

A MONOGRAPH
OF THE GENUS
ANAPTYCHIA

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WITH 56 FIGURES ON 9 PLATES



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Although *Anaptychia* is one of the commonest foliose lichen genera in tropical and temperate regions, it has never been revised monographically from modern taxonomic principles. There are, however, several regional revisions of the species in South America (Vainio, 1890; Lyngé, 1924) and Europe (Lyngé, 1916, 1935; Maas Geesteranus, 1952), but these revisions, in which comparatively few species are treated, are in many respects floras rather than monographs. In these revisions as well as in publications of other lichenologists the taxonomic treatment of the genus is not entirely satisfactory. Our knowledge of *Anaptychia* is based on numerous fragmentary publications, in which new taxa are frequently described without adequate reference to older taxa and without sufficient comparison with type specimens. There is also much confusion among lichenologists on the recognition of the various taxa, and it has been found necessary to revise many of the names.

It is more than a century since Körber (1848) published his "Grundriß der Kryptogamen-Kunde," in which he proposed the genus *Anaptychia*. In 1853, Massalongo published his "Memorie Lichenografiche." Here he enumerated 21 species of *Anaptychia*, transferring to the genus the species already described in the literature and adding several new species. Massalongo's concept of *Anaptychia* was rather broad, for it included some species of *Physcia*. Before Massalongo's publication, a number of well known species had already been described by the older lichenologists. Linnaeus, for example, described *Lichen leucomelos* and *L. ciliaris* in *Species plantarum* (ed. 2). Acharius also devoted some attention to *Anaptychia* species. In his earlier papers he referred them to the genera *Lichen* or *Parmelia*. Ten species now recognized as *Anaptychia*, about half of which he described as new, were enumerated in his last work, the comprehensive *Synopsis Methodica Lichenum*.

Important contributions to our knowledge of *Anaptychia* were made by Taylor (1847), but few lichenologists have paid any attention to them. Taylor described under *Parmelia* six species now recognized as *Anaptychia*. Although few in number, most of these species, except for *Parmelia ophioglossa*, are now recognized as valid. Thus, when Massalongo published in 1853 his important contribution to *Anaptychia*, more than 15 species, about half of the well known species, had already been de-

scribed by various authors. Our knowledge of the genus has been based for the most part on the work of these classical lichenologists.

Many recent workers, including Müller Argau, Vainio, Zahlbruckner, and Lynge, have tried to identify exotic *Anaptychia* almost exclusively with the older well known species, *A. hypoleuca*, *A. speciosa*, *A. leucomelaena*, *A. podocarpa*, etc., to which there is sometimes no relation at all. For instance, Müller described under *Physcia speciosa* many varieties and forms which are now usually recognized as distinct species. Vainio made a gross error in the interpretation of *A. hypoleuca* in his *Étude Lich. Brés.* Furthermore, up to the present time, no lichenologist has ventured to propose a subgeneric classification for *Anaptychia*, because it has been considered to be one of the simplest lichen genera.

With these points in mind, I began monographic work on *Anaptychia* in 1957. During the course of the study I published several regional revisions of the Japanese species, typifying wherever possible the taxa. It became evident, however, that the study should be extended to include the whole world. In the present work, therefore, I have attempted to complete a world monograph of the genus. My main objectives have been to typify each taxon already described, applying the type method, to describe new taxa, and finally to use the knowledge thus gained to erect a taxonomic subdivision of the genus. I have made considerable use of chemical components, which are one of the most important criteria used to distinguish the species.

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Diagnostic Characters

1. Thallus

The thallus of all *Anaptychia* species is foliose and dorsiventral, and the lobes are composed of repeatedly branched laciniae. In most species the laciniae are linear-elongate and adnate on the substratum, but in several species they are often ascending or suberect, for example in *A. podocarpa*, *A. echinata*, and *A. subascendens*. The laciniae, whether adnate or suberect, have an upper cortex, and the margins are distinctly or indistinctly corticate. In addition, several species, such as *A. fusca*, *A. speciosa*, *A. pseudospeciosa*, *A. diademata*, and *A. firmula*, are corticate on the underside. The cortex without exception is composed of conglutinated, thick-walled hyphae oriented mostly parallel to the surface in a longitudinal section.

Two species, *A. intricata* (Desf.) Mass. and *A. ephebea* (Ach.) Sant., have long been placed in *Anaptychia*. They have a strictly fruticose growth form with little or no dorsiventral differentiation. I feel that these two species do not belong in *Anaptychia* but should be removed to Trevisan's genus *Tornabenia*.

As I have already pointed out (1959a, p. 119), the thickness of the upper cortex in *A. hypoleuca* (Fig. 1) varies considerably in a transverse section of the laciniae. The cortex often projects downward into the medulla, and the lower surface of the cortex is distinctly flexuose. Hence the gonidial layer situated below the cortex is often interrupted and discontinuous. The same thickening of the upper cortex has been reported by Awasthi (1957, p. 136) in *A. pellucida*. The upper cortex of *A. pseudospeciosa* (Fig. 2) by comparison is more or less uniformly thickened and the gonidial layer is continuous. The type of thickening of the upper cortex is considered here to be one of the most important characters in separating species.

Anaptychia speciosa and related species have a lower cortex composed of longitudinally arranged thick-walled hyphae, as in the upper cortex, but a lower cortex is absent in most other species. Presence or absence of a lower cortex is therefore an important diagnostic character.

2. Rhizines

Rhizines are present in all *Anaptychia* species, even in species with ascending or suberect laciniae. They are rather variable in branching, length, and color. In most species, they originate from the marginal cortex. In species with a lower cortex they also originate on the under-surface and are not usually visible from above. The marginal rhizines of species without a lower cortex often project outwards and are very distinct from above. In fact, these marginal rhizines resemble cilia such as are found in some species of *Parmelia*. However, I hesitate to regard them as cilia. They have the same origin as typical rhizines and seem only to be a variation of rhizines.

Awasthi (1960, p. 440) feels that rhizines are not reliable as taxonomic characters because they merely seem to be ecological adaptations. I am inclined to think that they can be reliably used to distinguish species, especially if they are correlated with other characters. For example, the rhizines of *A. squamulosa*, a species with marginal and laminal squamules, are rather short and of the same color as the thallus, at least near the base. On the other hand, the rhizines of a closely related species, *A. fragilissima*, are very long and always jet black, and the laciniae are minutely dissected along the margins.

Tomentose or pubescent laciniae are very rare in *Anaptychia*, and so far they are known to occur only in *A. ciliaris* and *A. kaspica*. Laciniae with cilia on the uppersurface are also very rare in the genus. Laminal cilia are usually quite different from rhizines in branching and sometimes in color. In *A. comosa* and *A. cubensis* they are mostly simple and more pellucid than the rhizines.

3. Apothecia

In *Anaptychia*, apothecia originate within the thallus and are surrounded by a highly developed thalline margin. In the earlier stages, however, the margin of an apothecium is almost entire and the thalline margin is rather thin. The apothecia of *A. erinacea* are rather small and the margins are entire. They appear to represent the simplest juvenile stage in this type of development, and by their small size seem to have been arrested in this stage. The apothecia of *A. fusca*, *A. ciliaris*, *A. palmulata*, *A. ulothricoides*, and other species resemble the poorly developed type in having

almost entire margins, even though they are rather large and have quite thick thalline margins.

Most species with adnate growth form have laminal apothecia, but in the *podocarpa* group with subsascending laciniae they are terminal or subterminal. The development of apothecia in the *leucomelaena* group seems to represent a transition between laminal and terminal apothecia. The apothecia of *A. leucomelaena*, *A. neoleucomelaena*, etc., arise near the tips of laciniae, and after the apices of the laciniae cease further elongation, they become revolute by projection of the apothecia. Therefore the apothecia at maturity appear to be terminal or subterminal.

Lacinules arising from the margins of apothecia appear to be formed by elongation of the thalline margin. They have the same anatomy as the thallus; that is, if the thallus lacks a lower cortex, the lacinules also lack a cortical layer on the inner side. By contrast, lacinules of the *speciosa* group are corticate on both sides, as are the main laciniae. In several species, for example *A. lamelligera* and *A. coronata*, which lack a lower cortex, the lacinules are corticate only on the inner (or upper) side and are decorticate on the outer (or lower) side. This same condition can be seen in *A. subaquila* and *A. tentaculata*.

