY).

BRAZIL. Amazonas: Along Igarapé Caititu off Rio Uatumã at Antônio Filinto, 18, 19 Aug 1979, Buck 2977, 2998 (INPA, NY); Reserva Biologica de Campina INPA-SUFRAMA, on the Manaus-Caracarai road at a point 45 km from the intersection of the Manaus-Itacoatiara road, 6 Nov 1977, Dumont BR-102 (INPA, NY); Rio Cuieras just below mouth of the Rio Brancinho, 27 Sep 1971, Prance et al. 14960 (INPA, NY). Pará: Serra do Cachimbo, 763 km N of Cuiabá, ca. 400 m, 22 Apr 1983, Brako & Dibben 5858 (INPA, NY), 24 Apr 1983, Brako & Dibben 5870 (INPA, NY); Aeroporto Cachimbo, ca. 20 km N of the border with Mato Grosso, ca. 430-480 m, 27 Apr 1983, Brako & Dibben 6185. Roraima: Along the Manaus-Boa Vista road at a point 350 km from the intersection of the Manaus-Itacoatiara road, 18 Nov 1977, Dumont et al. BR-599B, BR-600 (INPA, NY).

Biatora pyrrhomelaena Tuck., Amer. J. Sci. Arts, ser. 2, 28: 205. 1859. Phyllopsora pyrrhomelaena (Tuck.) Swinscow & Krog, Lichenologist 13: 244. 1981. Type: Cuba. Oriente: Monte Verde Woods, 7 Apr, Wright, Lich. Cub. 178 (holotype, FH;

isotypes, BM, BUF, L=2x, UPS, US=2x). Fig. 45B.

Thallus squamulose, squamules round to irregular, 0.1-0.2 mm diam., complanate, closely adnate. Upper surface glabrous, fibrillose at the margin, PD+ orange. Isidia lacking. Cortex type 2, 15 um thick. Medulla containing a scarlet pigment. Prothallus abundant, red. Lichen substances: pigments.

Apothecia common. Disc plane to convex, pale olive to very dark red or black. Margin prominent, dark red to greenish with age, with abundant dark projecting fibrils. Exciple dark red, KOH+ scarlet. Hypothecium brown, KOH-. Hymenium pale tan, 40-50 um tall. Epihymenium not obvious. Ascus type "C" of Hafellner (1984). Ascospores simple, ovoid, 5-6 x 2 um.

Pycnidia not seen.

Distribution: West Indies and South America.

This species is here excluded from Phyllopsora. It belongs in the Bacidiaceae, but differs from Phyllopsora by its apothecial anatomy and pigmentation. It also does not belong in Biatora and should probably be assigned to an undescribed genus.

Specimens examined: CUBA. Wright, Lich. Cub. ser. 2, 123 (US), 124 (H-NYL 20498), Wright s.n. (H-NYL 20500).

VENEZUELA. Amazonas: Río Negro, at base of Cerro de la Neblina, 140 m, 25-28 Nov 1984, Brako 7519, 7556, 7620, 7744 (NY, VEN), Feb-Mar 1984, Buck 10839, 10884, 11036, 12784, 12785, 12799, 12894 (NY, VEN); Atabapo, surroundings of Culebra, between Cerros

Duida and Huachamacari, 200-400 m, 28-30 Jan and 6-9 Feb 1982, Guariglia et al. 1440 (NY, VEN).

FRENCH GUIANA. Piste de St. Elie, ca. 21 km SSW of Sinnamary, 3 Aug 1982, Boom & Mori 1495 (NY).

PERU. San Martín: Cerro Escalera, 900-1100 m, 13 Mar 1981, Santesson & Thor P72:72 (S); Lamas, Cerro Blanco (ca. 63 km W-WNW of Tarapoto), 1200 m, 17 Mar 1981, Santesson & Thor P77:16 (S).

BRAZIL. Amazonas: Along Igarapé Caititu off Rio Uatumã at Antônio Filinto, 18,19 Aug 1979, Buck 2951 (INPA, NY); Reserva Ducke, km 23 N of Manaus on road to Itacoatiara, 1 Nov 1977, Buck 1731 (INPA, NY); 60 km S of Humaitá, 4 May 1982, Fife et al. 4030; along the Rio Negro, 100 and 200 km upstream from Manaus, 40 m, 14-18 Oct 1980, Kalb 310 (Hb. Kalb). Pará: Serra do Cachimbo, 774 km N of Cuiabá, ca. 400 m, 22 Apr 1983, Brako & Dibben 5547 (INPA, NY); 780 km N of Cuiabá, 430-480 m, 29 Apr 1983, Brako & Dibben 6374, 6391, 6417 (INPA, NY); 842 km N of Cuiabá, ca. 350-500 m, 5 May 1983, Brako & Dibben 6743, 6768, 6775 (INPA, NY). Paraná: Reserva Ecológica Sapitanduva, between Morretes and Antonina, 110 m, 17-18 Jan 1987, Hatschbach & Brako 8891 (NY). Rondônia: Ca. 5 km S of Humaitá, E of São João, 2 May 1982, McFarland 38 (INPA, NY). Roraima: Along the Manaus-Boa Vista road at point ca. 360 km from the intersection of the Manaus-Itacoatiara road, 18 Nov 1977, Dumont et al. BR-495, BR-503 (INPA, NY). São Paulo: Ilha Comprida, sealevel, 15 Jul 1979, Sipman 14030 (B).

Lecidea curatellae Malme, Ark. Bot. 28A(7): 42. 1936.

Phyllopsora curatellae (Malme) G. Schneider, Biblioth. Lich. 13: 175. 1979. Type: Brazil. Mato Grosso: Cuiabá, 27 Nov 1893, Malme, Lich. Regnell. 2038 (lectotype designated by Swinscow & Krog, 1981, S; isolectotype, UPS).

Thallus effigurate, closely adnate. Upper surface white pruinose, margin smooth, Pd-. Isidia lacking. Cortex very thin. Prothallus lacking. Lichen substances: none detected.

Apothecia common. Disc plane to strongly convex, tan to brown with white pruina. Margin not obvious. Exciple brown, containing granules, KOH-. Hypothecium dark brown, KOH-. Hymenium tan, 40 um tall. Epihymenium not obvious. Ascus type "K" of Hafellner (1984). Paraphyses cellular, branched, apical cell not swollen, length to width ratio 20:1. Ascospores simple to uniseptate, ellipsoid, thick-walled, 9-12 x 3-4 um.

Pycnidia not seen.

Distribution: Central Brazil.

This species is here excluded from Phyllopsora. It belongs to an undescribed genus in the Lecanoraceae based on its ascal type, dark hypothecium and small ascospores.

Specimen examined: BRAZIL. Mato Grosso: Between Coxim and Rondonopolis, 400 m, 30 Apr 1980, Kalb 260 (Hb. Kalb).

Lecidea leucophyllina Nyl., Ann. Sci. Nat. Bot., sér. 4, 19: 347.

1863. Thallodima leucophyllinum (Nyl.) Müll. Arg., Rev. Mycol. 10: 60. 1888. Biatora leucophyllina (Nyl.) Tuck., Synop. N. Amer. Lich. 2: 40. 1888. Psorella leucophyllina (Nyl.) Zahlbr., Cat. Lich. Univ. 4: 402. 1926. Type: Cuba. Wright s.n. (holotype, H-NYL 17345c,e; isotypes as Wright, Lich. Cub. 213, BM=2x, BUF, FH-TUCK 3018, FH, G=3x, L=2x, UPS).

Thallus squamulose, squamules elongate and deeply incised, lobes ca. 0.1 mm wide, ascending, Pd+ pale orange. Upper surface dull, margin smooth. Soredia in round soralia, pulverent to farinose. Cortex a thin gelatinous sheath. Lichen substances: sekikaic acid and pigments.

Apothecia common. Disc strongly convex, orange-tan. Margin plane, concolorous. Exciple and hypothecium colorless, containing brown refractile granules, KOH-. Hymenium colorless, 20-30 um tall. Epihymenium not obvious. Ascus type "C" of Hafellner (1984). Ascospores uni- or multi-septate, ellipsoid to fusiform, thin-walled, 13-15 x 1.5-2.0 um.

Pycnidia not seen.

Distribution: Cuba and Brazil.

This species belongs to an undescribed genus in the Bacidiaceae based on its ascal type, its sorediate thallus containing sekikaic acid, its apothecia with refractile granules, and its long septate, thin-walled ascospores.

Specimens examined: BRAZIL. São Paulo: Ilha Comprida, 3 m, 15

Jul 1979, Kalb 163 (Hb. Kalb); Serra de Paranapiacaba, 40 km SW of São Paulo, 800 m, 19 Mar 1978, Kalb & Plöbst 1 (Hb. Kalb).

Lecidea stylophora Malme, Ark. Bot. 28A(7): 40. 1936.

Phyllopsora stylophora (Malme) G. Schneider, Biblioth. Lich. 13: 179. 1979. Type: Brazil. Mato Grosso: Serra da Chapada, Buritî, 27 Jun 1894, Malme s.n. (holotype, S, atranorin, terpenes; isotypes, G, H, US).

Thallus crustose, in part verrucose, closely adnate. Upper surface glabrous, margin with thick pale hyphae, in part stained yellow-orange, Pd-. Isidia cylindrical, laminal, simple to branched. Cortex prosoplectenchymatous, lumina of hyphae very thin, 40 um thick, containing small colorless granules not dissolving in KOH. Prothallus thin and web-like between the verruculae, hyphae at margin thicker and stained yellow-orange. Lichen substances: atranorin and terpenes.

Apothecia common. Disc plane to convex, pale to dark golden-brown. Margin slightly raised and darker than the disc. Exciple golden-brown to tinged red, KOH+ effusing a yellow solution. Hypothecium golden-brown, KOH+ as above. Hymenium tan, containing brown granules on the outerwall of the paraphyses and asci. Ascus type "K" of Hafellner (1984). Ascospores simple, ovoid to long ellipsoid or ellipsoid-fusiform, 8-16 x 3-5.

Pycnidia common, globose to disc-shape, partially immersed in

the thallus. Pycnospores rod-shaped, straight, 6-8 x 1 um.

Distribution: Venezuela and Brazil.

This species is here excluded from Phyllopsora. It belongs in the Lecanoraceae based on the ascal tip characteristic of the family and simple, hyaline, broad ascospores.

Specimens examined: VENEZUELA. Amazonas: Estacíon de Piscicultura, S of Puerto Ayacucho, 22 Nov 1984, Brako 7513 (NY, VEN).

BRAZIL. Mato Grosso: Between São Vicente and Aguas Quentes, 90 km ESE of São Paulo, 650 m, 2 Jul 1980, Kalb 268 (Hb. Kalb); 35 km SE of Cuiabá, 120 m, 3-4 Jul 1980, Kalb 269 (Hb. Kalb), 4 Jul 1980, Kalb 272 (HB. Kalb); Serra dos Coroados, Buritî, 600 m, 7 Jul 1980, Kalb 278 (Hb. Kalb); Chapada dos Guimarães, 550-600 m, 7 Jul 1980, Kalb 279 (Hb. Kalb); ca. 6 km SW of Buritî, 600 m, 8 Jul 1980, Kalb 280 (Hb. Kalb); 20 km NE of Chapada dos Guimarães, 670 m, 9 Jul 1980, Kalb 281 (Hb. Kalb). Mato Gross do Sul: Between Rio Verde do Mato Grosso and Coxim, 400 m, 28 Jun 1980, Kalb 255 (Hb. Kalb). Pará: Base Aérea do Cachimbo, ca. 20 km N of the border with Mato Grosso, ca. 430-480 m, 27 Apr 1983, Brako & Dibben 5827, 6041, 6084 (INPA, NY); Aeroporto Cachimbo, ca. 430-480 m, 27 Apr 1983, Brako & Dibben 6126, 6156, 6203, 6240A (INPA, NY); ca. 10 km N of Base Aérea do Cachimbo, ca. 430-480 m, 28 Apr 1983, Brako & Dibben 6305 (INPA, NY); 780 km N of Cuiabá, ca. 430-480 m, 29 Apr 1983, Brako & Dibben 6350 (INPA), 6362, 6412 (INPA, NY); cataracts on the Rio Curuá, 877 km N of Cuiabá, ca. 350-500 m, 2 May 1983, Brako & Dibben 6550 (INPA,

NY); 888 km N of Cuiabá, ca. 350-500 m, 4 May 1983, Brako & Dibben 6658, 6699 (INPA, NY), 7 May 1983, Brako & Dibben 6915, 6929 (INPA, NY). Roraima: Along the Manaus-Boa Vista road, 350 km from the intersection of the Manaus-Itacoatiara road, 18 Nov 1977, Dumont et al. BR-598 (INPA, NY).

Lecidea thaleriza Stirton, Trans. Glasgow Soc. Field Nat. 5: 217. 1877. Phyllopsora thaleriza (Stirton) G. Schneider, Biblioth. Lich. 13: 180. 1979. Type: South Africa. Somerset East, Boschberg, 1874, McOwan s.n. (holotype, BM; not found in GLAM). Fig. 48A.

Psora compaginata Müll. Arg., Rev. Mycol. 10: 60. 1888. Phyllopsora compaginata (Müll. Arg.) G. Schneider, Biblioth. Lich. 13: 175. 1979. Type: Paraguay. Cerro San Thomas, Jun 1881, Balansa 4134 (holotype, G, no lichen substances; isotypes, M, W; possible isotype, H-NYL 4132). Fig. 48B.

Thallus crustose, adnate. Upper surface continuous or areolate, glabrous, fibrillose at the margin. Isidia lacking. Cortex type 2, 40 um thick. Prothallus scant, pale. Lichen substances: none detected.

Apothecia common. Disc plane to convex, golden-brown. Margin slightly raised and paler than the disc. Exciple tan, KOH-. Hypothecium golden-brown, containing granules, KOH-. Hymenium pale, 50 um tall. Epihymenium gelatinous, 10 um thick. Ascus type "C" of

Hafellner (1984). Ascospores ellipsoid to short fusiform, 9-12 x 3-4 um.

Pycnidia common, golden-brown, almost totally immersed in the thallus. Pycnospores rod-shaped, straight, 8-9 x 1 um.

Distribution: Southern South America and Africa.

This species is here excluded from Phyllopsora. It belongs to an undescribed genus in the Bacidiaceae and differs from Phyllopsora by its pseudoparenchymatous hypothecium, its crustose thallus and its algal type which does not agree well with Pseudochlorella.

Specimens examined: BRAZIL. Goiás: 15 km SW of Goiania, 800 m, 13 Jul 1980, Kalb 289 (Hb. Kalb). Mato Grosso: Guia near Cuiabá, 12 May 1894, Malme, Lich. Regnell. 2676 (S); Cuiabá, 14 May 1894, Malme, Lich. Regnell. 2702C (S); Corumbá, 18 Aug 1894, Malme, Lich. Regnell. s.n. (S), 1 Aug 1894, Malme, Lich. Regnell. s.n. (S); Serra da Chapada, Buritî, 3 Jun 1894, Malme, Lich. Regnell. s.n. (S). Mato Grosso do Sul: Ca. 41 km S of Campo Grande, 550 m, 14 Nov 1979, Kalb 201, 209 (Hb. Kalb). Rio Grande do Sul: Santo Angelo near cachoeira, Serro Pellado, 18 Jan 1893, Malme, Lich. Regnell. 948 (S), 955, Lich. Austroamericani 275 (BM, H, S, US), 4 Feb 1893, Malme, Lich. Regnell. 1004 (S); Santo Angelo, 8 Feb 1893, Malme, Lich. Regnell. 1022 (S); between São Martinho and Santa Maria da Bocca do Monte, 6 May 1893, Malme, Lich. Regnell. 1305B (S); Porto Alegre, 30 May 1893, Malme, Lich. Regnell. 1318, Lich. Austroamericani 296 (BM, H, S, US).

PARAGUAY. Cerro de Yaguaron, 17 Jun 1879, Balansa 4150 (G=2x),

1878, Balansa s.n. (G), 1888, Balansa s.n. (H-NYL P.M. 4115); Cerro Curupaiti, Apr 1879, Balansa 4199 (BM); Cerro San Thomas, Balansa s.n. (H-NYL P.M. 4132); Areguá near Asunción, 22 Jul 1893, Malme, Lich. Regnell. 1442 (S), 20 Aug 1893, Malme, Lich. Regnell. 1639 (BM, S).

ARGENTINA. Misiones: Puerto do Iguazú, 31 Aug 1980, 200 m, Kalb 306 (Hb. Kalb); San Ignacio, Colonia Jabebiry, 310 m, 14 Feb 1956, Montes 10.071D (M).

KENYA: Central Prov.: Fort Hall District, Thika, Blue Post Hotel at Chanya River, 1550 m, 25 Feb 1979, Moberg 4582C (UPS).

SOUTH AFRICA. Transvaal: Pietersburg District, Farm Llewellyn, Soutpansburg Mt., just below summit, NE of Vivo, 1600 m, 13 Jan 1986, Harris 18768, 18769 (NY).

Phyllopsora longispora Swinscow & Krog, Nord. J. Bot. 5: 493. 1985.

Type: Kenya. Western Prov.: Kakamega District, Kakamega Forest, 1700 m, 20 Jan 1970, Santesson 21698a (holotype, UPS, triterpenoids detected by Swinscow & Krog, 1985).

Thallus squamulose, squamules round to elongate, 0.2-0.5 mm diam., convex, adnate to ascending, Pd-. Upper surface glabrous, fibrillose at the margin. Isidia cylindrical to coralloid. Cortex type 2, 25 um thick. Prothallus dark red. Lichen substances: triterpenoids.

Apothecia common. Disc plane, tan to orange. Margin raised, tinged red. Exciple tinged red, KOH-. Hypothecium tan, KOH-.

Hymenium pale, 60 um tall. Epihymenium not obvious. Ascospores tri- to multiseptate, acicular, thin-walled, 40-55 x 2-4 um.

Pycnidia not seen.

Distribution: Kenya.

This species is here excluded from Phyllopsora. It belongs to an undescribed genus in the the Bacidiaceae. It has a squamulose thallus like Phyllopsora and Psorellopsis, spores like Psorellopsis, and apothecial anatomy like Bacidia rosella. It is only known from the type collection.

Names previously removed from Phyllopsora or Psorella:

Psorella coccocarpoides (Nyl.) Zahlbr. = Psora?, suggested by Swinscow & Krog, Lichenologist 13: 240. 1981.

Psorella leptosperma (Müll. Arg.) Zahlbr. = Bacidia laciniosa Swinscow & Krog, Lichenologist 13: 242. 1981.

Psorella pannarioides (Knight) Mull. Arg.= Bacidia pannarioidea Knight, Trans. Proc. New Zealand Inst. 12: 374. 1880.