The margins of apothecial lacinules are sometimes ciliate. This character can apparently be used reliably to distinguish species, especially in the *A. podocarpa* group. For instance, the lacinules of *A. echinata* always have long simple cilia of the same color as the thallus. These cilia are not true cilia but a kind of rhizine, because they usually have the same color and branching as the rhizines of the thallus. The apothecial lacinules of *A. subaquila* and *A. tentaculata* are rhizinate below, just as the laciniae of the thallus are.

Some species of *Anaptychia* have hairs (or cilia) or spinules on the receptacle of the apothecia. This character seems to be extremely stable and is useful in distinguishing species.

The hymenium is tinged blue with I (iodine) in all species of the genus. When I is applied to a section of the thallus or apothecium, the cortex is tinged violet to bluish violet in several species. This I⁺ blue reaction was first reported by Vainio (1890, p. 137) in *A. obscurata* var. *serpens* (= *A. dactyliza* f. *serpens*) and recently by Awasthi (1957, p. 134) in *A. pellucida* and *A. himalayaensis*. However, the reaction in the thalline cortex is unstable, and it is not reliable enough to distinguish species. The I reaction is positive in only a few specimens of *A. hypoleuca*, negative in the majority. On the other hand, the reaction in the cortex of the receptacle is rather stable, especially in the *podocarpa* group. It is remarkable that localities of species exhibiting a positive I reaction, excepting *A. dactyliza*, are concentrated in eastern Asia.

4. Spores

The spores in the earlier stages have a uniformly thickened thin wall with one main elongate locule (sporoblast). A median septum soon forms and the two resulting locules begin to divide. In *A. ciliaris*, *A. ulotbricoides*, *A. fusca*, *A. palmulata*, and other species, the division ends at this stage, and later the spores turn dark brown (Fig. 3). Consequently the spores in these species always have rather thin walls. It is noteworthy that no lichen substances have been demonstrated in any of these species (excepting *A. fusca*). In the *speciosa* and *hypoleuca* groups the wall thickens, and the spores are uniformly thick-walled at maturity. The coloration of the spores apparently commences when the wall is completely thickened (Fig. 4).

A number of lichenologists, including Zahlbruckner, have considered the spores of *Anaptychia* to be two-celled. In many species, however, a number of smaller cells may be seen between the main locules and the outer spore wall. For the purposes of this article, I am defining these cells as "sporoblastidia." In order to see them clearly, the spores must be examined in a 0.5% iodine solution, for they are nearly invisible when examined in water or glycerin-alcohol-water. Sporoblastidia arise from each end of the main locules, in most cases as if by budding (Fig. 5). They even arise from the lateral parts of the locules as well as from the apical part, in *A. leucomelaena*, *A. dactyliza*, *A. pellucida*, etc., and the mature spores almost look multicellular or muriform (Fig. 6).

If we consider the development of spores, we can recognize three distinct groups of species: (1) those with thin-walled spores, (2) those with thick-walled spores, and (3) those with thick-walled spores and sporoblastidia at maturity. These three types are of fundamental importance in the taxonomic subdivision of the genus.

5. Chemical Components

The chemical components of each species or taxon are just as important in the taxonomy of *Anaptychia* as they are in *Cladonia*, *Parmelia*, and *Cetraria*. It is quite impossible to make an intelligent study of *Anaptychia* without using chemistry as a taxonomic character of the same level of importance as morphological characters. For lichenologists who are not conversant in microchemical methods, this will impose definite limitations on their ability to use the keys in this monograph and identify species. Unfortunately this situation cannot be avoided here any more than it could be in *Cladonia* or *Parmelia*.

Since there is very little recent information on the chemistry of *Anaptychia*, I found it necessary to analyse the chemicals in all of the

species, using Asahina's standard microchemical methods. Abbreviations of chemical reagents used are as follows: K, an aqueous mixture of equal volumes of 5% potassium hydroxide and 20% potassium carbonate; C, saturated solution of bleaching powder; PD, a 2% ethanolic solution of paraphenylenediamine (it is also convenient to use a small brush dipped in alcohol, rubbed on a PD crystal, and applied to the thallus); I, a 0.5% iodine solution; G.A.W., glycerin-ethanol-water (1:1:1); An, glycerin-ethanol-aniline (2:2:1); o-T, glycerin-ethanol-*o*-toluidine (2:2:1); and Ac. X., the dried acetone extract of thallus fragments.

The following lichen substances were found in *Anaptychia*.

1. Atranorine. This substance gives yellow slender curved needles with o-T or An. The occurrence of this common substance has already been reported by Asahina (1936) and Hale (1956, p. 115).

2. Zeorine. The occurrence of this substance has been reported by Asahina and Yoshioka (1940) and Hale (1956). When the Ac. X. is heated with An or o-T under a cover glass, double pyramid-shaped colorless crystals are formed.

3. Norstictic acid. Norstictic acid usually occurs together with salazinic acid in *Anaptychia*. When a mixture of both acids is treated with K without heat, fine red needles of the potassium norstictate complex appear first. After a short while, the red x-shaped crystals of the potassium salazinate complex may be observed. Norstictic acid may also be proved easily with o-T, in which it forms pale yellow 4-angled lamellae.

4. Salazinic acid. This acid occurs alone or mixed with norstictic acid. In o-T it forms characteristic boat-shaped yellow crystals.

5. An undetermined substance first reported in *A. dissecta* (Kurokawa, 1959b, p. 182). Up to the present time I have found that it also occurs in *A. angustiloba*, *A. albidiflava*, *A. pandurata*, and *A. spinulosa*. The medulla of species containing this substance reacts PD⁺ deep yellow. When the Ac. X. is heated with An, fusiform, deep yellow thin plates are observed (along with the slender curved needles of atranorine and the double pyramid-shaped crystals of zeorine). The crystals in o-T are deep yellow, rectangular parallelepiped, and show straight extinction with respect to the long edges.

6. An undetermined substance in *A. appalachensis*. When the Ac. X. is treated with K without heat, fine straight colorless needles radiating from a point are precipitated.

Besides the above colorless substances, there are a few pigments that have not yet been chemically identified but which are extremely important for species determination. For example, there is an undetermined yellow pigment, reacting K⁺ deep purple, deposited on the under-

surface of *A. obscurata*, *A. flabellata*, *A. dendritica*, *A. hypochraea*, and *A. pandurata*. The medulla in *A. firmula* and *A. rugulosa* is pigmented by a yellow substance reacting K⁺ purple. The undersurface of *A. obesa* is beautifully orange-yellow, and that of *A. vulgaris* is partly purple-violet. These pigments are probably anthraquinones, judging from their color reaction with K. Other yellow pigments that are negative with K are probably pulvic acid derivatives; they are found in *A. appalachensis*, *A. casarettiana*, *A. corallophora*, *A. lamelligera*, and *A. lutescens*.

No lichen substances at all have been found in a few species, in particular *A. ciliaris*, *A. palmulata*, and *A. ulothricoides*. These species all have thin-walled spores.

Subgeneric Classification

Of the diagnostic characters outlined above, spore differences are considered of primary importance in setting up two sections within the genus. The origin of apothecia and growth form of the thallus can be used to divide the sections into series. The following division of *Anaptychia* is proposed. These taxa will be described and discussed more fully where they occur in the list of species below.

ANAPTYCHIA Körb.

Section 1. **ANAPTYCHIA**

Series 1. **Anaptychia**

Series 2. **Speciosae** Kurokawa

Section 2. **POLYBLASTIDIUM** Kurokawa

Series 1. **Polyblastidium**

Series 2. **Palpebratae** Kurokawa

Series 3. **Leucomelaenae** Kurokawa

Series 4. **Podocarpae** Kurokawa

Phytogeography

Studies of the distribution of *Anaptychia* based on literature reports are of course not satisfactory. There has been a great deal of confusion among lichenologists as to the proper recognition of the species, and the genus has long been in need of a critical study. Although the precise delimitation of the distribution patterns for all of the species are not yet perfectly known, the following features of phytogeography may be noted.

The morphologically primitive members of the genus, that is species in the series *Anaptychia* (*A. ciliaris*, *A. fusca*, *A. palmulata*, *A. ulothricoides*,

etc.), all with thin-walled spores, have all certainly originated from a northern or boreal stock. None of them have been found yet in the Southern Hemisphere. They also tend to have rather restricted ranges. For instance, *A. ciliaris* and *A. fusca* are apparently restricted to Europe, and *A. palmulata* is found only in eastern North America and eastern Asia. However, *A. kaspica* occurs not only in Europe but also in North America and Nepal, and it may be regarded as an incompletely circum-boreal element.