Psorella psorina (Nyl. ex Hue) Zahlbr. = Lecidea psorina Nyl. ex Hue, Nouv. Archs. Mus. Hist. Nat. Paris, sér. 3, 3: 120. 1891.

Psorella spruceana (Müll. Arg.) Zahlbr. & Krog = Bacidia spruceana (Müll. Arg.) Swinscow & Krog, Lichenologist 13: 245. 1981.

Psorella triptophyllina (Nyl.) Zahlbr. = Eschatogonia?, suggested by Swinscow & Krog, Lichenologist 13: 246. 1981.

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INDEX

This index provides page references to all names in the text. Pages of main entries and descriptions are underlined. Boldface indicates taxa currently accepted in Phyllopsora. Generic names for species not belonging to Phyllopsora are in parenthesis after the species name.

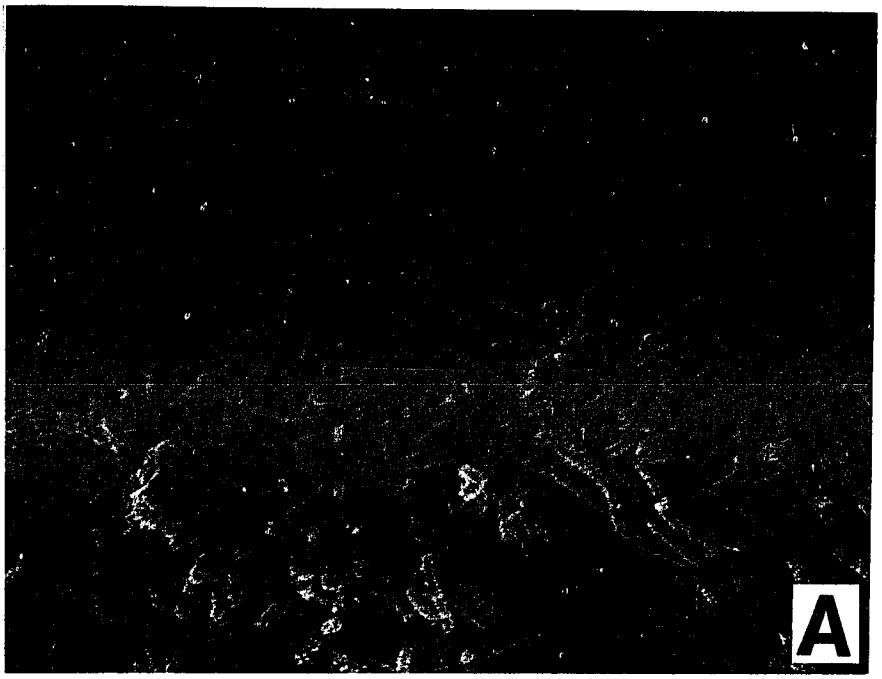
FIG. 9. Cross-sections of thallus - Type 1 cortex.

Phyllospora parvifolia var. breviuscula

(Isotype: Cuba, Wright, Lich. Cub. 181, UPS).

A. SEM micrograph, 450x.

B. Light microscope, 400x.


A

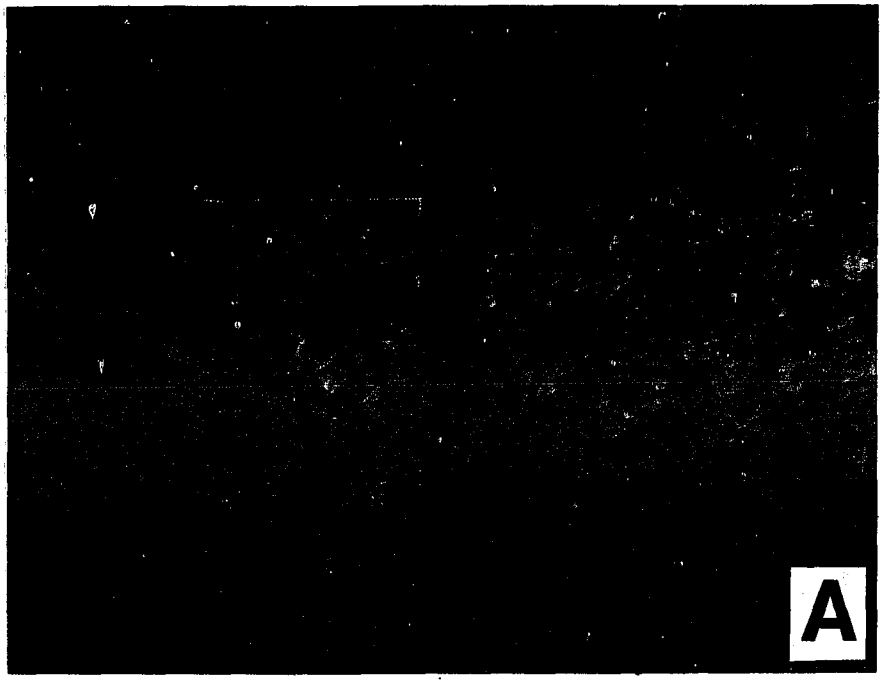

B

FIG. 10. Cross-sections of thallus - Type 2 cortex.

Phyllopsora parvifolia (Brazil, Malme, Lich. Regnell. 1227, S).

A. SEM micrograph, 450x.

B. Light microscope, 400x


A


B

FIG. 11. A. Cross-sections of thallus - thin gelatinous cortex.

Phyllopsora intermediella (Isotype: Cuba, Wright,

Lich. Cub. 183, BM).

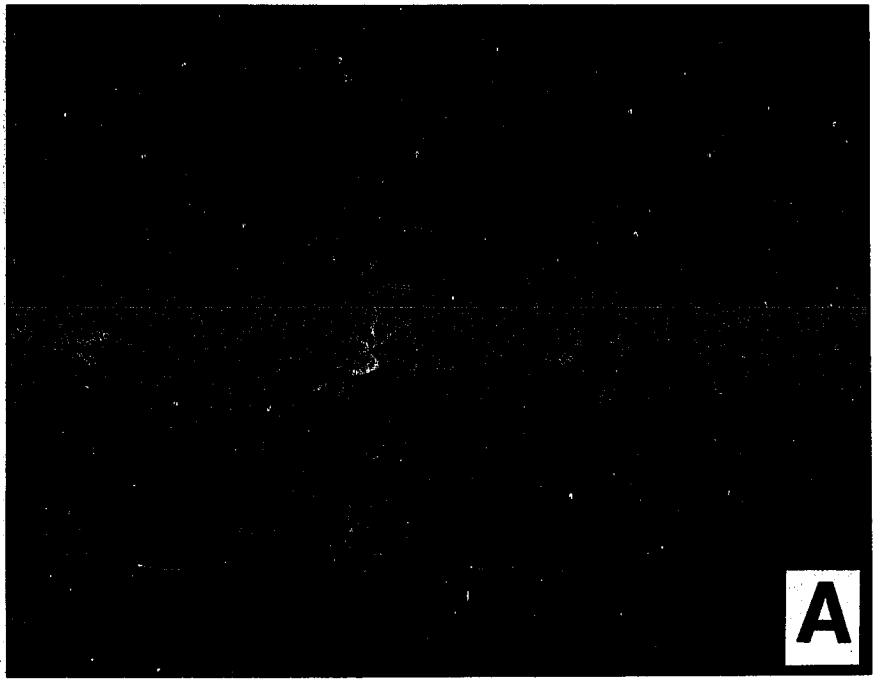
SEM micrograph, 900x.

B. Algal cells.

Phyllopsora parvifolia (Brazil, Malme, Lich. Regnell.

1227, S).

Light microscope, scale =20 um.


A

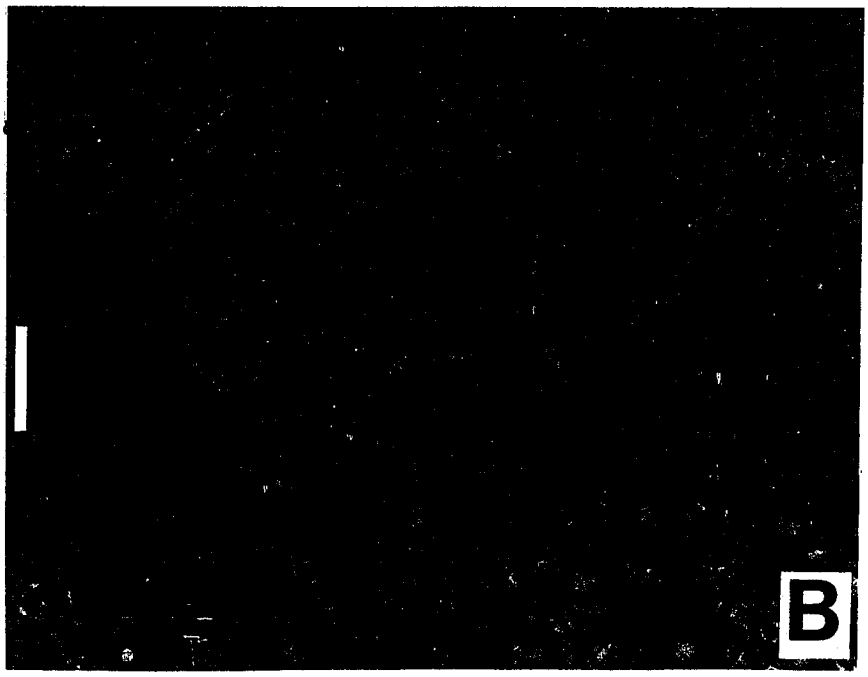

B

FIG. 12. Hyphae of lower surfaces.

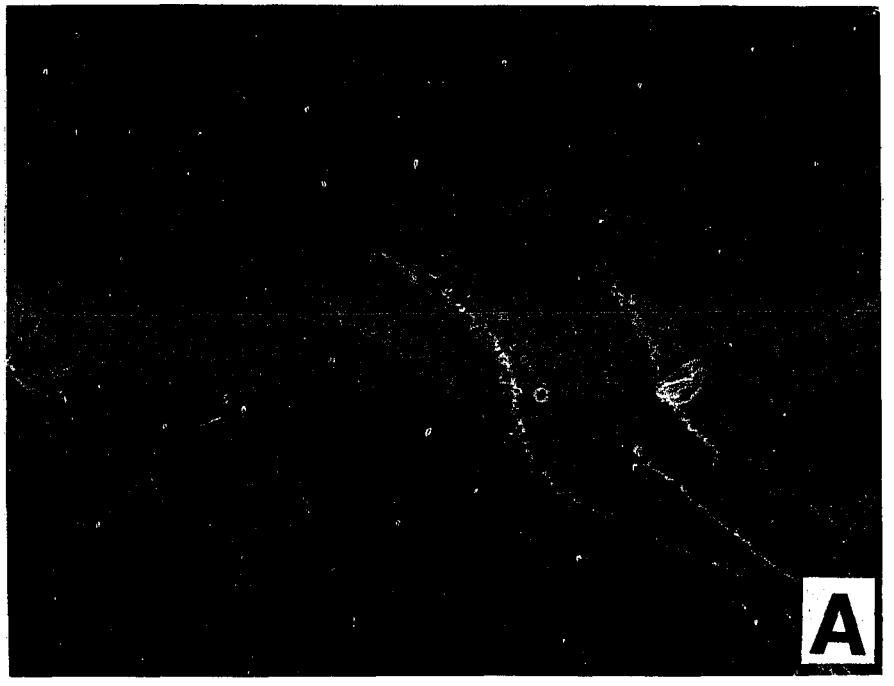
A. SEM micrograph, 1500x.

Phyllopsora parvifolia var. *breviuscula*

(Isotype: Cuba, *Wright*, Lich. Cub. 181, UPS).

B. SEM micrograph, 3000x.

Phyllopsora parvifolia (Brazil, *Malme*, Lich. Regnell. 1227, S).


A

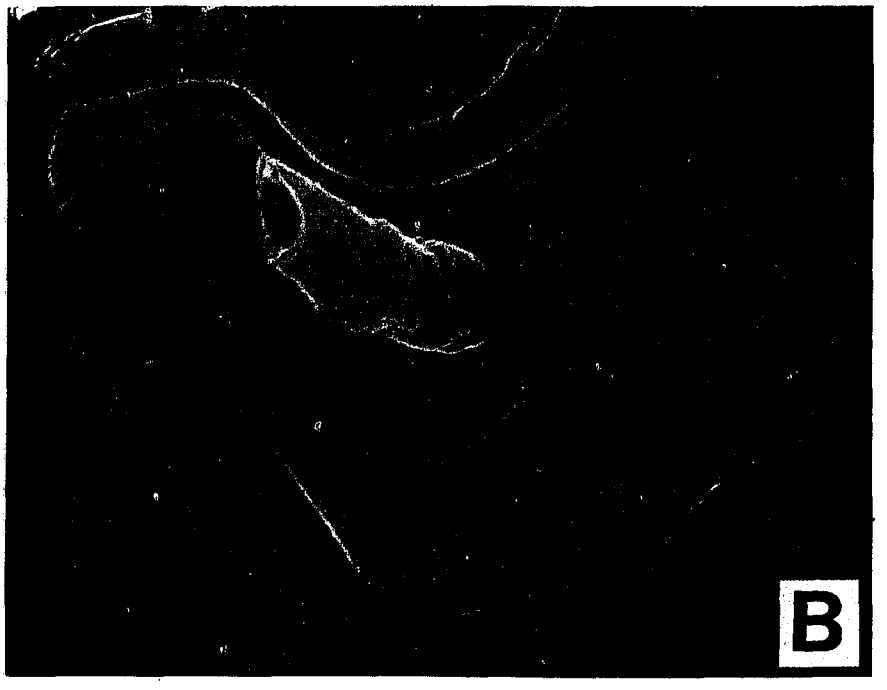
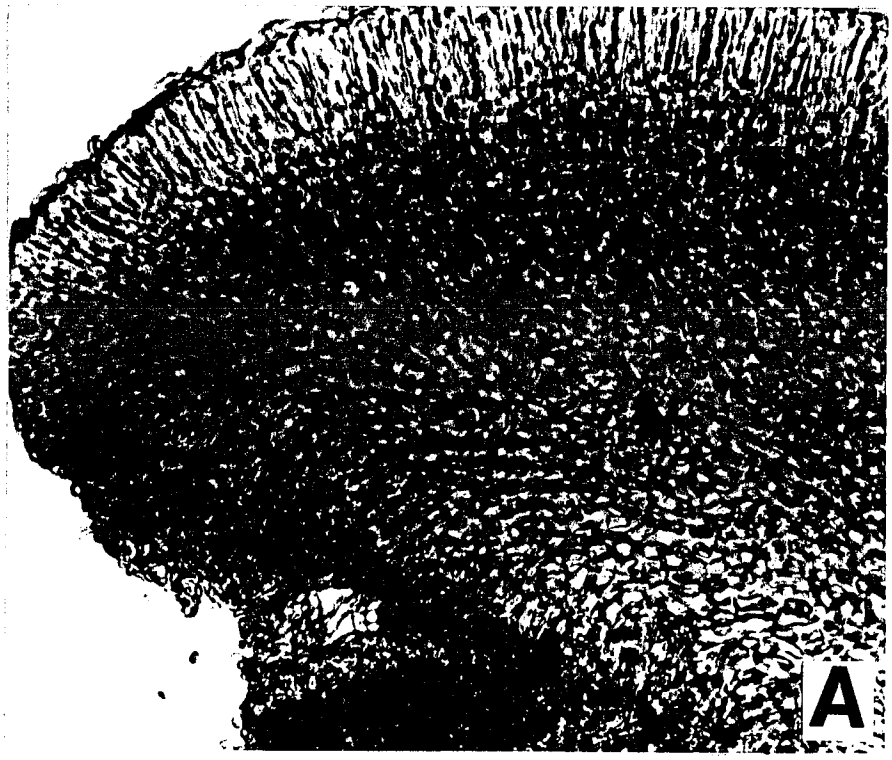

B

FIG. 13. Cross-sections of apothecia.

A. Phyllopsora parvifolia (Brazil, Malme, Lich. Regnell. 1227, S) 160x.

B. Phyllopsora intermediella (Isotype: Cuba, Wright, Lich. Cub. 183, BM) 160x.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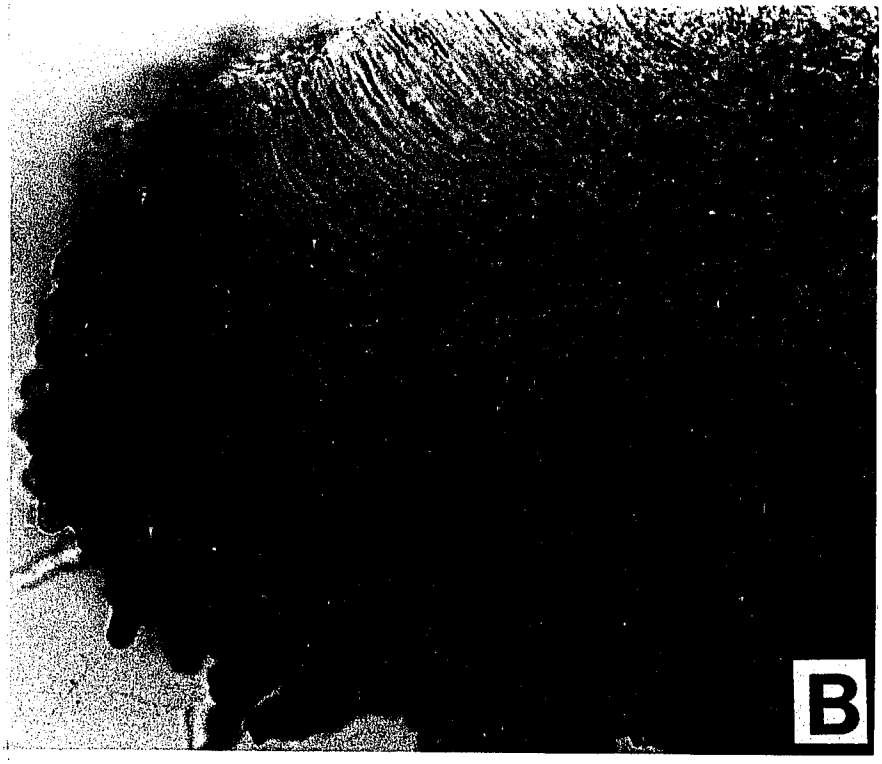

B

FIG. 14. Cross-section of apothecium showing pigmented exciple. Phyllopsora corallina var. santensis (Florida, USA, Brako 8227, NY).

A. 120x.

B. 240x.


A

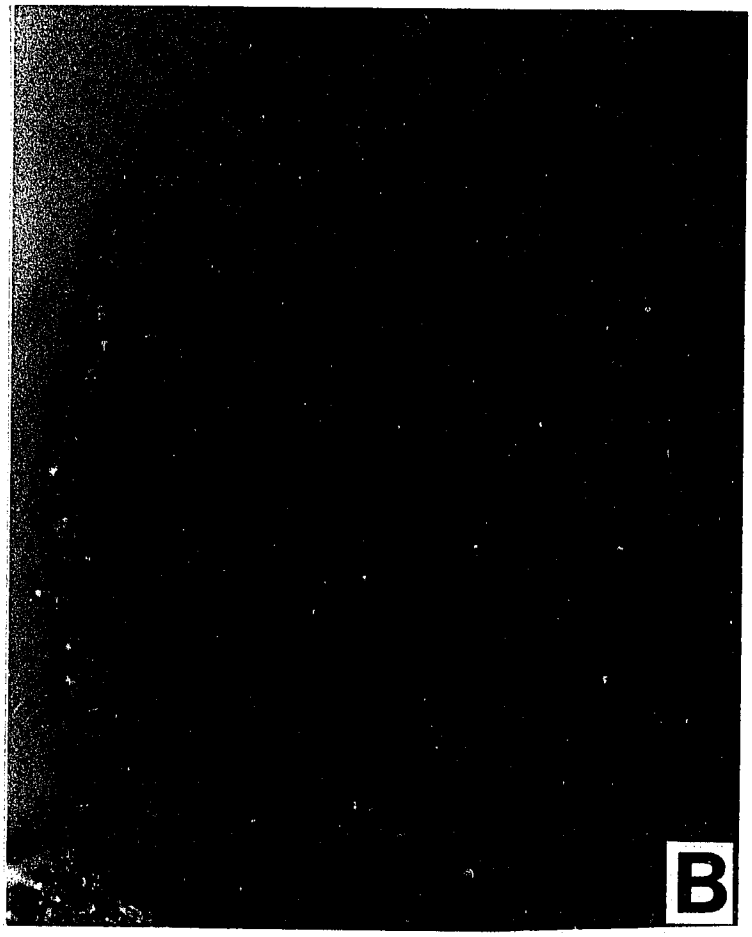
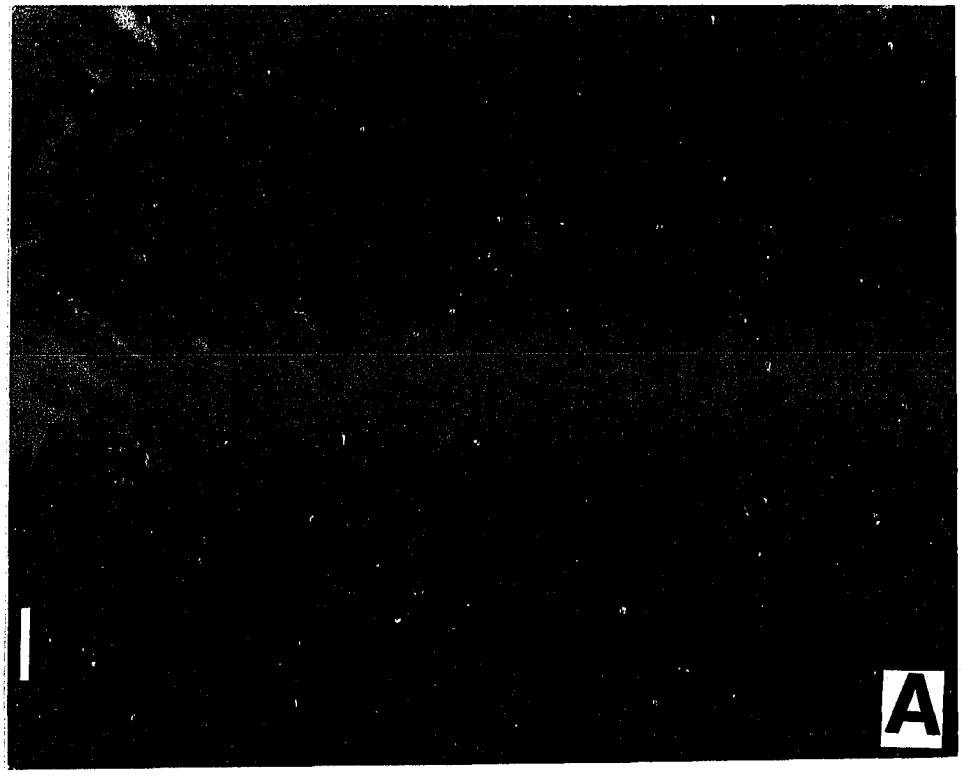

B

FIG. 15. A. Paraphyses.

Phyllopsora parvifolia (Brazil, Malme, Lich. Regnell. 1227, S), mounted in phloxine, scale = 10 um.

B. Ascus structure showing masse axiale and rostrate dehiscence, Phyllopsora parvifolia (Brazil, Malme, Lich. Regnell. 1227, S), mounted in MLS, pretreated with KOH, scale = 10 um


A

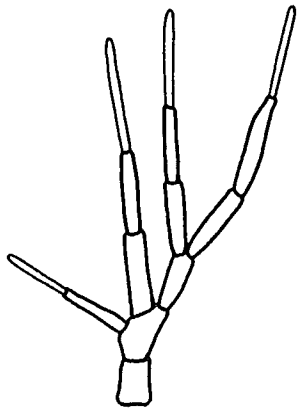

B

FIG. 16. Conidiogenous cells and pycnospores. *Phyllopsora furfuracea* (Dominican Republic, Harris 20481, NY).

A. Line drawing.

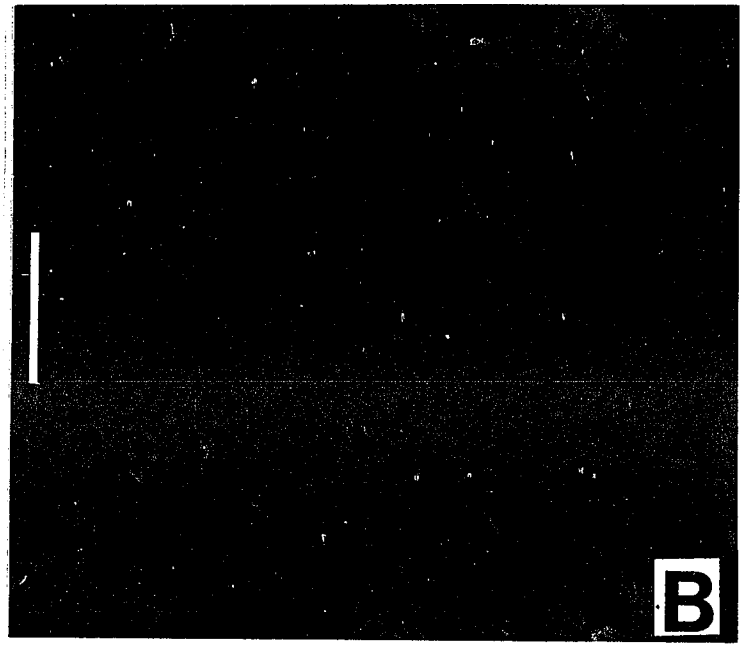
B. Photograph, scale = 10 um.

C. Cross section of pycnidium, 400 x.



10 µm

A



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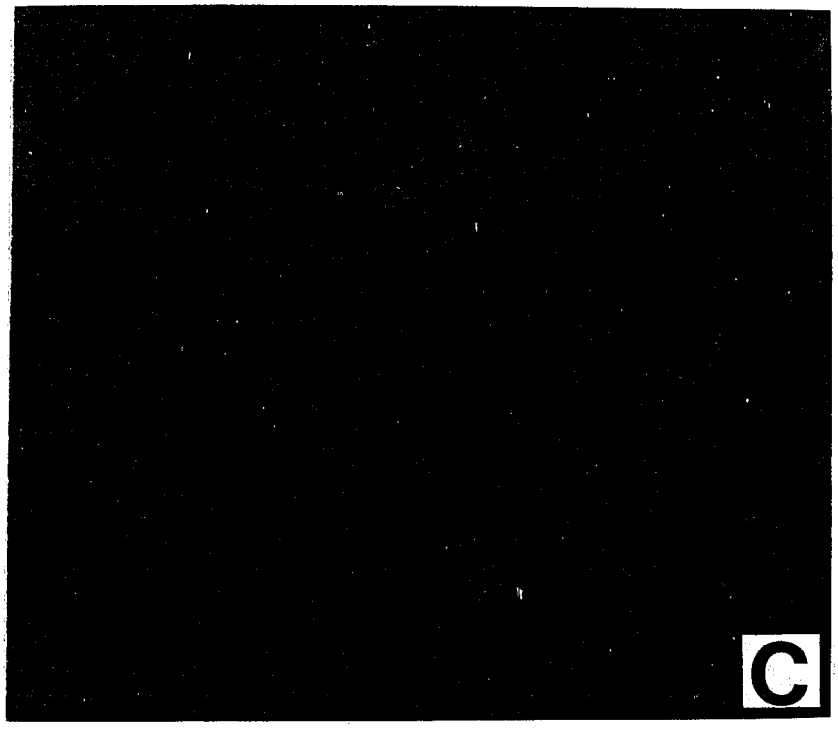
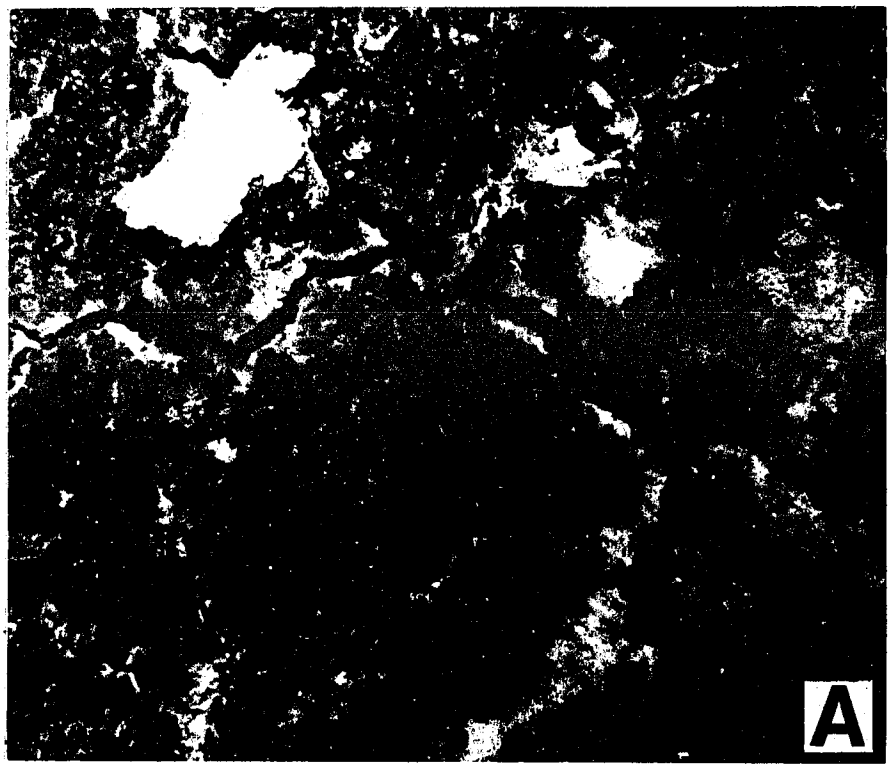


C

FIG. 17. A. Phyllopsora bibula (Holotype: Juan Fernandez Islands, lBertero 16481, FH) 12x.

B. Phyllopsora buettneri (Holotype: Togo, Bismarksberg, Dr. Büttner s.n., G) 12x.


A

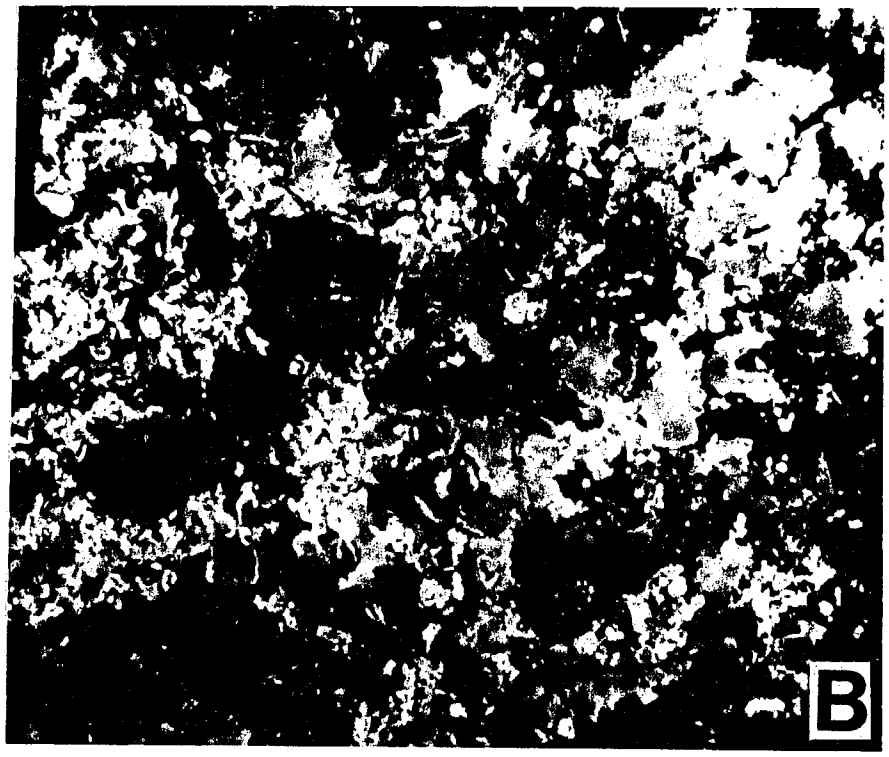
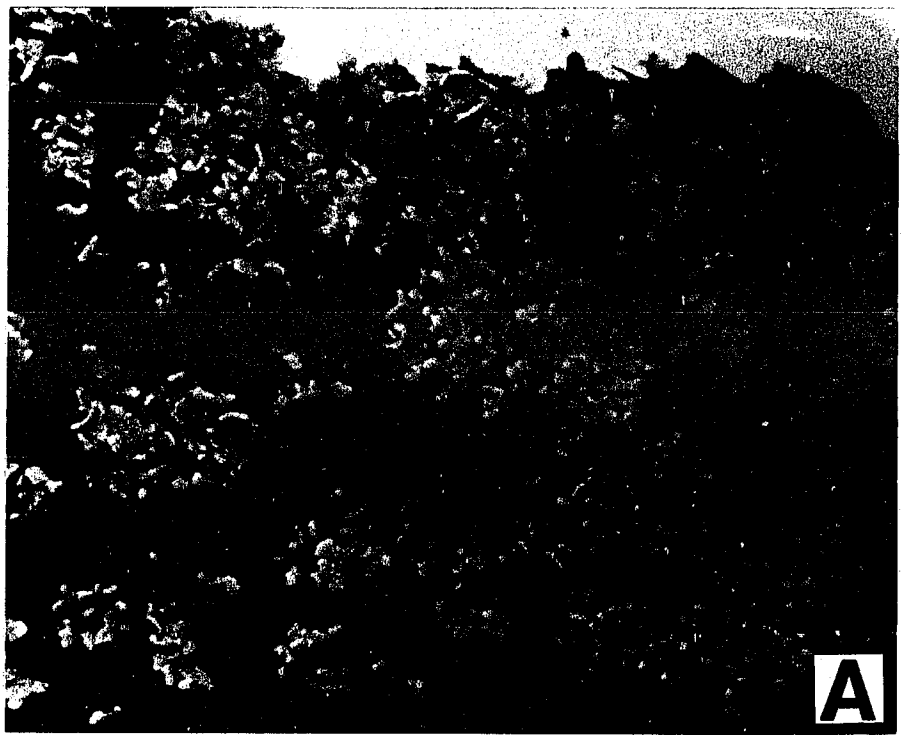

B

FIG.18. A. Phyllopsora buettneri var. glauca (Brazil, Ilha Comprida, Kalb 313, Hb. Kalb) 12x.

B. Phyllopsora buettneri var. melanoglauca (Holotype: Brazil, Schiffner s.n., W) 12x.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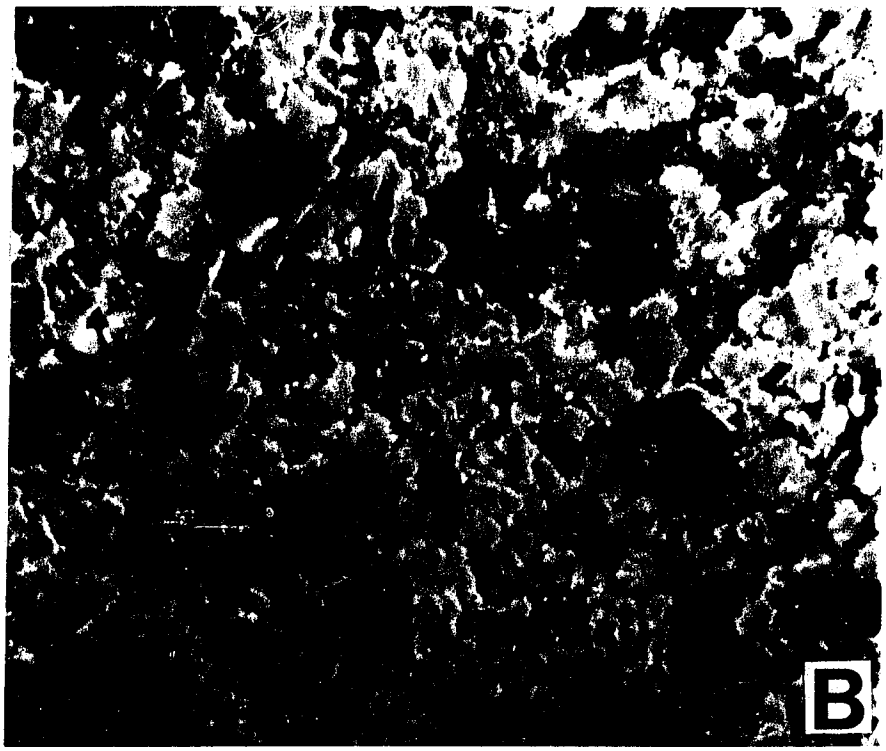
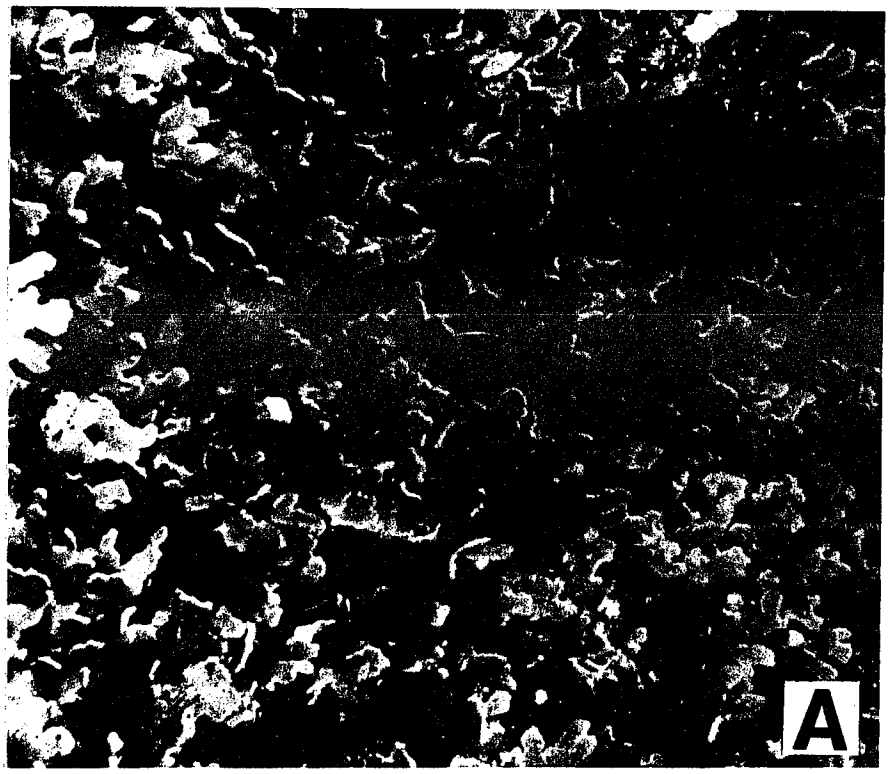

B

FIG. 19. A. Phyllopsora buettneri var. munda (Holotype: Brazil, Hambergerburg, Malme, Lich. Regnell. 617b, S) 12x.