Many species in the series *Speciosae* with thick-walled spores appear to be widely distributed in temperate and tropical regions. Although *A. obscurata*, *A. flabellata*, and other species in the series *Polyblastidium* may be regarded as forming a pantropical element, there appear to be two main centers of distribution, one in the Americas tropics and one in the Himalayas. Section *Polyblastidium* reaches its highest development in these two regions. On the other hand, other species in this section are widely distributed in the Southern Hemisphere.

The distribution of *A. hypoleuca* is quite remarkable. It occurs in eastern North America, eastern Asia, including Formosa, and the eastern part of the Himalayas. This type of distribution has been known for vascular plants since the 19th century and has been discussed in detail for mosses by Iwatsuki (Journ. Hattori Bot. Lab. 20: 304. 1958). *A. palmulata* has a similar disjunctive distribution in eastern North America and eastern Asia (Fig. 9a).

Taxonomic Treatment

ANAPTYCHIA KÖRB.

Anaptychia Körb. Grundr. Krypt.-Kunde, 197 (1848).

Lichenoides [Dill.] Hoffm. Descr. Adumbr. Pl. Lich. 1: 12. 1790. Type: *Lichenoides ciliare* (L.) Hoffm. [= *Anaptychia ciliaris* (L.) Körb.].

Hagenia Eschw. Syst. Lich. 20. 1824 (non Gmelin 1791 = Rosaceae). Type: *Hagenia ciliaris* (L.) Eschw. [= *Anaptychia ciliaris* (L.) Körb.].

Heterodermia Trev. Atti Soc. Nat. Milano 11: 613. 1868. Lectotype: *Heterodermia ciliaris* (L.) Trev. [= *Anaptychia ciliaris* (L.) Körb.].

Pseudophyscia Müll. Arg. Bull. Herb. Boiss. II Append. 1: 10. 1894. Lectotype: *Pseudophyscia ciliaris* (L.) Müll. Arg. [= *Anaptychia ciliaris* (L.) Körb.].

Cbaudburia Zahlbr. Ann. Mycol. 30: 432. 1932. Type: *Cbaudburia indica* Zahlbr. [= *Anaptychia diademata* (Tayl.) Kurokawa].

Thallus foliose; laciniae dorsiventral, usually repeatedly branched, corticate on the uppersurface or on both the uppersurface and the lower-surface, cortex composed of densely intertwined hyphae oriented mostly in a longitudinal direction.

Apothecia sessile or substipitate, lecanorine; hymenium hyaline, I+ blue; hypothecium indistinctly delimited from the proper exciple; paraphyses filamentous, septate, sparsely branched near the apices, apices brown and more or less inflated; asci cylindrical or subclavate, 8-spored; spores ellipsoid, often with a median constriction, brown to dark brown, 1-septate, with 2 locules, locules sometimes with sporoblastidia at maturity.

Type species: *Anaptychia ciliaris* (L.) Körb.

It has long been thought that the genus *Anaptychia* was first proposed by Massalongo in his "Memorie Lichenografiche" in 1853. Actually Körber published *Anaptychia* as a nomen novum for the genus *Hagenia* Eschw. in 1848. Even though Körber did not publish a diagnosis for *Anaptychia*, the name must be considered as validly published because he cited *Hagenia* as a synonym and pointed out that *Hagenia* Eschw. was a later homonym of *Hagenia* Gmel. The genus *Hagenia* Eschw. is typified by *H. ciliaris* (L.) Eschw., so that the type species of *Anaptychia* is *A. ciliaris* (L.) Körb.

Prior to Körber's publication, Hoffmann in 1790 had adopted the name *Lichenoides*, based on a "genus" of Dillenius. He cited three species, *L. flammeum*, which is *Xanthoria flammea* (L.) Hillm., *L. hispidum*, a doubtful species, and *L. ciliare*, which is *Anaptychia ciliaris* (L.) Körb. The latter species is the most obvious choice as a lectotype for the genus *Lichenoides*.

The generic name *Lichenoides*, although validly published, has not been used since Hoffmann's time, whereas *Anaptychia* has long been the commonly used name for this genus. For this reason, I would propose that *Anaptychia* be conserved against *Lichenoides* as a nomen genericum conservandum.

Acharius in Luyken, Tentament Historiae Lichenum (1809), included some species of *Anaptychia* in his genus *Borrera*. However, *Borrera* is a synonym of *Teloschistes* and is properly typified by *Teloschistes chrysophthalmus* (L.) Beltr.

KEY TO THE SECTIONS OF ANAPTYCHIA

- 1a. Locules of spores without sporoblastidia Sect. 1. *Anaptychia*
- 1b. Locules of spores with sporoblastidia at maturity . Sect. 2. *Polyblastidium*

Section 1. ANAPTYCHIA

Spores ellipsoid, with a median constriction, brown to dark brown, 1-septate, with 2 locules, walls thin or thickened, uniformly thickened.

Type species: *Anaptychia ciliaris* (L.) Körb.

KEY TO THE SERIES OF SECTION ANAPTYCHIA

- 1a. Spore walls thin Ser. 1. *Anaptychia*
- 1b. Spore walls thickened Ser. 2. *Speciosae*

Series 1. **Anaptychia**

Spores ellipsoid, with a median constriction, brown, 1-septate, with 2 locules, spore wall thin.

Type species: *Anaptychia ciliaris* (L.) Körb.

This series is characterized by producing brown spores with thin walls. None of the species here produce any lichen substances, except for *A.fusca*. They are apparently restricted in range to the Northern Hemisphere.

KEY TO SPECIES IN SERIES ANAPTYCHIA

- 1a. Laciniae more or less ascending apically; surface tomentose.
 - 2a. Receptacle of apothecia without spinules (1) *A.ciliaris*
 - 2b. Receptacle of apothecia with spinules (2) *A.kaspica*
- 1b. Laciniae loosely appressed to the substratum; surface not tomentose.
 - 3a. Thallus greyish to dirty white (8) *A.ulotbricoïdes*
 - 3b. Thallus greenish olive to dark brown.
 - 4a. Thallus isidiate (5) *A.isidiza*
 - 4b. Thallus without isidia.
 - 5a. Thallus covered with long narrow lacinules in the central part (6) *A.stippaea*
 - 5b. Thallus without lacinules.
 - 6a. Margins of apothecia entire or nearly entire.
 - 7a. Thallus brown to dark brown, rhizines simple and short (3) *A.fusca*
 - 7b. Thallus olive brown to brown, rhizines, often squarrosely branched (4) *A.palmulata*
 - 6b. Margins of apothecia distinctly lacinulate.
 - 8a. Laciniae entirely corticate below; Formosa (9) *A.tentaculata*
 - 8b. Laciniae partly corticate below; Mediterranean region (7) *A.subaquila*

1. *ANAPTYCHIA CILIARIS* (L.) Körb.

in Mass. Mem. Lichenogr. 35. 1853 (Figs. 3, 7)

Lichen ciliaris L. Sp. Pl. 2: 1144. 1753. *Lobaria ciliaris* (L.) Hoffm. Deutschl. Fl. 144. 1795. *Parmelia ciliaris* (L.) Ach. Meth. Lich. 255. 1803. *Physcia ciliaris* (L.) DC. in Lam. et DC. Fl. France, ed., 3, 2: 396. 1805. *Borreria ciliaris* (L.) Ach. Lich. Univ. 496. 1810. Lectotype: Specimen illustrated by Dillenius (Hist. Musc. 150. 1742) in Tab. XX, fig. 45 (OXF).

Many varieties and forms have been described for *A.ciliaris*, especially in Europe, but only a few of them seem worthy of recognition.

KEY TO FORMS OF *A. CILIARIS*

- 1a. Laciniae less than 2 mm. wide f. *nigrescens*
- 1b. Laciniae more than 2 mm. wide.
 - 2a. Pycnidia rare or absent.
 - 3a. Margins of apothecia distinctly lacinulate f. *ciliaris*
 - 3b. Margins of apothecia crenate or almost entire f. *agriopa*
 - 2b. Pycnidia numerous, frequently congested in low semiglobose verrucae; verrucae often confluent.
 - 4a. Verrucae of the same color as the thallus or somewhat darker ...
..... f. *verrucosa*
 - 4b. Verrucae dark brown to blackish brown f. *melanosticta*

1a. f. *CILIARIS*

Parmelia ciliaris δ *actinota* Ach. Meth. Lich. 256. 1803. *Anaptychia ciliaris* f. *actinota* (Ach.) Arn. Flora 67: 166. 1884. Holotype: Suecia (H).