B. Phyllopsora canoumbrina (Holotype: Trinidad, Thaxter 19, FH), scale = 2 mm.


A


B

FIG. 20. Phyllopsora chlorophaea (Lectotype: Brazil, Puiggari 1721 G)

A. Cross-section of apothecium showing pigment throughout exciple and hypothecium, 120x.

B. Habit, scale = 1 mm.


A

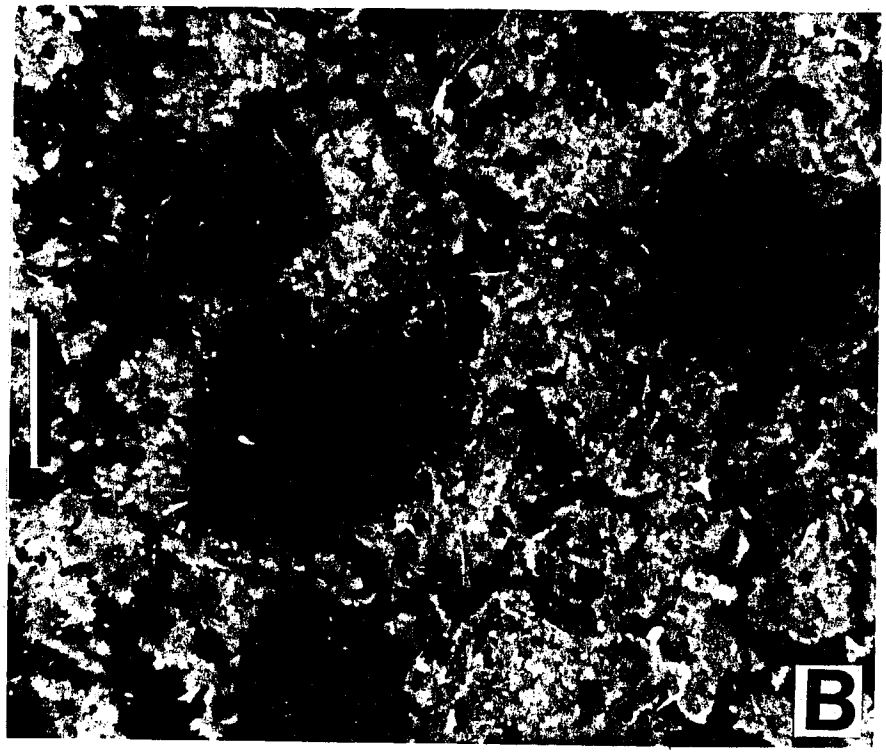

B

FIG. 21. Phyllopsora confusa (Holotype: Kenya, Krog and Swinscow K 48/177, O) 12x.

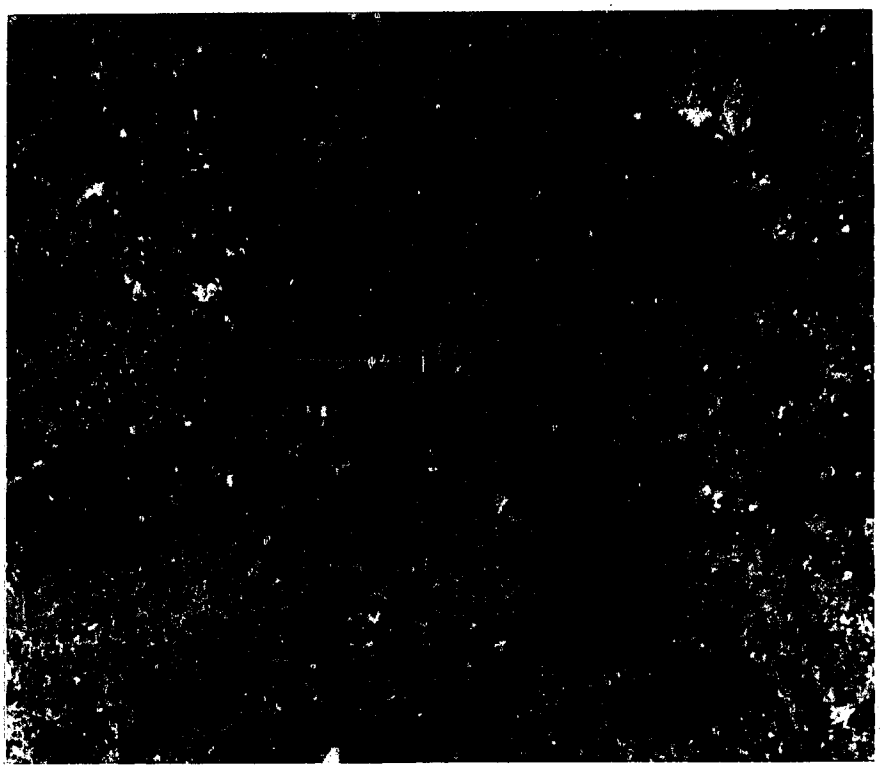
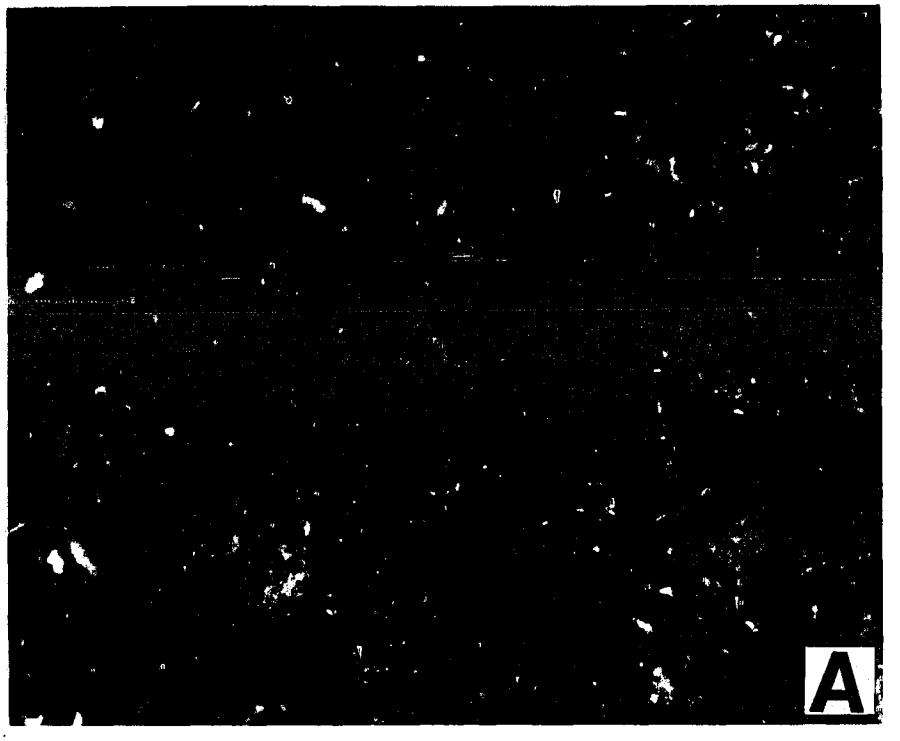


FIG. 22. A. Phyllopsora corallina (Holotype: Brazil, Martius s.n. M) 12x.

B. Phyllopsora corallina var. glaucella (Holotype: Mexico, Liebmann, Pl. Mex. 7381a, TUR-VAIN 34026) 12x.


A

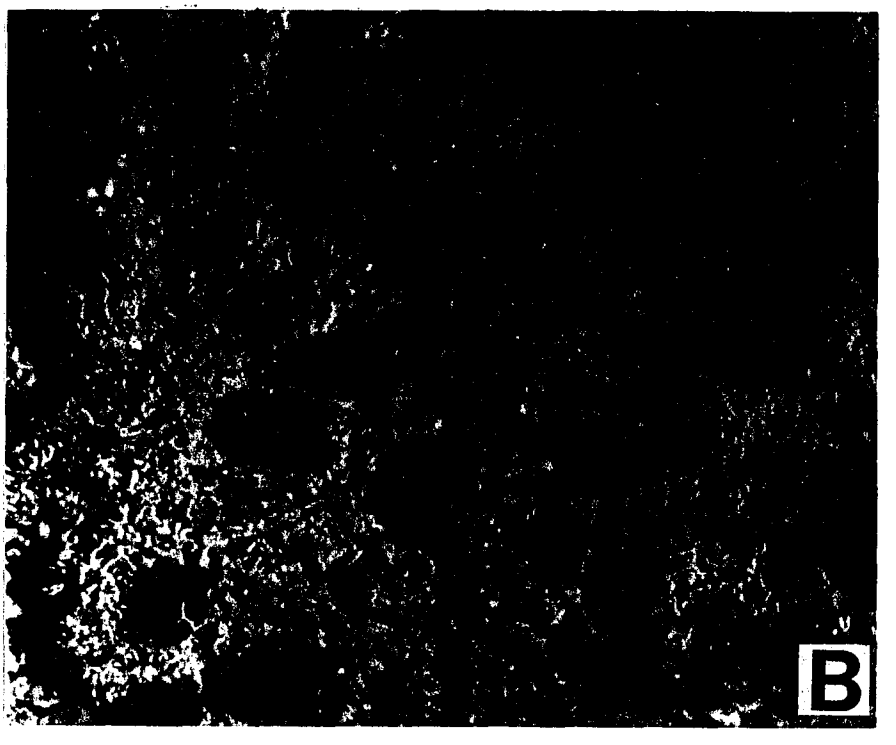

B

FIG. 23. A. Phyllopsora corallina var. ochroxantha (Phyllopsora martinii, isotype: Kenya, Krog & Swinscow K 42/3, UPS), scale = 2 mm.

B. Phyllopsora corallina var. ochroxantha (Isolectotype: Bolivia, Weddell s.n., PC), 12x.


A

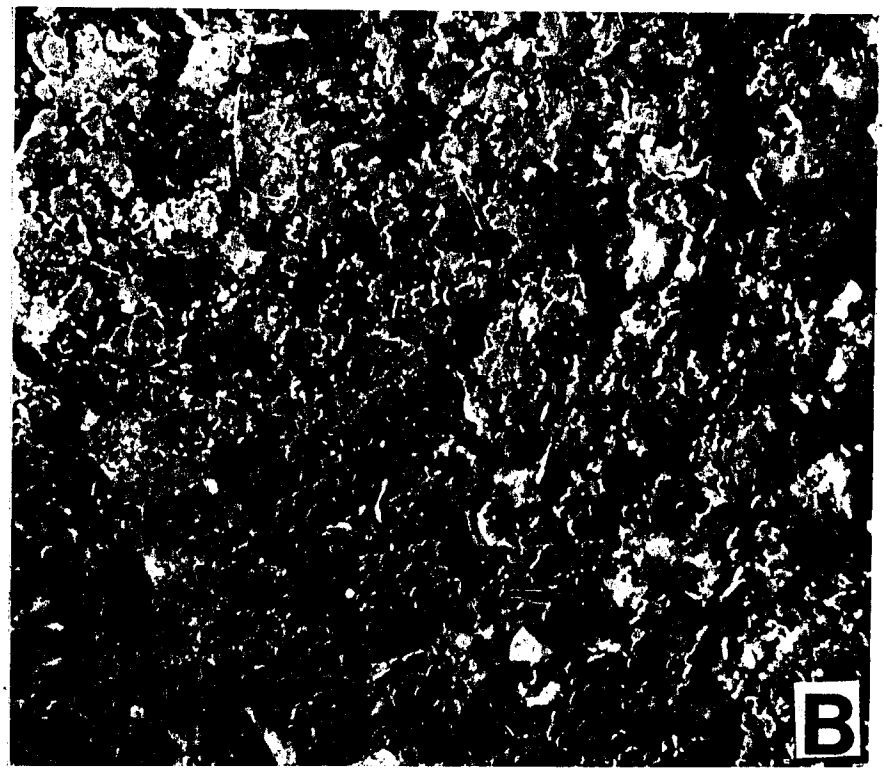
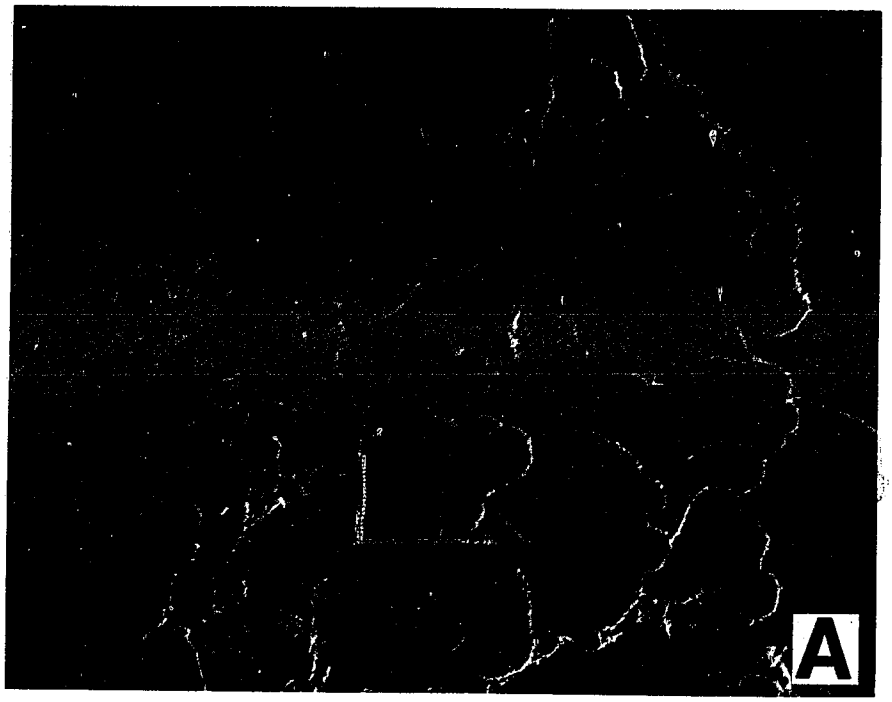

B

FIG. 24. *Phyllopsora corallina* var. *ochroxantha* (*Phyllopsora polydactyla*, holotype: Brazil, *Puiggari* 2156, G)

A. SEM micrograph 50x.

B. Habit, 12x.


A

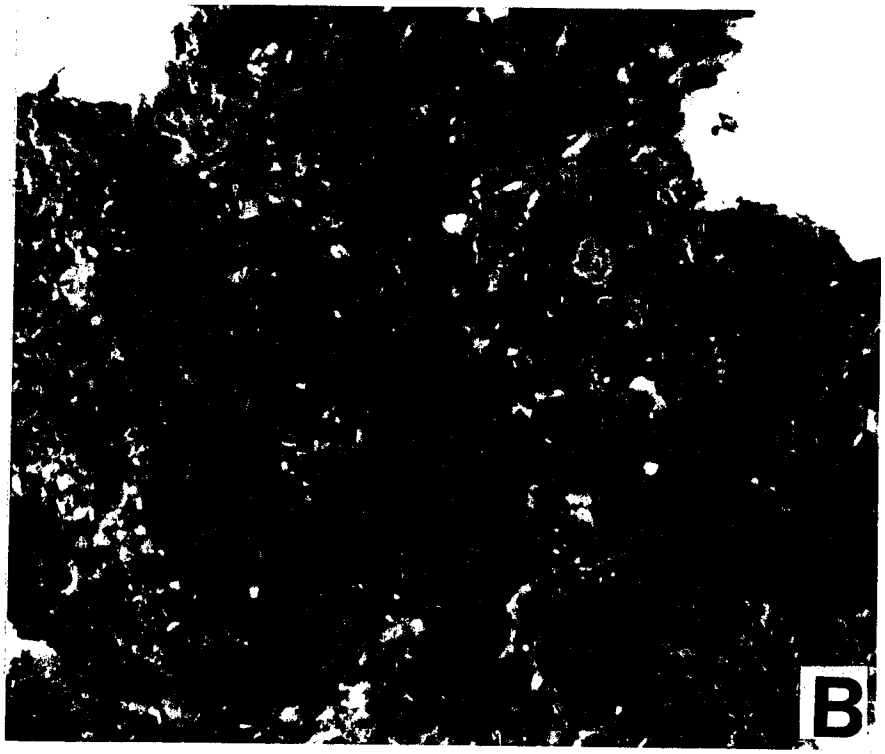

B

FIG. 25. A. Phyllopsora corallina var. ochroxantha (Phyllopsora martinii, isotype: Kenya, Krog & Swinscow K 42/3 UPS) 12x.