Thallus foliose, greyish white or sordid to brownish grey, loosely attached to the substratum and forming extensive colonies up to 15 cm. or more across, composed of linear-elongate and repeatedly dichotomously branching laciniae; laciniae subascending towards the apices, more than 2 mm. wide, plane or somewhat convex, pubescent; beneath decorticate, paler than the upper surface, irregularly veined, with marginal rhizines of the same color as the thallus, 1–6 mm. long, simple or rarely branched towards the apices, pubescent. Laciniae about 300 μ thick; upper cortex irregularly thickened and its lower surface distinctly flexuose, sometimes projecting downward to the lower surface of the thallus without any cover of medulla; gonidial layer often interrupted by the upper cortex and discontinuous, gonidia 10–15 μ in diameter; medullary layer very thin and in places evanescent; lower cortex absent.

Apothecia laminal, stipitate or subsessile, 2–5 mm. in diameter, margins lacinulate, lacinules ciliate along the margins; disc brown or dark brown, white pruinose but at length often naked; receptacle without spinules; hymenium 150–200 μ high, I⁺ blue; cortex of receptacle irregularly thickened, I⁻; asci cylindrical or somewhat clavate, about 120 \times 30 μ ., 4–8-spored, spores dark brown, ellipsoid and with roundish apices, more or less constricted at the center, 17–23 \times 28–43 μ ., spore walls thin and uniformly thickened.

Reaction: Thallus K⁻. ; med. K⁻, C⁻, KC⁻, PD⁻.

Chemical ingredient: No lichen substances demonstrated.

This typical form is characterized by lacinules on the margins of apothecia, and the thallus is often well developed, often attaining a diameter of 20 cm. or more. It appears to be the commonest and best developed form of *A. ciliaris*. The type specimen of *A. ciliaris* designated above in OXF has lacinules on the margins of apothecia.

Anaptychia ciliaris and its various forms seem to be among the most common lichens in northern Europe. Its range extends westward to European Russia and the Caucasus, but it has not yet been collected in eastern Siberia or Saghalien.

Representative specimens examined:¹⁾ **Europe:** Norway. Fet, Gan, Lyngø (FH). Sweden. Par Kyrkslätt, Nylandia, G. Lång (FH). Finland. Valamo Island, Karelia Ladogensis, Norrlin et Nylander, Herb. Lich. Fenn. 95 (FH, sub *Physcia ciliaris* f. *scopulorum*). Austria. Near Pottenstein, Flora Exs. Austro-Hung. 343 (FH). Switzerland. Geneva, without collector (FH).

1b. f. *AGRIOPA* (Ach.) Boist. Nouv. Fl. Lich. 2: 49. 1903

Parmelia ciliaris β. *agriopa* Ach. Meth. Lich. 255. 1803.

There are three specimens on a sheet labeled "Borreria ciliaris var. *agriopa*" in the Acharian herbarium at H. One of them is marked with an X, probably by Acharius himself, and is the most suitable type for f. *agriopa*, a plant with short, subdigitately branched laciniae and a naked disc.

Representative specimens examined: Norway. Oslo, Aker, F. Kior (FH). Sweden. Västergötland, Magnusson 5198 (FH). Germany. Ludwigshafen am Rhein, Voigtländer (FH). Switzerland. Zürich, T. Fryman (FH). Canary Islands. Gran Canaria Island, San Mater, Cook 677 (FH). Italy. Hotel Itas, Liguria, Sbarbaro (FH).

1c. f. *VERRUCOSA* (Ach.) Boist. Nouv. Fl. Lich. 2: 49. 1903

Borreria ciliaris ε. *verrucosa* Ach. Lich. Univ. 497. 1810. *Hagenia ciliaris* f. *verrucosa* (Ach.) Rabenh. Deutsch. Kryptog. Fl. 2: 115. 1845. Lectotype: Helvetia (H), isotype in BM.

Pycnidia numerous, frequently congested in low semiglobose verrucae; verrucae concolorous with the thallus or darkening, often confluent.

There are two specimens on the sheet labeled *Borreria ciliaris* var. *verrucosa* at H. The larger one from Switzerland is marked with an X, in all probability after Acharius' time. It is an appropriate lectotype. The smaller specimen from "Amer. Bor." can be identified as *A. ecbinata* (Tayl.) Kurokawa.

¹⁾ Abbreviations of herbaria follow the Index Herbariorum (Lanjouw and Stafleu, 1956) except for the following: As = private herbarium of Y. Asahina, Tokyo; Aw = private herbarium of D. D. Awasthi, Lucknow; lkm = private herbarium of Y. Ikoma, Tottori, Japan; Krk = author's private herbarium; Nak = private herbarium of M. Nakanishi, Hiroshima, Japan; Tan = private herbarium of Y. Tanaka, Nara, Japan; and Yosh = private herbarium of I. Yoshimura, Kochi, Japan. In order to conserve space, I have cited only selected specimens examined, especially for the very common species.

Representative specimens examined: Sweden. Uppsala, F. Nord (FH). Finland. Mjölö, Helsinki, H. Hallmén (FH). U.S.S.R. Novgorod district, Savicz (FH).

1d. f. *MELANOSTICTA* (Ach). Harm. Lich. de France 447. 1907

Parmelia ciliaris γ. *melanosticta* Ach. Meth. Lich. 255. 1803. *Borrera ciliaris* γ *melanosticta* Ach. Lich. Univ. 497. 1810. *Physcia ciliaris* f. *melanosticta* (Ach). Th. Fr. Lich. Scand. 1: 133. 1871. Type: Europe, lectotype (H), isotype (BM).

Parmelia mamillata Tayl. in Hook. Lond. Journ. Bot. 6: 171. 1847. Lecto-type: Dr. Fischer (ex Herb. Hook.) (FH-Tayl).

Physcia ciliaris var. *scopulorum* Nyl. Not. Sällsk. Fauna Fl. Fenn. 3: 86. 1857. *Anaptychia ciliaris* f. *scopulorum* (Nyl.) Arn. Flora 67: 166. 1884. Holotype: Ad Kilsøng pasoichis (H: Nyl. Herb. 32577).

Thallus dark or sordid grey, sometimes brownish grey; pycnidia numerous, frequently congested in low semiglobose verrucae; verrucae dark brown or brownish black, often confluent.

Representative specimens examined: Norway. Lökeberg, F. Kior (FH). Sweden. Stockholm, A. Hülphers (FH). On marine rocks, Ljusterö, Uppland, Hülphers (FH). Germany. Buckow, Brandenburg, Hillmann (FH). U.S.S.R. Lars, Caucasus, Elenkin (FH).

1e. f. *NIGRESCENS* (Bory) Zahlbr. Cat. Lich. Univ. 7 :714. 1931

Borrera ciliaris β. *nigrescens* Bory, Exped. Sci. Morée 3 (2): 307. 1832. Type: Mt. Dia, in lîle de Naxos (not seen).

Borrera crinalis Schleich. in Schrad. Lich. Helvet. 488. 1839. *Parmelia ciliaris* var. *crinalis* (Schleich.) Torss. Emem. Lich. Byssac. Scand. 11. 1843. *Physcia ciliaris* var. *crinalis* (Schleich.) Schaer. Enum. Crit. Lich. Europe 10. 1850. *Anaptychia ciliaris* var. *crinalis* (Schleich.) Rabenh. Flecht. Europ. fasc. IV, no. 100. 1856. Type: Europe, isotype (?) in M.

Parmelia ciliaris var. *leptophylla* Wallr. Fl. Crypt. Germ. 3: 484. 1831. Type: Europe (not seen).

Borrera ciliaris c. *tomentella* Bory, Exped. Sci. Morée 3 (2): 307. 1832. Type: Mt. Dia, in lîle de Naxos (not seen).

Borrera ciliaris d. *glabrissima*, loc. cit. Type: Mt. Dia, Naxos, isotypes at G and H (Nyl. Herb. 32588).

Physcia ciliaris var. *solenaria* Duby in Schaer. Enum. Crit. Lich. Europe 10. 1850. *Anaptychia solenaria* (Schaer.) Savicz, Bot. Material, Notul. Syst. Sect. Crypt. 14: 5. 1961. Type: Europe (not seen).

This form is easily distinguished from other forms of *A. ciliaris* by having narrower laciniae less than 2 mm. wide. It is also very close to *A. kaspica* Gyel., a widespread species which differs in having spinules on the receptacle of apothecia.