B. Phyllopsora corallina var. phaeobyssina (Holotype: Guadeloupe, Duss 481, TUR-VAIN 22602) 12x.


A

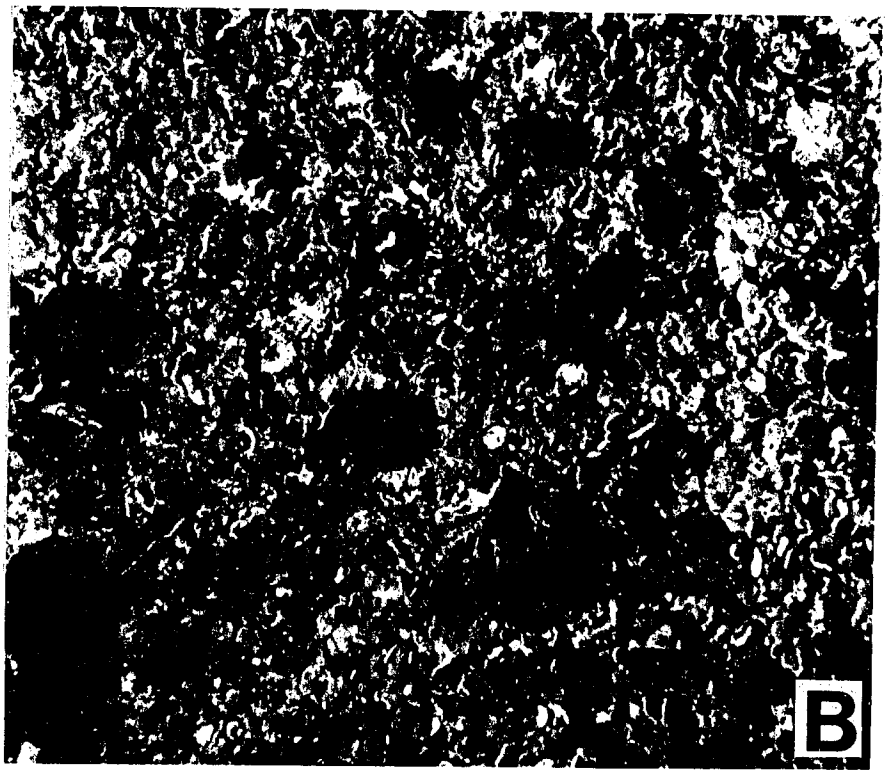
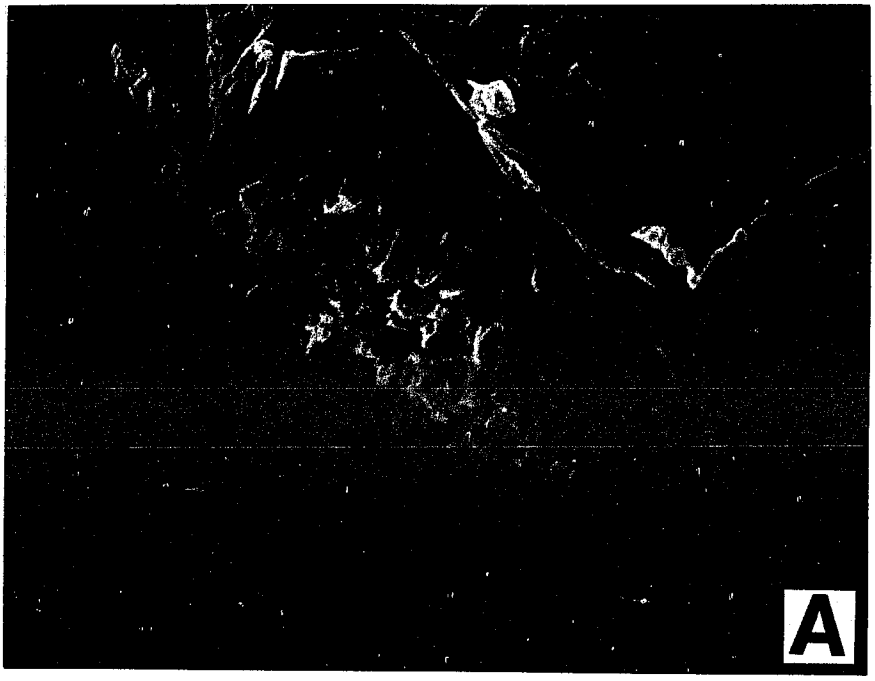

B

FIG. 26. Phyllopsora corallina var. phaeobyssina (Holotype: Guadeloupe, Duss 481, TUR-VAIN 22602)

A. SEM micrograph, cross-section of flattened isidium, 2000x

B. SEM micrograph, isidia, 50x.


A

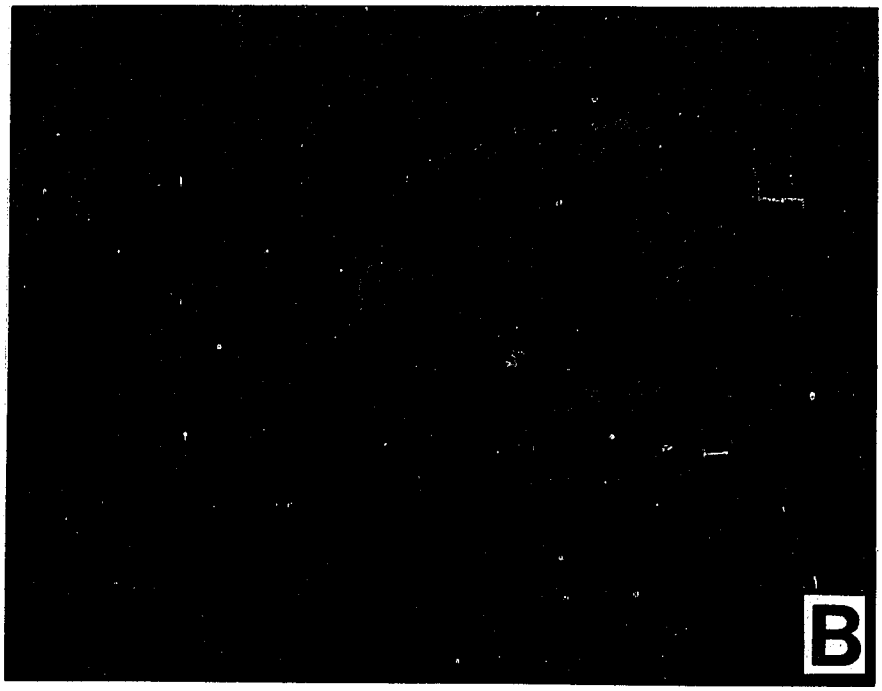

B

FIG. 27. Phyllopsora corallina var. santensis (USA, Florida, Brako 8227, NY).

A. SEM micrograph showing smooth surface of the apothecia and globose to cylindrical isidia, 50x.

B. Habit, scale = 2 mm.


A

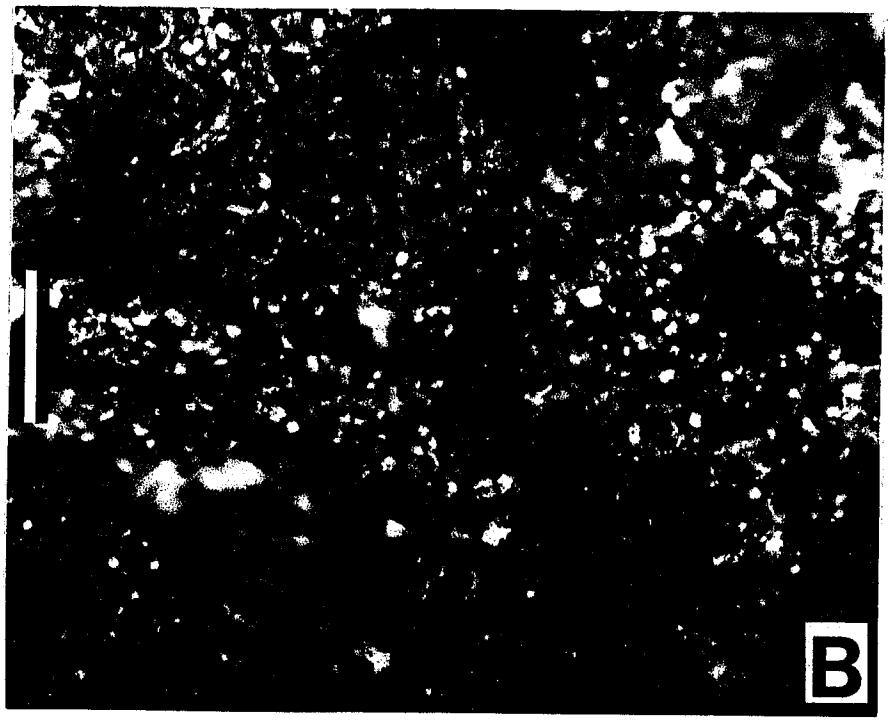

B

FIG. 28. A. Phyllopsora cuyabensis (Holotype: Brazil, Malme, Lich. Regnell. s.n., S) 12x.

B. Phyllopsora fendleri (Venezuela, Merida, López-Figueiras & Sipman 18483, MERF) 12x.


A

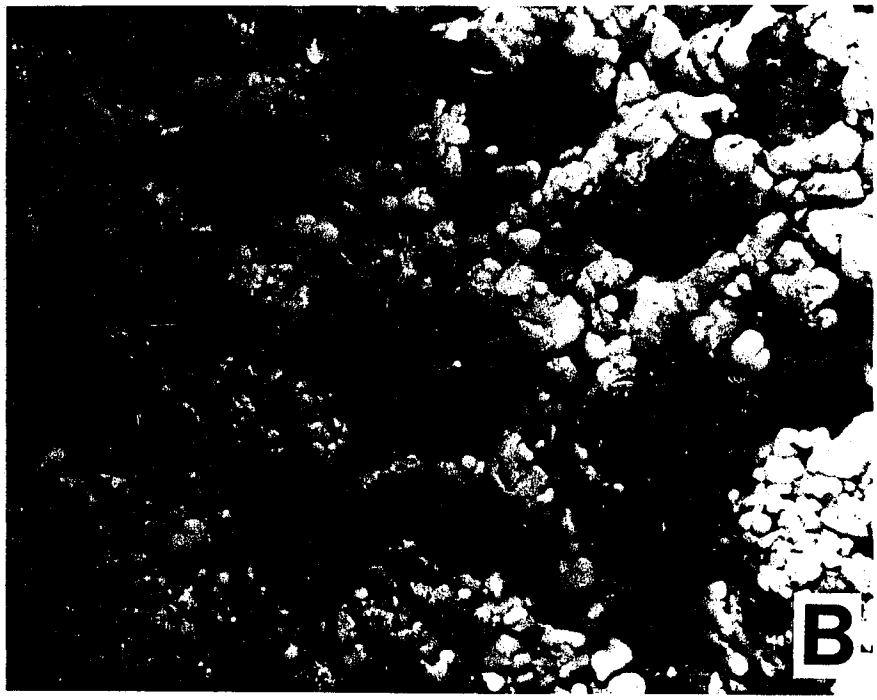
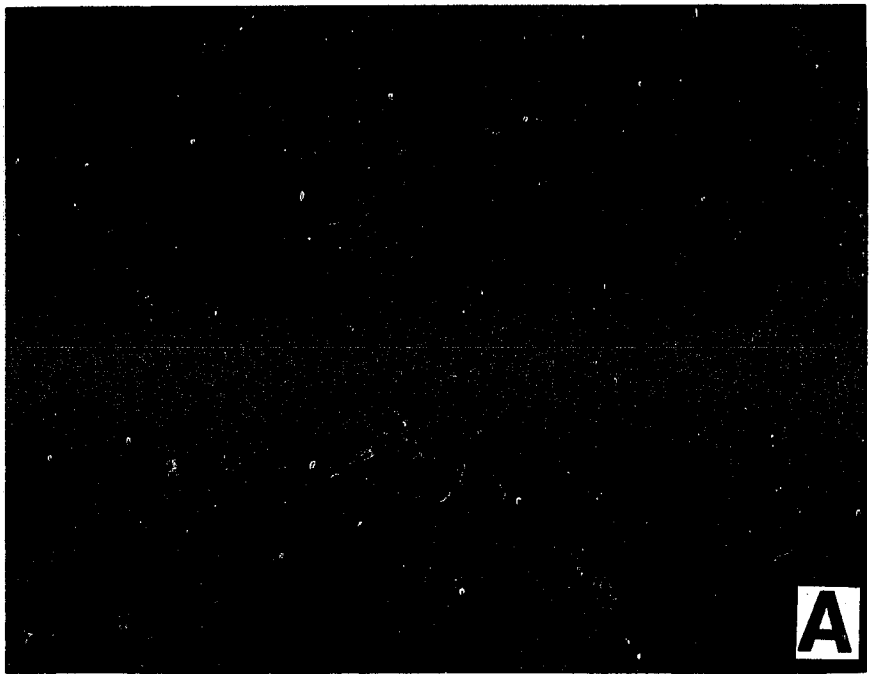

B

FIG. 29. Phyllopsora cuyabensis (Holotype: Brazil, Malme, Lich. Regnell. s.n., S)

A. SEM micrograph showing young squamules, 400x.

B. SEM micrograph showing rough upper cortex, 100x.


A


B

FIG. 30. A. Phyllopsora furfuracea (Dominican Republic, Harris 19751, NY) 12x.

B. Phyllopsora halei (Holotype: USA, Louisiana, Hale 58, FH-TUCK 2828) 12x.


A

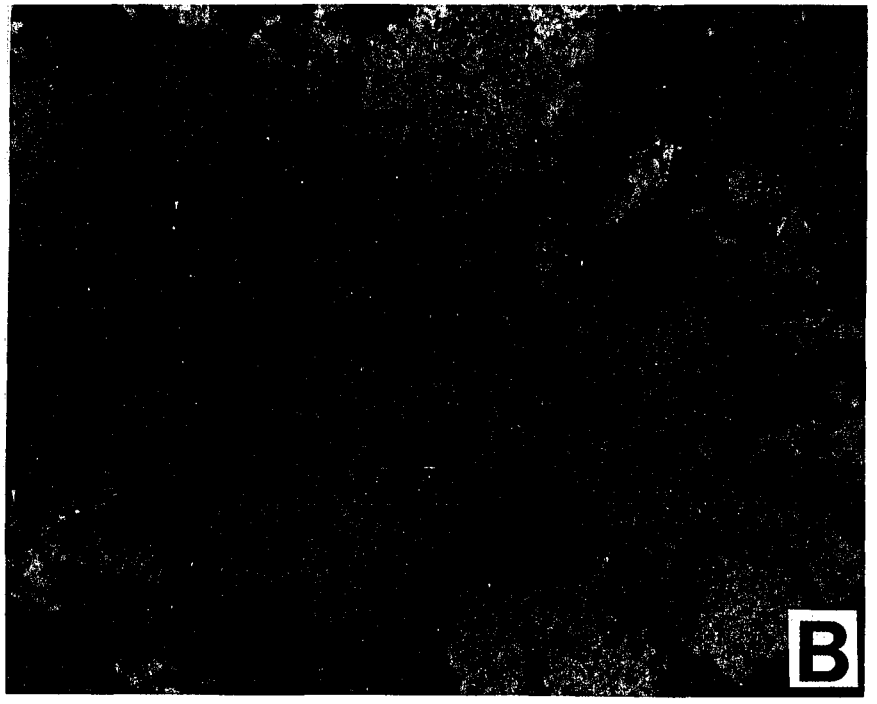

B

FIG. 31. A. Phyllopsora intermediella (Ecuador, Galapagos Islands, Isla Santa Cruz, Weber L-40262, COLO) 12x

B. Phyllopsora isidiotyla (Holotype: Brazil, Vainio, Lich. Bras. Exs. 222, TUR-VAIN 22634) 12x.


A

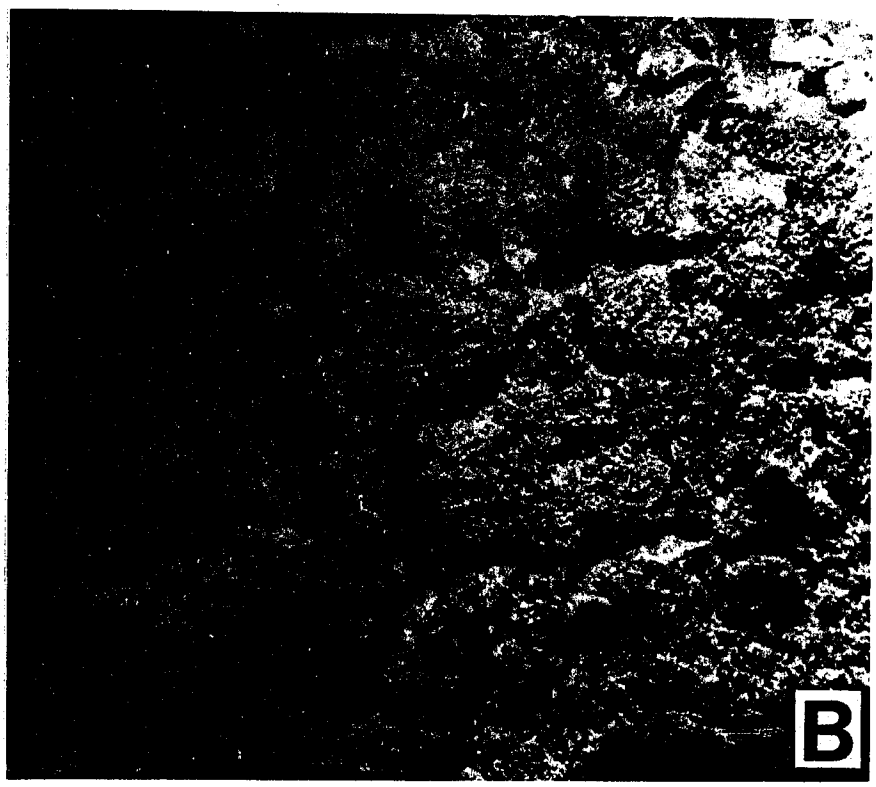
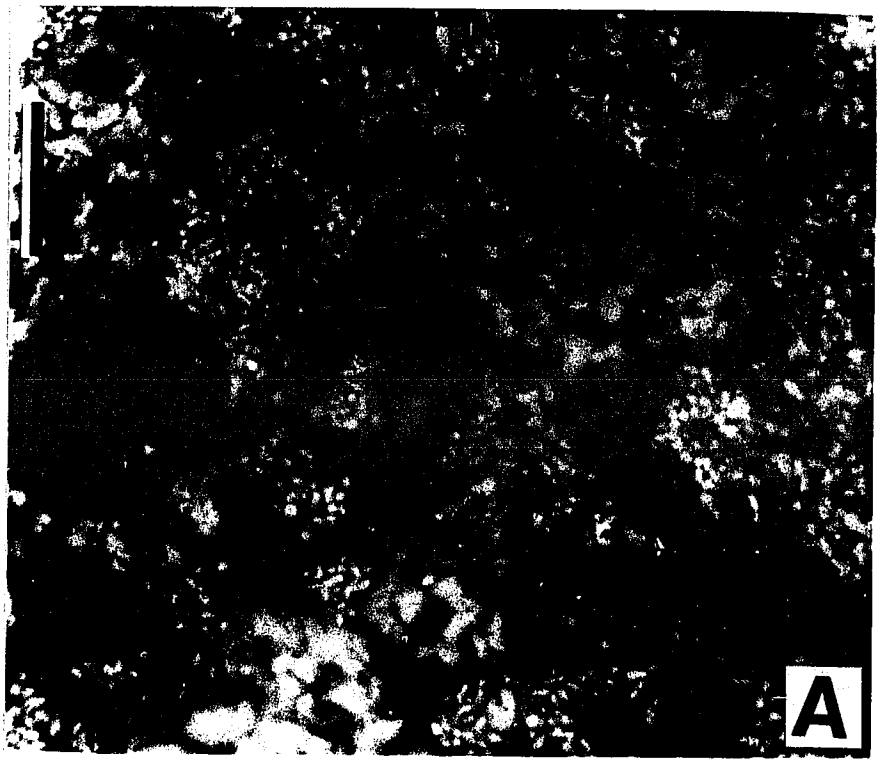

B

FIG. 32. A. Phyllopsora kalbii (Holotype: Brazil, Kalb 258, NY), scale = 2 mm.

B. Phyllopsora minor (Lectotype: St. Vincent, Elliott 261, TUR-VAIN 22612A), scale = 2 mm.


A

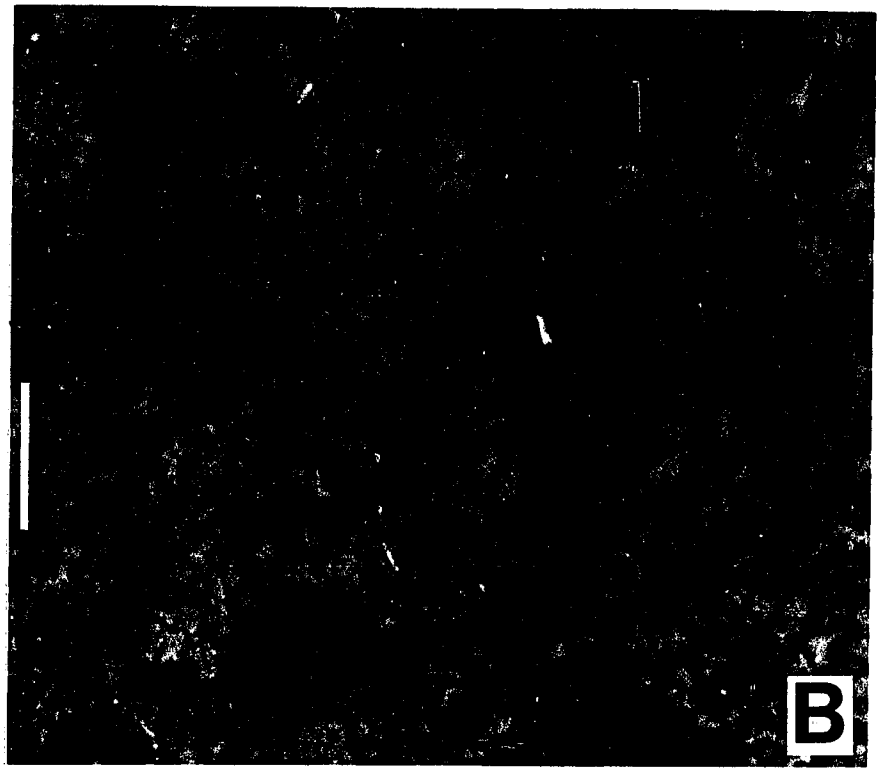
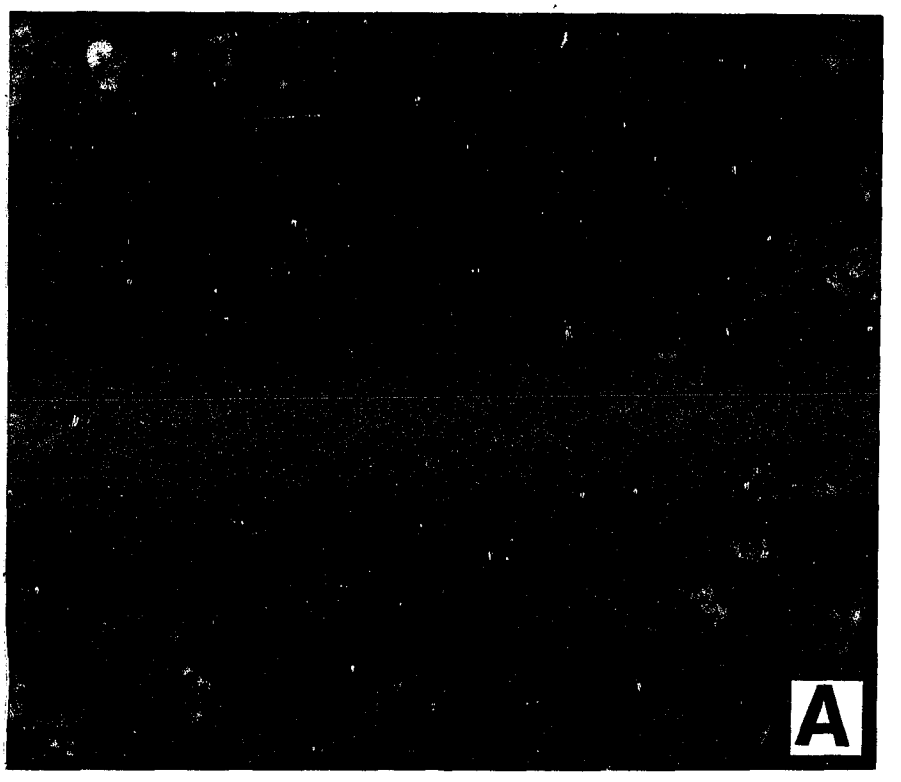

B

FIG. 33. Phyllopsora parvifolia (Brazil, Malme, Lich. Regnell. 1227, S).

A. Habit, 12x.

B. Lobules, 24x.


A

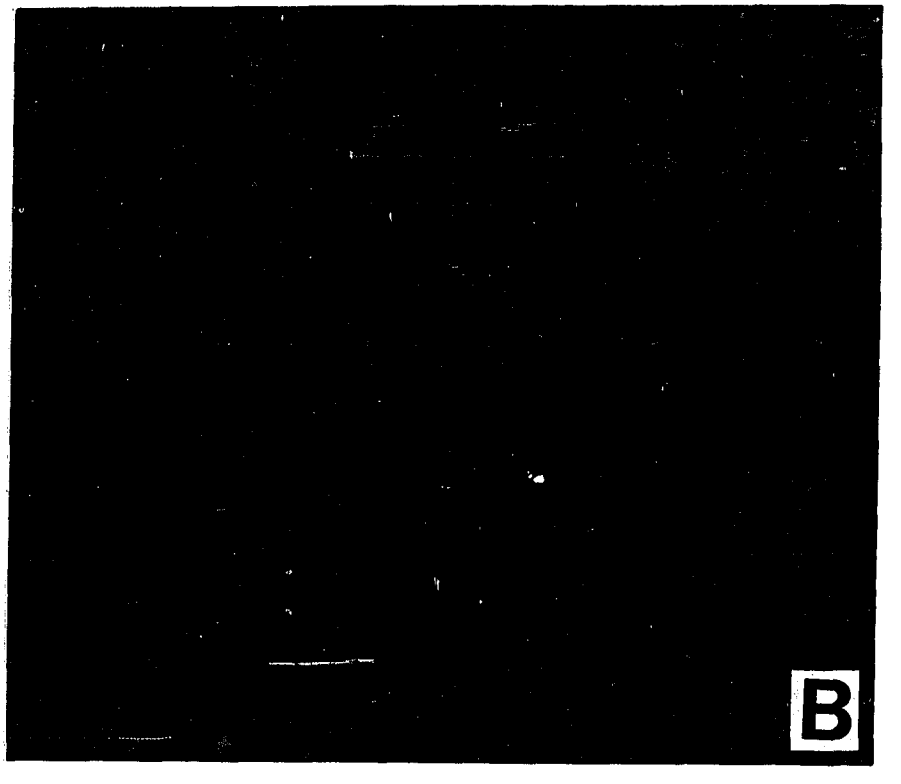
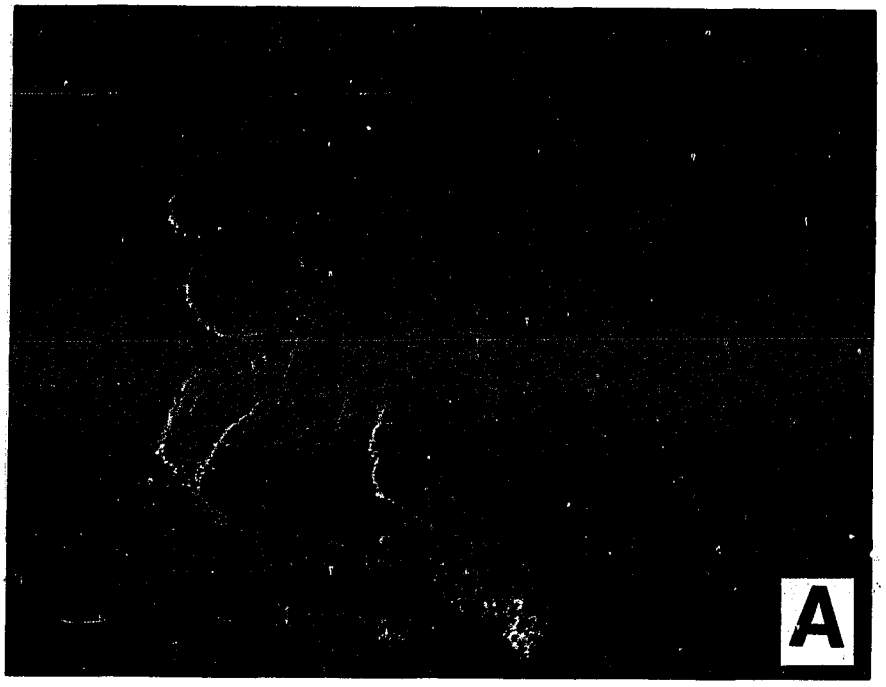

B

FIG. 34. Phyllopsora parvifolia var. breviuscula (Isotype: Cuba, Wright, Lich. Cub. 181, UPS).

A. SEM micrograph showing fan-shaped squamules and pycnidia (arrow), 40x.

B. Habit, scale = 2 mm.


A

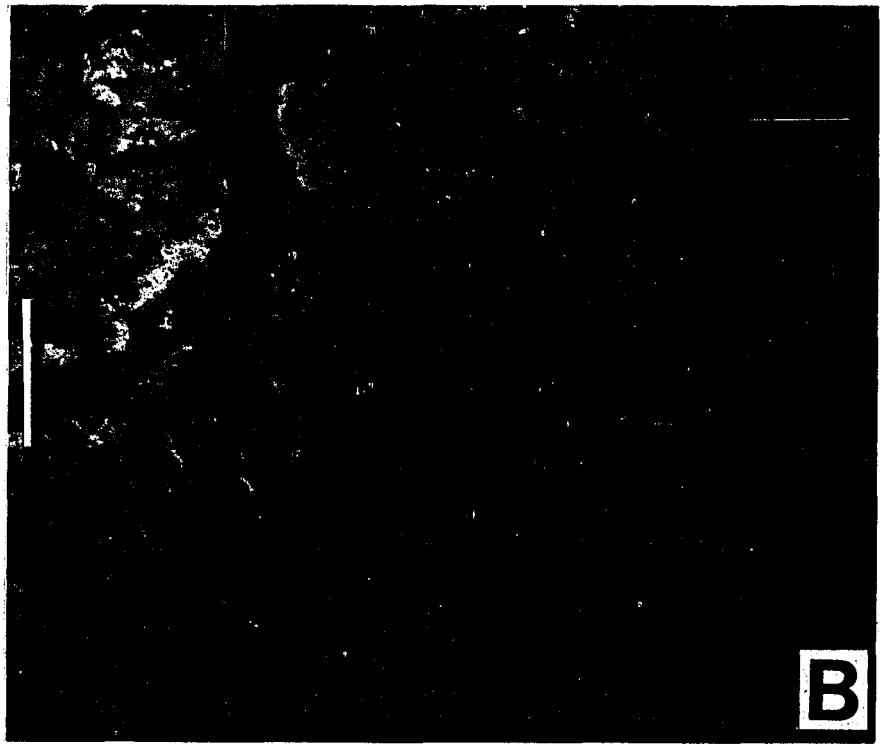
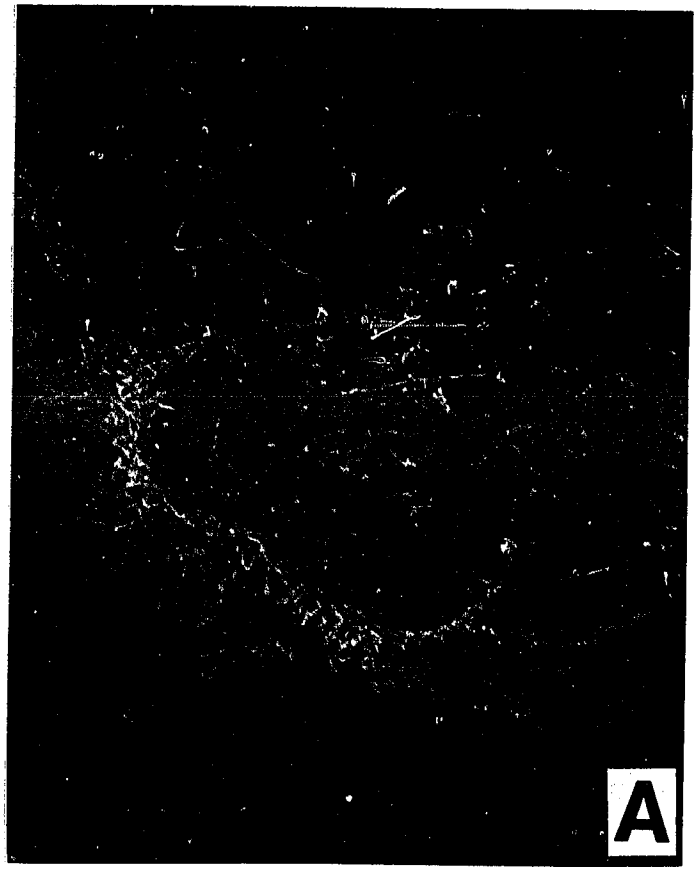

B

FIG. 35. Phyllopsora parvifolia var. breviuscula (Isotype: Cuba, Wright, Lich. Cub. 181, UPS).

A. SEM micrograph of upper surface of squamules with coarse projecting fibrils, 150x .

B. SEM micrograph of upper surface, 400x.


A

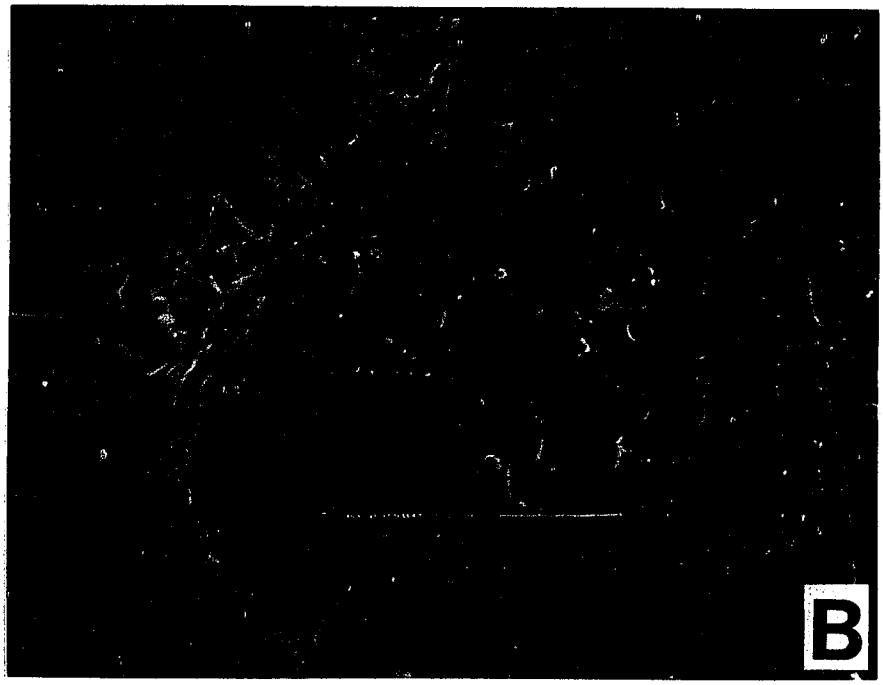

B

FIG. 36. Phyllopsora parvifoliella (Lectotype: Wright, Lich. Cub. 182, BM) 12x.

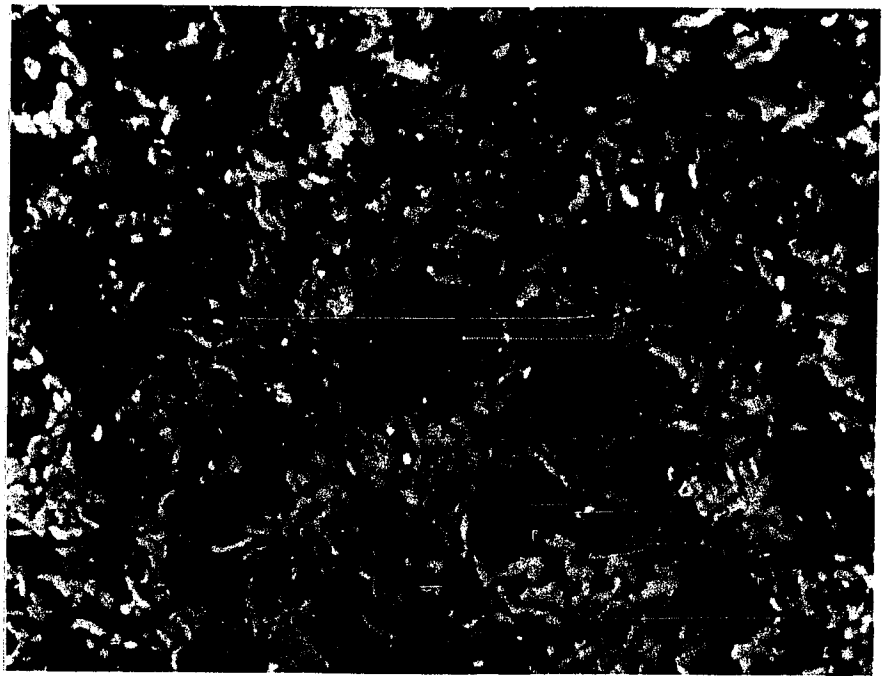


FIG. 37. A. Phyllopsora subcrustacea (Holotype: Paraguay, Malme, Lich. Regnell. 1612B, S) 12x.