Representative specimens examined: Sweden. Brännö, Västergötland, Kjellmert (US). No. precise locality, Stenhammar, Lich. Exs. Sueciae 42 (US). Stockholms Skärgård Harotan, Uppland, Vrang, Crypt. Exs. Vindob. 2470-b (US). Canary Islands. Teneriffa, Bourgeau, Pl. Canariensis 266 (US).

2. *ANAPTYCHIA KASPICA* Gyel. Ann. Crypt. Exot. 4: 166.1932

Type: Persia borealis, J. et A. Bornmüller 10249 (W, isotype).

Parmelia ciliaris var. *angustata* Tuck. Proc. Amer. Acad. Arts Sci. 1: 224. 1848.
Physcia ciliaris var. *angustata* (Tuck). Müll. Arg. Flora 65: 318. 1882. Type: Rocky Mountains (FH-Tuck).

Anaptychia ciliaris β. *angustata* Mass. Mem. Lichenogr. 35. 1853. Type: Newfoundland (M).

Thallus foliose, loosely adnate on bark or rock, brownish grey to dark brown, laciniate; laciniae linear-elongate, repeatedly dichotomously branched, convex, pubescent, 0.2–1.5 mm. wide; beneath decorticate, pale, canaliculate, more or less veined; rhizines marginal, mostly simple, of the same color as the thallus. Laciniae 220–300 μ thick; upper cortex more or less irregularly thickened, 30–120 μ thick, with a brownish outermost thin layer; gonidial layer discontinuous, gonidia 10–20 μ in diameter; medulla 140–180 μ thick; lower cortex absent.

Apothecia subterminal, more or less stipitate, 1–4 mm. in diameter; disc dark brown, white pruinose, becoming naked; margins almost entire; receptacle spinulate, spinules 0.3–1.0 mm. long, of the same color as the thallus; hymenium 150–170 μ high; asci 33–36 × 130–150 μ; spores brown, 1-septate, with 2 locules, 12–18 × 30–42 μ, walls thin.

Reaction: Thallus K⁻; med. K⁻, C⁻, KC⁻, PD⁻.

Chemical ingredients: No lichen substances present; crystals of calcium oxalate often deposited in the medulla.

This species has long been confused with *A. ciliaris* and has usually be considered a variety or form of it. However, *A. kaspica* is characterized by having narrower laciniae and by having spinules on the receptacle of apothecia. It is widely distributed in the Northern Hemisphere, whereas *A. ciliaris* seems to be restricted to Europe.

The name *A. ciliaris* var. *crinalis* has long been applied to this species. However, a specimen at M annotated by Schaerer as “*Borrera crinalis* Schleich.” is identical with *A. ciliaris* f. *nigrescens* (Bory) Zahlbr. As indicated above, this specimen may be an isotype of Schleicher’s species.

Specimens examined: **Asia.** India. Shankaracharya Hill, 5000 ft. Kashmir, Awasthi 2638 (Aw, FH, Krk, M); Near River Pahalgan, Seshadri A-7 (Awasthi 3403) (Aw); Near Tangmerg, 7000 ft., B. Kaul (Awasthi 4014) (Aw); Uri to Poonch, near Aliabod, Steward 13967 (FH). **North America.** Canada. Cliffs of Bic, Pringle (FH); near Cape Rossier, Macoun, Canad. Lich. 55 (FH); Cape Breton, Macoun, Canad. Lich. 25 (FH); top of seashore cliffs about 5 m. above sea, Mainadieu, Lamb 6925 (FH); Rimouski, Quebec, Collins 5083, 5138 (FH). U.S.A. Lake Superior, C. G. Loring (FH); Mackinac, Michigan, M. L. Wilson (FH); Mt. Horrid, Rochester, Vermont, D. L. Dutton 1409 (FH); northern Minnesota, Fink 200 (FH). **Europe.** Austria. Südtirol. 1400 m., Schröpel (M). Yugoslavia. Ragusa, Damatia, Latzel (FH).

3. *ANAPTYCHIA FUSCA* (Huds.) Vain.

Termész. Füzetek 22: 299. 1899

(Fig. 8a-c)

Lichen fuscus Huds. Fl. Angl. ed. 2, 533. 1778. Lectotype: Bangor (Wales?) (OXF). This specimen was first published by Dillenius (Hist. Musc. 175. 1741) in Tab. 24, fig. 69 and is apparently the same specimen referred to by Hudson.

Lichen aquilus Ach. Lich. Suec. Prodr. 109. 1798. *Parmelia aquila* (Ach.) Ach. Meth. Lich. 201, 1803. *Anaptychia aquila* (Ach.) Mass. Mem. Lichenogr. 36. 1853. *Physcia aquila* (Ach.) Nyl. Prodr. Lich. Gall., Act. Soc. Linn. Bord. 309. 1857. *Pseudophyscia aquila* (Ach.) Hue, Bull. Soc. Bot. Fr. 46: 1905. 1899. Holotype: Gallia austr. (H).

Parmelia crossophylla Wahlb. in Ach. Meth. Lich. Suppl. 48. 1803. *Parmelia aquila* β *crossophylla* Ach. Lich. Univ. 488. 1810. *Anaptychia fusca* var. *crossophylla* (Ach.) Anders. Strauch- u. Laubfl. Mitteleuropa. 208. 1928. Lectotype: Lapponia (H).

Physcia aquila var. *corsica* Müll. Arg. Flora 61: 483. 1878. *Anaptychia fusca* var. *corsica* (Müll. Arg.) Zahlbr. Cat. Lich. Univ. 7: 722. 1931. Holotype: Corsica, Requin, Boissier (G).

Physcia aquila var. *meridionalis* Müll. Arg. Flora 61: 483. 1878. *Anaptychia fusca* var. *meridionalis* (Müll. Arg.) Zahlbr. Cat. Lich. Univ. 7: 723. 1931. Holotype: Near Hyeres, Gallia merid., A. Metzler 69 (G).

Anaptychia palmatula var. *caucasica* Vain. Termész. Füzetek 22: 299. 1899. Holotype: On granite rocks, Caucasus, Lojka, It. Cauc. 1861 (TUR, Vain. Herb. 7852).

Thallus foliose, adnate to the substratum, chestnut-brown to blackish brown; laciniae repeatedly dichotomously or irregularly branched, sub-linear-elongate, more or less discrete to contiguous at the circumference but often covered with imbricate, narrower, short secondary lacinules towards the center; beneath sordid white or brownish, black at the center, corticate, sparingly rhizinate, rhizines brownish black to black, simple or rarely irregularly branched, 0.5–1.0 mm., long. Laciniae 300–400 μ thick; upper cortex colorless, with the brownish outermost layer covered by a hyaline thin horny layer 10–15 μ thick, in transverse section very irregularly thickened and its lower surface distinctly flexuose, varying from 30–100 μ in thickness, often projecting into the medulla and sometimes fusing with the lower cortex; gonidial layer often interrupted by the upper cortex, gonidia 8–12 μ in diameter; lower cortex thickened, 200–250 μ thick.

Apothecia sessile, 1–3 mm. in diameter; margin entire or somewhat crenate; disc concave or plane, blackish brown, without pruina; hymenium about 200 μ high, I+ blue; cortex of receptacle very thin along the lateral part and quite thickened (200–250 μ) at the base, I-; asci cylindrical or somewhat clavate, 30–40 \times 130–170 μ , 8-spored; spores dark brown, ellipsoid, with roundish apices and constricted at the center,

17–23×35–48 μ , 1-septate, with 2 hemispherical locules and a uniformly thickened wall (Fig. 8c). Pycnidia immersed in the thallus, with black tips; microconidia colorless, cylindrical, about 1×3 μ .

Reaction: Thallus K⁻; med. K⁻, C⁻, KC⁻, PD⁻.

Chemical ingredients: A small amount of atranorine can be demonstrated microchemically.

There are two specimens on the sheet of *Parmelia aquila* in the Acharian herbarium at H. One from North America is very light brown and the other from "Gallia austr." dark brown. The former specimen is obviously *A. palmulata* and the latter is *A. fusca*. The North American specimen, sent to Acharius by Muhlenberg (see Tuckerman, Syn. N. A. Lich. 1: 72. 1882), seems to have been added to the sheet after the publication of *Lichen aquilus*. The specimen from France must therefore be considered the type of *L. aquilus*.

According to Maas Geesteranus (1952), *Anaptychia fusca* is a maritime species occurring all along the Atlantic coast from Norway and Great Britain down to Italy in the Mediterranean. It usually grows on rocks. This species has not yet been collected in America or eastern Asia.