B. Phyllopsora rosei (Holotype: Great Britain, James s.n., BM) 12x.


A

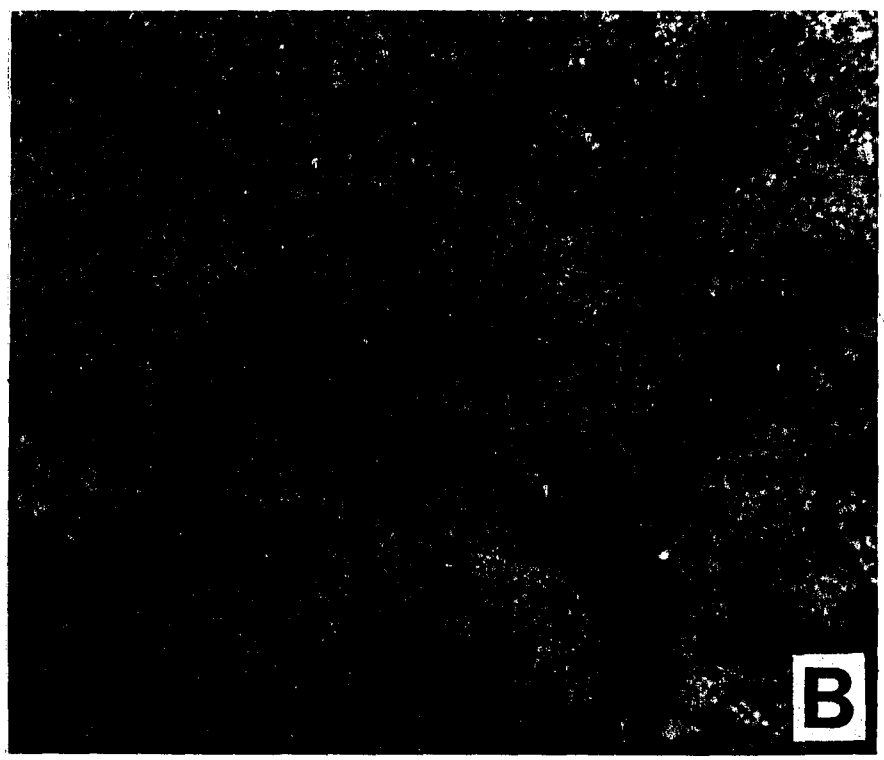
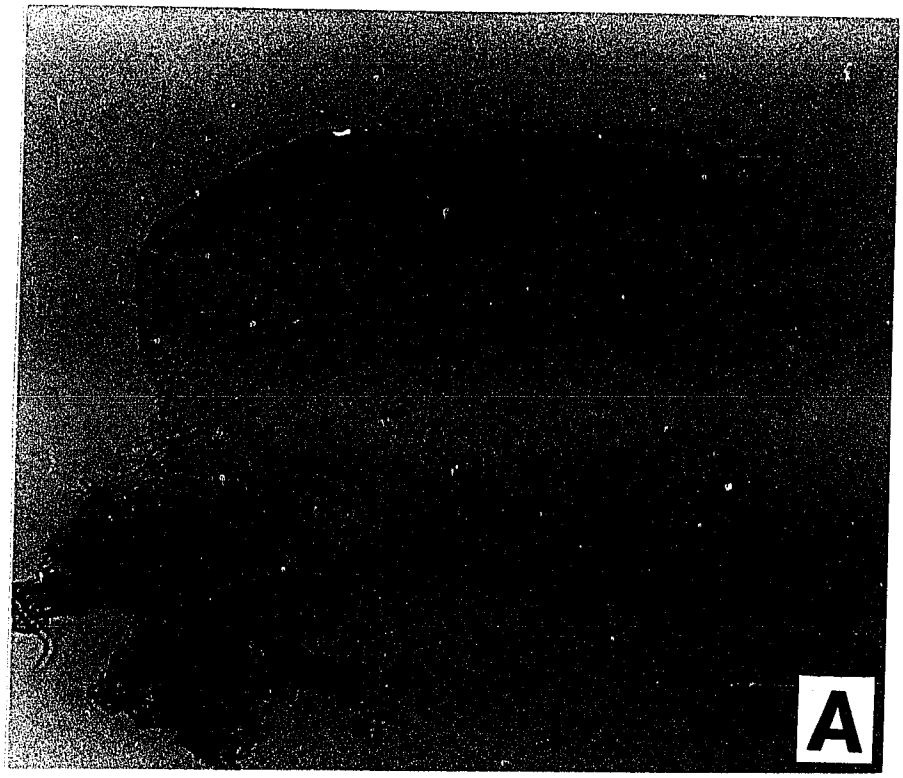

B

FIG. 38. Phyllopsora rosei (Holotype: Great Britain, James s.n., BM).

A. Cross-section of apothecium, 100x.

B. Cross-section of apothecium, 400x.


A

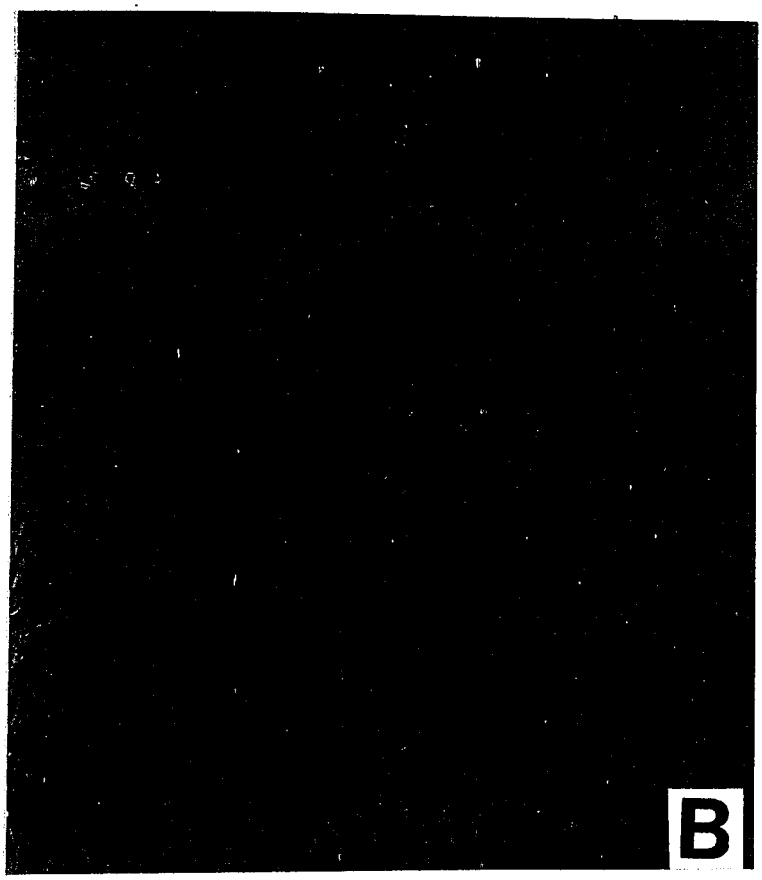
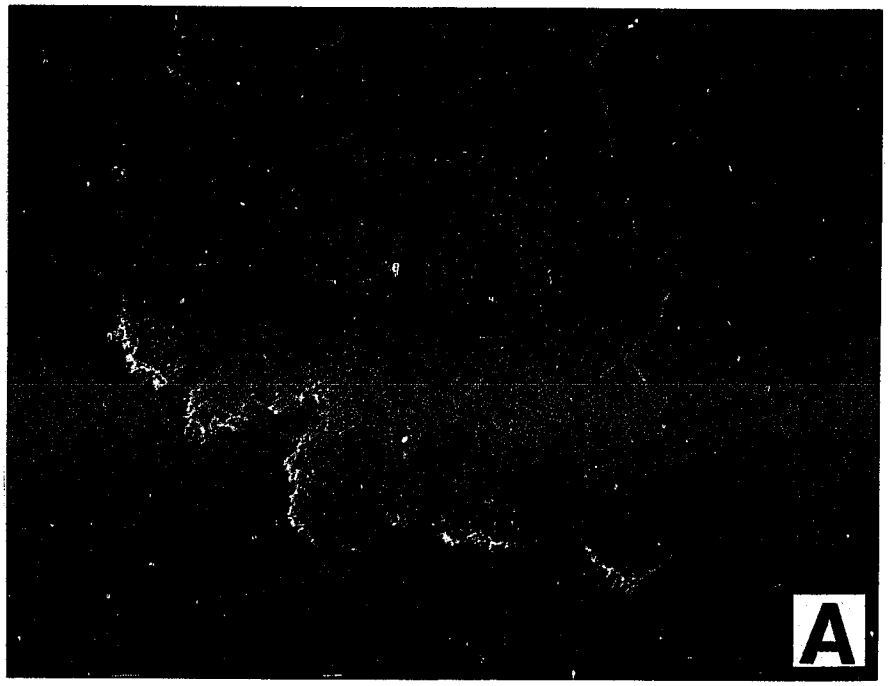

B

FIG. 39. Crocynia pyxinoides (Brazil, Kalb 268, Hb. Kalb)

A. SEM micrograph of squamules, 40x

B. Habit, 24x.

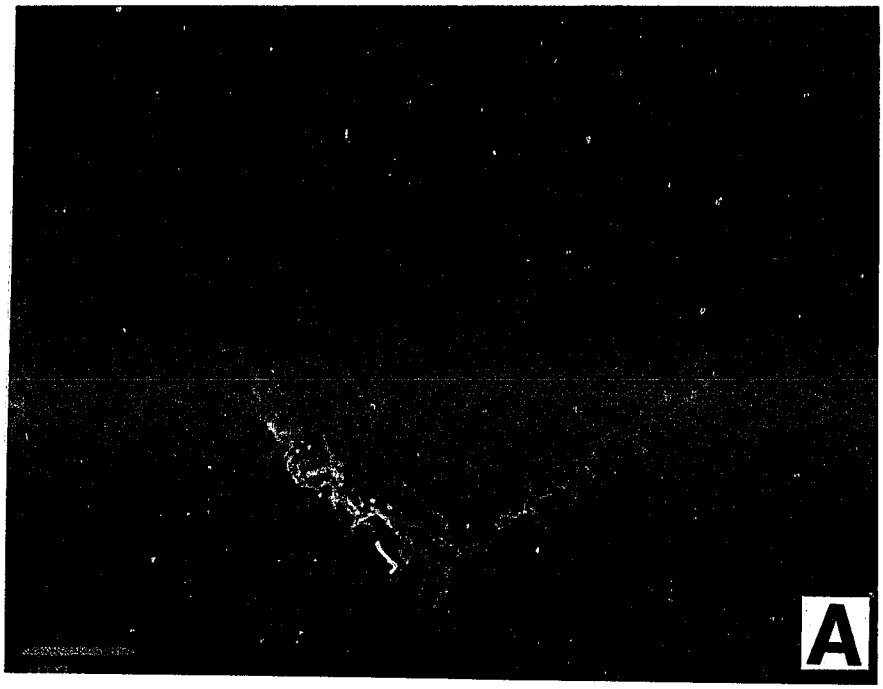

A


B

FIG. 40. Crocynia pyxinoides (Brazil, Kalb 268, Hb. Kalb).

A. SEM micrograph of upper surface of squamules, 150x

B. SEM micrograph of upper surface of squamules, 400x


A

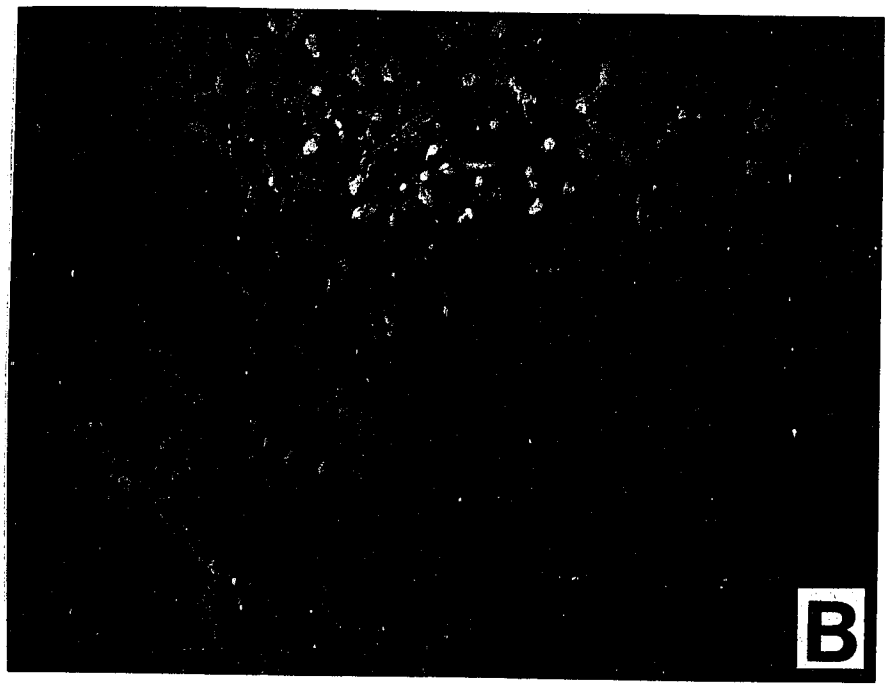

B

FIG. 41. Crocynia pyxinoides (Brazil, Kalb 268, Hb. Kalb).

A. Cross-section of apothecium, 100x.

B. Cross-section of apothecium, 400x.


A

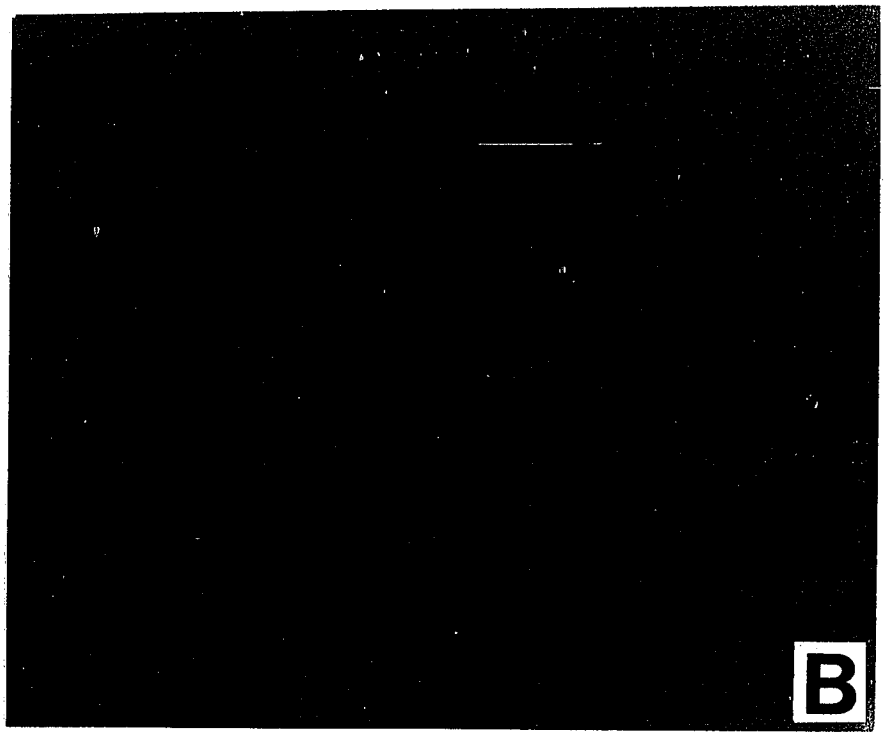

B

FIG. 42. Crocynia pyxinoides (Brazil, Kalb 268, Hb. Kalb).

Asci and paraphyses mounted in MLS, scale = 10 um.

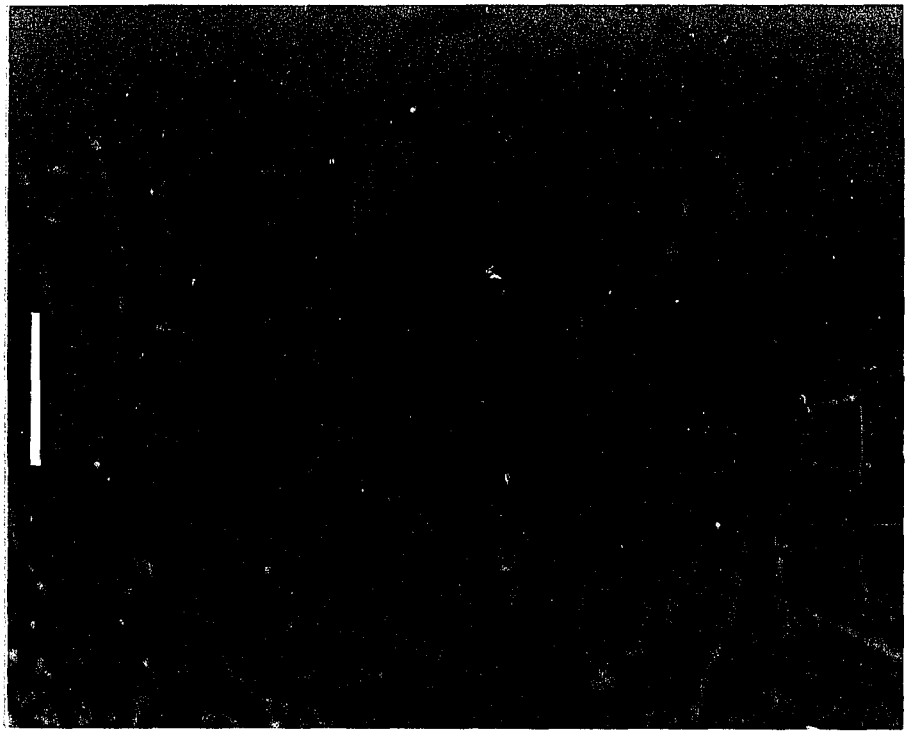
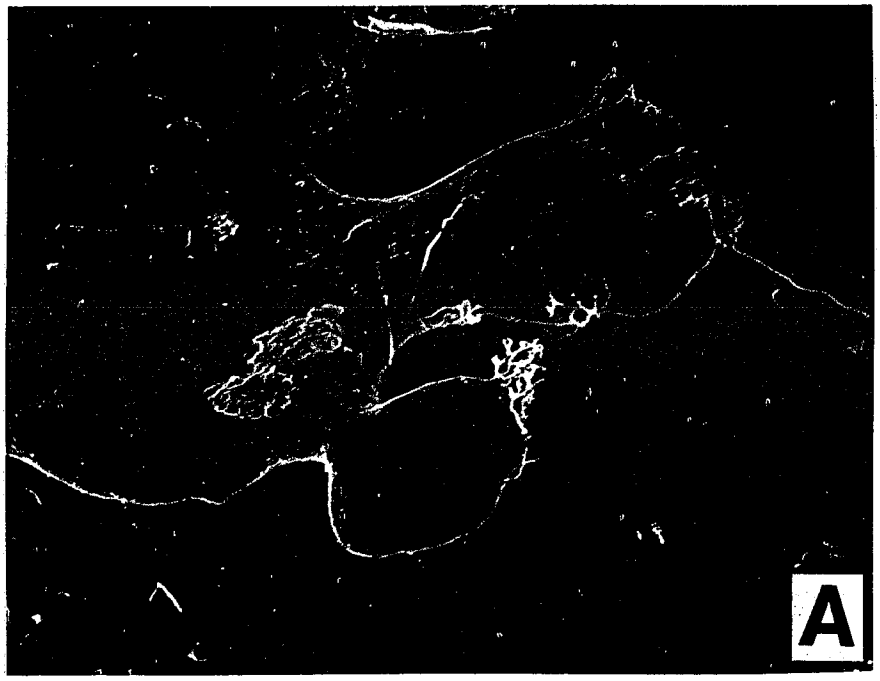


FIG. 43. Eschatogonia prolifera (Guyana, Sipman & Aptroot 18812, B).