Representative specimens examined: **Europe.** Sweden. Göteborg, Hellbom (FH-Tayl); Bohuslän, Marstrand, Blomberg (As); Smögen, Magnusson 24793 (Krk). France. Coast of Normandie, Maugeot (As). Canary Islands. No precise locality, ex herb. Schaerer (As).

4. *ANAPTYCHIA PALMULATA* (Michx.) Vain.

Termész. Füzetek 22: 299. 1899

(Figs. 9a, b, 21)

Psoroma palmulata Michx. Fl. Bor. Amer. 2: 321. 1803. *Lecanora palmulata* (Michx.) Ach. Lich. Univ. 421. 1810. *Physcia palmulata* (Michx.) Nyl. Lich. Jap. 33. 1890. *Pseudophyscia aquila* var. *palmulata* (Michx.) Hue, Nouv. Arch. Mus., ser. 4, 1: 117. 1899. Type: Grandfather Mountain, North Carolina (not seen).

Parmelia detonsa Fr. Syst. Orb. Veg. 1: 284. 1825. *Physcia detonsa* (Fr.) Nyl. Act. Soc. Linn. Bord. 21: 309. 1856. *Physcia aquila* var. *detonsa* (Fr.) Tuck. Proc. Amer. Acad. Arts Sci. 4: 389. 1860. *Heterodermia detonsa* (Fr.) Trev. Atti Soc. Ital. Sci. Nat. Milano 11: 615. 1868. Holotype: North America, Schweinitz (UPS).

Thallus foliose, forming rosettes or irregularly spreading colonies, loosely attached, greenish to brownish olive or rarely chestnut brown; laciniae dichotomously or subdigitately branched, glabrous, epruinose or sometimes slightly pruinose towards the apices, short and minutely notched, contiguous at the circumference but soon covered with imbricate narrow secondary laciniae at the center; beneath corticate, sordid white or light brown or at times blackish brown towards the center, rhizinate; rhizines paler than the thallus but turning black, simple but soon squarrosely or fasciculately branched, 0.3–1.0 mm. long. Laciniae

200–350 μ thick; upper cortex colorless, with a greyish brown surface layer about 10 μ thick, uniformly thickened, 40–80 μ thick; gonidial layer continuous, 40–60 μ thick; medullary layer thin, 30 μ thick; lower cortex thickened, 100–200 μ thick, colorless but turning light brown in the outer half.

Apothecia sessile, constricted at the base, 1–4 mm. in diameter, margins entire or crenate, disc concave, brown to blackish brown, without pruina; hymenium colorless and hyaline, 200–250 μ high, I+ blue; cortex of receptacle very thin along the lateral part and thickened at the base, I-; asci cylindrical to subclavate, 30–40 \times 150–200 μ , 8-spored; spores dark brown, ellipsoid, with rounded apices and central constriction, 17–23 \times 35–46 μ , 1-septate with 2 hemispherical locules; spore wall thin, uniformly thickened.

Reaction: Thallus K-; med. K-, C-, KC-, PD-.

Chemical ingredients: No lichen substances demonstrated.

Anaptychia palmulata is similar and closely related to *A. fusca*, but the thallus has an overall greenish olive color. The form and size of spores and the apothecia are very similar in the two species. The thallus of *A. fusca* is chestnut-brown to blackish brown and the color is fairly stable. In *A. palmulata* the color is more variable, but even when chestnut-brown, it is distinguished from *A. fusca* by the form of the rhizines.

In eastern Asia *A. palmulata* is widely distributed throughout the Japanese Archipelago, from Saghalien to Kyusyu, and Korea. Zahlbruckner reported it from Yunnan. It is also very common in eastern North America (Hale, 1956), collected at the base of deciduous trees in mature woods. This species shows a typical disjunctive distribution pattern in eastern Asia and eastern North America.

Although the specific name is given as “palmulata” by Michaux, an alternative spelling “palmatula” has been widely adopted by recent lichenologists.

Representative specimens examined: **Asia.** Kurile. Etorofu, Mayekawa (As). Japan. Honsyu. Prov. Mutu. Mt. Osorezan, Kurokawa 56223-a (Krk). Prov. Simotuke. Ozegahara, Ikoma 5115 (Ikoma). Prov. Musasi. Mt. Bukosan, Asahina 170-a (As). Prov. Etyu. Arimine, Asahina (As). Prov. Suruga. Subasiriguti, Mt. Fuji, Asahina (As). Sikoku. Mt. Ishizuti, F. Fujikawa (As). Kyusyu. Prov. Higo. Watari, Mayebara 249 (As). Korea. Mt. Uti-Kongo, Asahina (As). China. Yunnan, near Ngulukö at Lidjiang, Likiang, Handel-Mazzetti 10651 (W). **North America.** U.S.A. New England, Tuck., Lich. Amer. Sept. Exs. 18 (As, M; as *Parmelia detonsa*); New Bedford, Massachusetts, Wiley, Lichenoth. Univ. 122 (M, as *Physcia aquila* var. *detonsa*); near Cambridge, Mass., Clar. Boll., Körb., Lich. sel. Germ. 396 (M, as *Parmelia detonsa*). North Carolina, no precise local., Curtis (M). Ohio. Near Columbus, Bogue, Lich. Bor.-Amer. Exs. 87 (M, as *Physcia aquila* b. *detonsa*). Wisconsin. 7 mi. NW. of Wisconsin Rapids, Wood Co., Thomson, Lich. Wisc. Exs. 5 (Krk).

5. *ANAPTYCHIA ISIDIZA* Kurokawa, nom. nov.

(Fig. 22)

Anaptychia palmulata var. *isidiata* Zahlbr. Bot. Mag. (Tokyo) 41: 364. 1927. Type: Prov. Settu, Mt. Rokko, Japan, Asahina 176 (As, isotype).

Laciniae of the thallus with laminal and marginal isidia, laminal isidia cylindrical, often branched, marginal isidia more or less dorsiventral in juvenile stages, later becoming suberect and cylindrical, often branched.

Apothecia sessile, receptacle isidiate, isidia cylindrical.

Otherwise as in *A. palmulata*.

This species is closely related to *A. palmulata*, but it is easily separated by having isidia. It has long been considered as a variety of *A. palmulata*, but it seems to be a species endemic to the Japanese Archipelago, while *A. palmulata* shows a broad disjunctive distribution in eastern Asia and eastern North America. A new combination was not possible since there is already published an *Anaptychia isidiata* Tomin (Bull. S. Usuari Branch State Russ. Geogr. Soc. 220. 1926). Unfortunately the type of this species has not been available for comparison.

Representative specimens examined: **Asia**. Saghalien. Aikawa, Asahina (As); Kami-Kiminai, Hunai-gun, H. Sase (TNS). Japan. Prov. Mutu. Mt. Osorezan, Kurokawa 56223-b (Krk). Prov. Uzen. Mt. Iide, R. Ogata (TNS). Prov. Simotuke. Yumoto, Nikko, Asahina (As). Prov. Musasi. Mt. Siraiwa, Titibu, Kurokawa 510272 (Krk). Prov. Izu. Mitohama, Asahina 209 (As). Prov. Sinano. Sibunoyu, Yatugatake Mts., Kurokawa 58206 (Krk). Prov. ETTYU. Yamada-mura, Higasi-Tonami, M. Nishijima (As). Prov. Mikawa. Mt. Horaiji, Kurokawa 56030 (Krk). Prov. Inaba. Zyuroppon-matu, Tottori City, Ikoma 6122 (lkm). Okinosima Island, Mt. Daimanji, Togo, Nakanishi 2911, 2926 (Nak). Sikoku. Mt. Isizuti, F. Fujikawa (As). Kyusyu. Prov. Hyuga. Masaki, K. Mayebara 146 (As).

6. *ANAPTYCHIA STIPPAEA* (Ach.) Nád. v.

Stud. Bot. Czech. 8: 75. 1947

Parmelia aquila β *stippaea* Ach. Meth. Lich. 202. 1803. *Anaptychia fusca* var. *stippaea* (Ach). Anders. Strauch- u. Laubfl. Mitteleuropa. 208. 1928. Holotype: Sweden (H); isotype in BM.

Thallus foliose, olive-brown to chestnut brown, laciniate; laciniae more or less irregularly branched, densely lacinulate along the margins, lacinules about 0.1 mm. wide, up to 7 mm. long, often branched, more or less ascending towards the apices; beneath pale, corticate, rhizines short, dark brown, simple or sometimes squarrosely branched. Laciniae 250–320 μ thick; upper cortex irregularly thickened, often projecting into the medulla and sometimes fusing with the lower cortex; gonidial layer and medulla often interrupted by the upper cortex, gonidia 10–19 μ in diameter; lower cortex thick, irregularly thickened.

Apothecia not seen.

Reaction: Thallus K⁻; med. K⁻, C⁻, KC⁻, PD⁻.

Chemical ingredients: No lichen substances demonstrated.

Anaptychia stippaea is very close to *A. fusca*, from which it differs in having long narrow lacinules in the central part of the thallus. As pointed out by Nádvořník and Poelt, *A. fusca* is one of the maritime species occurring along the Atlantic coast in Europe, whereas *A. stippaea* has been collected only from the inland mountainous regions of Europe.

Specimens examined: **Europe.** Austria. Tirol, Arn. Lich. Exs. 705 (M, As). Czechoslovakia. Slovakia, Carpati, 2100 m., Vezda, Lich. Bohemoslov. Exs. 89 (M).

7. *ANAPTYCHIA SUBAQUILA* (Nyl.) Kurokawa, comb. nov.
(Fig. 23)

Physcia subaquila Nyl. Syn. Lich. 1: 421. 1860. *Heterodermia subaquila* (Nyl.) Trev. Atti Soc. Ital. Sci. Nat. Milano 11: 616. 1868. *Parmelia subaquila* (Nyl.) Jatta, Monogr. Lich. Ital. Merid. 109. 1889. *Physcia aquila* var. *subaquila* (Nyl.) Oliv. Rev. de Bot. 12: 83. 1894. Lectotype: Vizzavaria, Corsica, Norrlin (H, Nyl. Herb. 32392).

Thallus foliose, adnate on rock, ochraceous brown to chestnut brown; laciniae repeatedly dichotomously or irregularly branched, linear-elongate, more or less discrete at the circumference, with imbricate, narrow and short secondary lacinules towards the center; laciniae and lacinules often distinctly white pruinose near the tips; beneath brownish to blackish, densely rhizinate; rhizines blackish-brown to black, squarrosely branched, 0.5–2.0 mm. Laciniae 230–300 μ thick; upper cortex more or less uniformly thickened, 60–100 μ thick, gonidia 6–13 μ in diameter; lower cortex discontinuous, distinct only around the base of the rhizines.

Apothecia sessile, 1–6 mm. in diameter; disc dark brown, white pruinose, afterwards naked; margins densely lacinulate, lacinules corticate on the upper surface, often branched, densely white pruinose but afterwards naked, 1–2 mm. long, sometimes rhizinate below; hymenium 160–200 μ high, spores dark brown, ellipsoid, with rounded apices and a median constriction, 16–20 \times 27–40 μ .

Reaction: Thallus K⁻; med. K⁻, C⁻, KC⁻, PD⁻.

Chemical ingredients: No lichen substances demonstrated.

This species has long been considered a synonym of *A. fusca*. Although the two species are very closely related, *A. subaquila* has dense squarrosely branched rhizines, which usually form a mat under the laciniae. The rhizines of *A. fusca* are very sparse, thick, and simple or rarely irregularly branched. In addition, whereas the margins of the apothecia in *A. fusca* are almost entire, those of *A. subaquila* are densely lacinulate just as in

A. tentaculata. As mentioned above, the lower cortex of *A. fusca* is extremely thickened. By contrast, the lower cortex of *A. subaquila* is very thin and discontinuous, and it is often lacking, especially on the younger laciniae.

Specimens examined: **Europe**. France. On lava at Agde (Agatha), Nylander (H, Nyl. Herb. 32395). Italy. Corsica, Bautler (H, Nyl. Herb. 32393). Yugoslavia. An alten Buchen im Ternovaner Walde bei Sazna, 100 m., Görzin Krain, Glowacki, Arn. Lich. Exs. 532 (H, Nyl. Herb. 32348). Algeria. Di Aoub, Flagey 93 (H, Nyl. Herb. 32350).

8. *ANAPTYCHIA ULOTHRICOIDES* (Vain.) Vain.

Bot. Tidskr. 26: 245. 1904

Physcia ulothricoides Vain. Act. Hort. Petrop. 10: 553. 1888. Lectotype: Kopetdah, Turkistan, on *Juniperus*, G. Radde in 1886 (TUR, Vain. Herb. 7827).

Physcia asiana Nyl. in Broth. Oefers. Finska Veg. Soc. Förh. 40: 6. 1898. Holotype: Ad terram argillosam umbrosam, reg. silv. super, in valle fl. Schamsi, Alpes Alexandri, Brotherus 22 (H, isotype in G).

8a. f. *ULOTHRICOIDES*

Thallus foliose, greyish or sordid white, forming rosettes or rarely irregularly spreading colonies, laciniate; laciniae plane, more or less wrinkled at the center, without soredia or isidia, contiguous at the circumference, 3–8 cm. wide; beneath white and rugulose, with numerous rhizines, corticate; rhizines concolorous with the thallus, densely branched, 3–5 mm. long. Laciniae 250–400 μ thick; upper cortex colorless, the surface layer greyish, about 30 μ thick, in transverse section very irregularly thickened and the lower surface distinctly flexuose, varying from 30–110 μ thick, often projecting downward into the medulla; gonidial layer often interrupted by the upper cortex, gonidia 13–16 μ in diameter; lower cortex of the same structure as the upper, 30–60 μ thick.

Apothecia laminal, sessile, 1–3.5 mm. in diameter, with entire or somewhat crenate margins; disc concave or plane, blackish brown, slightly pruinose but becoming naked; hymenium colorless and hyaline, 130–200 μ high, I⁺ blue; cortex of receptacle irregularly thickened; asci cylindrical or subclavate, about 30 \times 100 μ , 8-spored; spores dark brown, ellipsoid, with rounded apices, constricted at the center, 13–17 \times 29–34 μ , 1-septate, with 2 hemispherical locules, the spore wall uniformly thin.

Pycnidia immersed in the thallus, with blackish ostioles; microconidia colorless, cylindrical, 1–2 \times 3–5 μ .

Reaction: Thallus K⁻; med. K⁻, C⁻, KC⁻, PD⁻.

Chemical ingredients: No lichen substances demonstrated; numerous crystals of calcium oxalate are deposited in the medulla, especially in f. *tenuior*.

This species is closely related to *A. fusca*, but it differs in color of the thallus. According to Vainio (1888), *A. ulothricoides* occurs on the bark of juniper and among mosses on rocks. Nylander described *Physcia asiana* without knowing of Vainio's species.

Specimens examined: Turkistan. Kopet-dah, G. Radde (TUR, Vain. Herb. 7826, 7828-30, paratypes). Asia. China. Zaidam, Kuku-Nor, Przewalski 8 (UPS). Tibet. Koke Usse Thal, 3950 m. and 4200 m., A. Tagel (TUR), Vain. Herb. 7834, 7832); Bio Tag, 4200 m., Tagel (TUR, Vain. Herb. 7835).

8a. f. *TENUIOR* (Vain.) Zahlbr. Cat. Lich. Univ. 7: 743. 1931

Physcia ulothricoides f. *tenuior* Vain. Act. Hort. Petrop. 10: 554. 1888. Holotype: Kopet-dah, Turkistan, G. Radde (TUR, Vain. Herb. 7836).

Laciniae 0.2-0.5 mm. wide, 180-250 μ thick. Otherwise as in f. *ulothricoides*.

9. *ANAPTYCHIA TENTACULATA* (Zahlbr.) Kurokawa,
comb. nov.
(Figs. 10, 24)

Physcia tentaculata Zahlbr. Fedde Repert. 33: 37. 1933. Holotype: Mt. Morrison (or Niitaka), Formosa, Oct. 11, 1927, S. Sasaki (Asahina F 419) (W, isotype in As).

Thallus foliose, forming rosettes or irregular colonies, 5-9 cm. across, greenish grey or brownish grey; laciniae irregularly branched, 1-2 mm. wide, plane to concave, slightly pruinose near the apices, without soredia or isidia, margin irregularly crenate; beneath black but with a pale periphery, corticate, densely rhizinate; rhizines black, densely branched. Laciniae 150-200 μ thick; upper cortex uniformly thickened, 30-50 μ thick; gonidial layer continuous, 25-30 μ thick, gonidia 8-13 μ in diameter; medullary layer 30-50 μ thick; lower cortex 30-60 μ thick, with a black outer layer.