A. SEM micrograph of upper surface of squamule, 150x.

B. SEM micrograph of upper cortex, 3000x


A

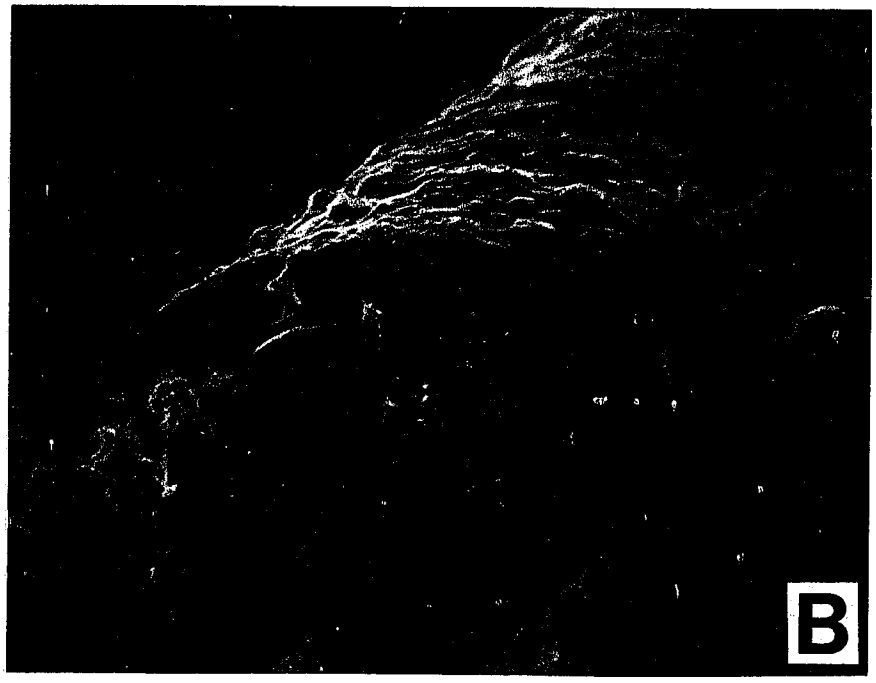
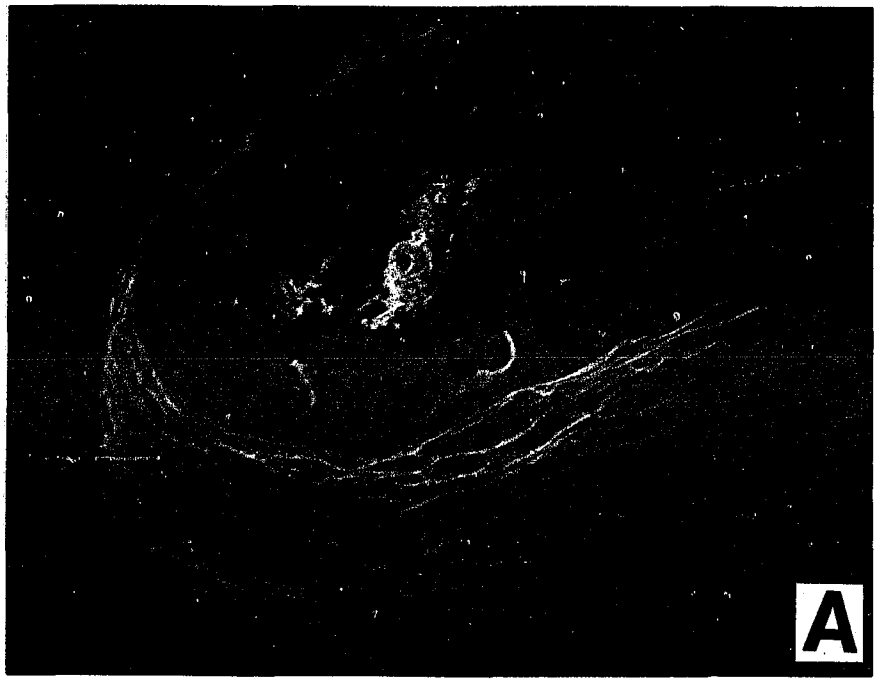

B

FIG. 44. Eschatogonia prolifera (Guyana, Sipman & Aptroot 18812, B).

A. SEM micrograph of cortex, 3000x.

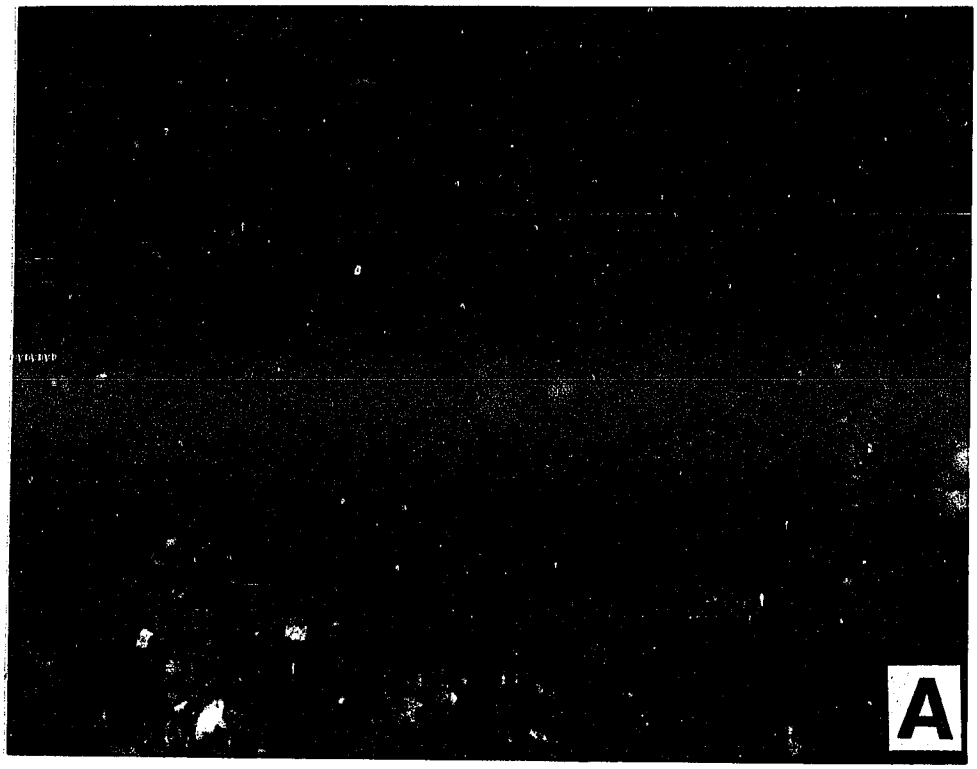
B. Cortex and attached apothecium, 24x.


A


B

FIG. 45. A. Psorellopsis cognata (Isolectotype: Cuba, Wright, Lich. Cuba. 218, FH-TUCK 3019) 12x.

B. Biatora pyrrhomelaena (Isolectotype: Cuba, Wright, Lich. Cub. 178, BM) 12x.


A

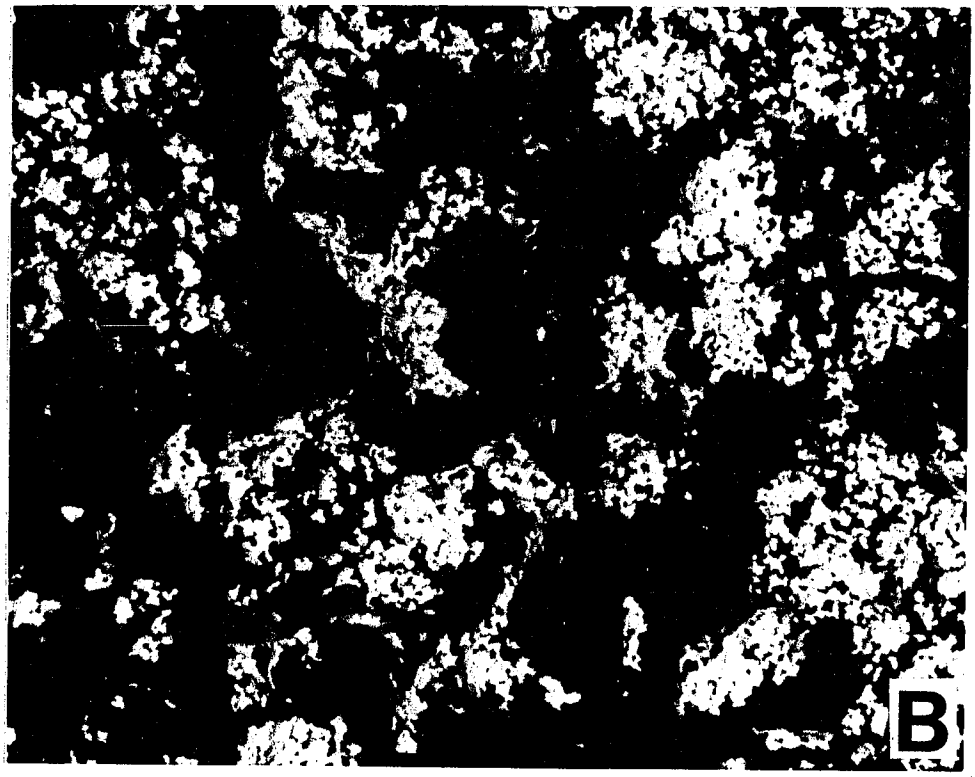

B

FIG. 46. Psorellopsis cognata (Isolectotype: Cuba, Wright, Lich. Cuba 218, FH-TUCK 3019).

A. Cross-section of apothecium, 120x.

B. Cross-section of apothecium, 240x.

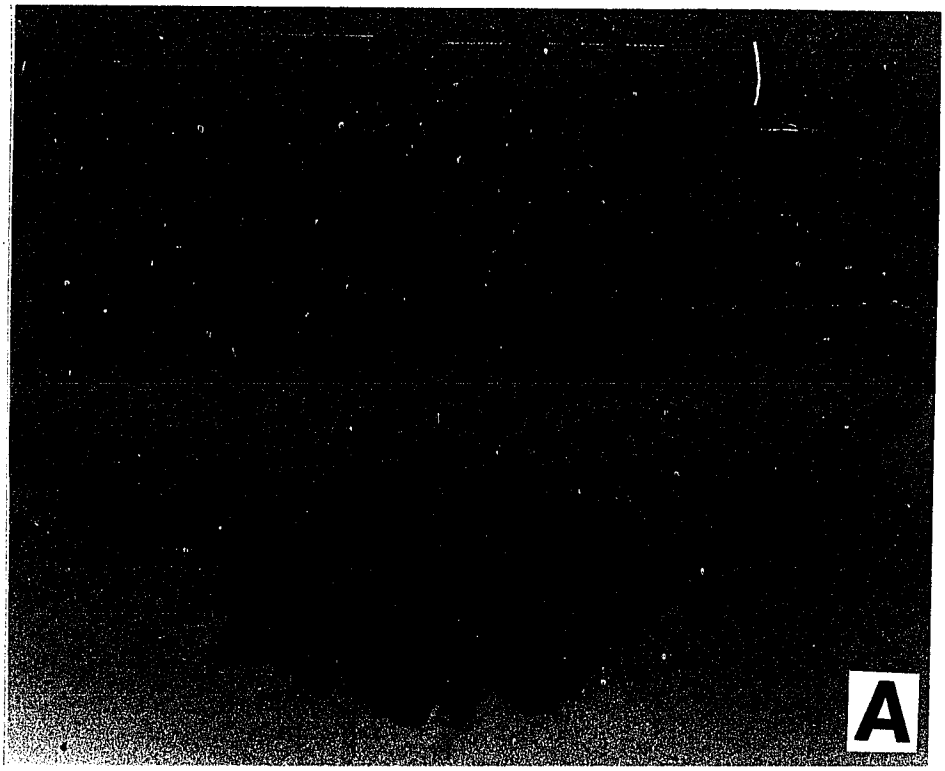

A


B

FIG. 47. Psorellopsis pertexta (Holotype: Cuba, Wright s.n., H-HYL 17344).

A. Cross-section of apothecium, 120x.

B. Cross-section of apothecium, 240x.


A

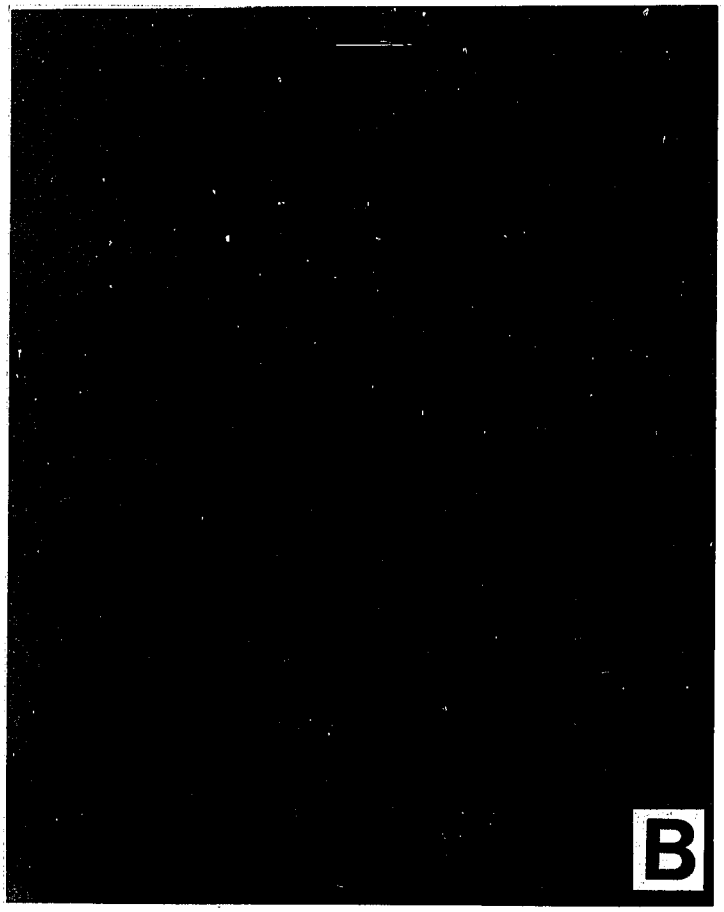
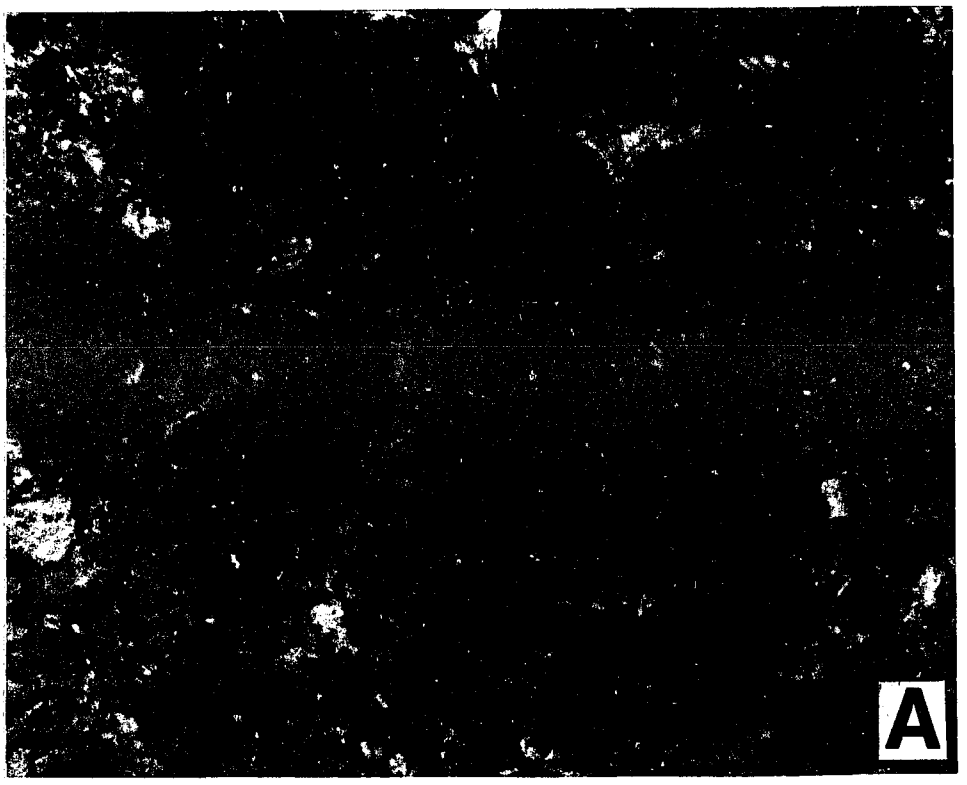

B

FIG. 48. A. Lecidea thaleriza (Holotype: South Africa, McOwan s.n., BM) 12x.

B. Lecidea compaginata (Holotype: Paraguay, Balansa 4134, G), scale = 1 mm.


A


B