Apothecia laminal, sessile, constricted at the base, 1-6 mm. in diameter, with long lacinules on the margins, the lacinules of the same structure as the thallus and rhizinate below; disc blackish brown, pruinose but becoming naked; hymenium colorless, about 200 μ high, I⁺ blue; cortex of receptacle uniformly thickened, I⁻; asci cylindrical or subclavate, about 30 \times 150 μ , 8-spored; spores dark brown, ellipsoid, with rounded apices, constricted at the center, 15-18 \times 27-33 μ , 1-septate, with 2 hemispherical locules, the wall uniformly thin.

Reaction: Thallus K⁻; med. K⁻, C⁻, KC⁻, PD⁻.

Chemical ingredients: No lichen substances demonstrated.

This species is endemic to Formosa and occurs on mosses on tree bark.

Specimen examined: Shukoran, Taityu, Formosa, T. Suzuki (As).

Series 2. **Speciosae** Kurokawa, ser. nov.

Sporae ellipsoideae, medio saepe levissime constrictae, brunneo-fuscae, 1-septatae, 2-loculares, loculis sporoblastidiis parvis haud praeditis, membranis incrassatis.

Type species: *Anaptychia speciosa* (Wulf.) Mass.

This series is characterized by producing thick walled spores. They resemble those of section *Polyblastidium*, but the locules never form any small sporoblastidia. All species of *Anaptychia* with a lower cortex (except those in ser. *Anaptychia* mentioned above) belong to this series, and there are only a few species here without a lower cortex.

KEY TO SPECIES IN SERIES SPECIOSAE

- 1a. Laciniae decorticate below.
 - 2a. Laciniae ascending towards the apices (28) *A. erinacea*
 - 2b. Laciniae appressed to the substratum.
 - 3a. Laciniae with numerous squamules or soredia along the margins (26) *A. microphylla*
 - 3b. Laciniae without squamules or soredia.
 - 4a. Laciniae broad, 0.5–2 mm. wide; margins of apothecia crenate or lacinulate (25) *A. hypoleuca*
 - 4b. Laciniae narrower, 0.3–0.8 mm. wide; margins of apothecia with white points in younger stages (27) *A. punctifera*
- 1b. Laciniae corticate below.
 - 5a. Medulla yellow or sordid yellow, K⁺ red or purple.
 - 6a. Medulla PD⁻.
 - 7a. Laciniae narrow, less than 1 mm. wide; apothecia rather small, less than 2 mm. in diameter (22) *A. firmula*
 - 7b. Laciniae broad, 0.7–2 mm. wide; apothecia more than 2 mm. in diameter (23) *A. rugulosa*
 - 6b. Medulla PD⁺ deep yellow, containing an unknown substance (24) *A. albidiflava*
 - 5b. Medulla white.
 - 8a. Thallus sorediate.
 - 9a. Medulla PD⁻ or pale yellow, not containing salazinic or norstictic acids.
 - 10a. Laciniae linear-elongate, margins mostly entire; spores 14–18 × 30–37 μ; margins of apothecia crenate or lacinulate; from Europe (10) *A. speciosa*
 - 10b. Laciniae short, often flexuously bent; spores 12–14 × 23–31 μ; margins of apothecia sorediate; from tropical and temperate zones (11) *A. pseudospeciosa* var. *tremulans*
 - 9b. Medulla PD⁺ distinctly yellow, containing norstictic or salazinic acids.
 - 11a. Soralia subterminal; containing norstictic acid; salazinic acid also proved with KOH+K₂CO₃ test (11) *A. pseudospeciosa*

- 11b. Soralia marginal; not containing norstictic acid; salazinic present (KOH+K₂CO₃ or o-T tests). (17) *A. domingensis*
- 8b. Thallus not sorediate.
- 12a. Thallus with isidia or squamules.
- 13a. Thallus isidiate.
- 14a. Medulla PD⁻ or PD⁺ pale yellow, not containing salazinic acid (16) *A. isidiophora*
- 14b. Medulla PD⁺ distinctly yellow, K⁺ yellow turning red, containing salazinic acid.
- 15a. Isidia mostly laminal (19) *A. granulifera*
- 15b. Isidia mostly marginal
(18) *A. tropica* var. *antillarum*
- 13b. Thallus with numerous squamules; medulla PD⁺ deep yellow, containing an unknown substance (20) *A. dissecta*
- 12b. Thallus without isidia or squamules.
- 16a. Medulla PD⁻ or PD⁺ pale yellow, not containing norstictic or salazinic acids or unknown substances.
- 17a. Thallus moderately rhizinate below, rhizines often of the same color as the thallus.
- 18a. Laciniae scarcely or not at all pruinose
(12) *A. diademata*
- 18b. Laciniae densely pruinose (14) *A. albopruinosa*
- 17b. Thallus densely rhizinate below; rhizines jet black
(15) *A. polyrhiza*
- 16b. Medulla PD⁺ yellow, K⁺ persistent red, containing norstictic or salazinic acids or unknown substances.
- 19a. Medulla PD⁺ deep yellow, containing an unknown substance; laciniae rather narrow (21) *A. angustiloba*
- 19b. Medulla PD⁺ yellow, containing norstictic acid and/or salazinic acid.
- 20a. Containing norstictic acid; salazinic acid also proved with KOH+K₂CO₃ test
(13) *A. rubescens*
- 20b. Containing salazinic acid, proved with KOH+K₂CO₃ or o-T tests (18) *A. tropica*

10. *ANAPTYCHIA SPECIOSA* (Wulf.) Mass.

Mem. Lichenogr. 36. 1853

Lichen speciosus Wulf. in Jacq. Coll. Bot. 3: 119, 1789. *Parmelia speciosa* (Wulf.) Ach. Meth. Lich. 198. 1803. *Physcia speciosa* (Wulf.) Nyl. Prodr. Lich. Gall. Act. Soc. Linn. Bord. 307. 1857. Type: In sylvaram Montis Calvariae saxi (not seen).

Thallus foliose, greyish white, forming continuous colonies up to 15 cm. or more across; laciniae repeatedly dichotomously or subdigitately branched, linear-elongate but minutely notched, 0.5–1.5 mm. wide, plane or somewhat convex, not ascending towards the apices, glabrous, without pruina, rarely somewhat discrete at the circumference, with capitate soralia at the tips of short lateral branches; beneath corticate,

white or sordid brown towards the center, sparsely rhizinate, rhizines concolorous with the thallus or becoming darker towards the apices, irregularly or fruticosely branched. Laciniae 250–350 μ thick; upper cortex occasionally I⁺ slightly violet, with a greyish surface layer 15–20 μ thick, in transverse section uniformly thickened, 50–120 μ thick; gonidial layer continuous; medullary layer 100–130 μ thick; lower cortex of the same structure as the upper, about 30 μ thick, rarely becoming thinner near the apices of the laciniae; rhizines sometimes I⁺ violet to blue.

Apothecia laminal, substipitate, 3–8 mm. in diameter, with crenate or lacinulate margins; lacinules corticate on both sides; disc brown to blackish brown; hymenium colorless and hyaline, 130–200 μ high, I⁺ blue; cortex of receptacle uniformly thickened, rarely I⁺ slightly violet; asci cylindrical or somewhat clavate, 15–18 \times 120–170 μ , 8-spored; spores brown, ellipsoid, constricted at the center, 14–18 \times 30–37 μ , spore wall very thick, 1-septate, with 2 subglobose, obovate or obconical locules.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

As far as is known, this species occurs only in Europe, growing over mosses on tree or rocks. Plants so named outside of Europe are referable to *A. pseudospeciosa*, which is discussed below.

Representative specimens examined: **Europe.** Germany. Oberammergau, Bayern, Schnabl (As); Oberstdorf, Allgäu, Löscher (As); Knoten, Kärnten, 1000 m., Simmer (As); Heidelberg, W. Ahles (As). Austria. Tyrol, Arnold (As).

11. *ANAPTYCHIA PSEUDOSPECIOSA* Kurokawa,
Journ. Jap. Bot. 34: 176. 1959
(Fig. 2)

Holotype: Amagi Pass, Suisyoti, Prov. Izu, Japan, Aug. 20, 1956, Y. Asahina, Lich. Jap. Exs. 203 (As, isotypes in Krk, TNS, US).

11a. var. *PSEUDOSPECIOSA* f. *PSEUDOSPECIOSA*

Thallus foliose, greyish white, forming rosettes or colonies about 5 cm. in diameter; laciniae repeatedly dichotomously or subdigitately branched, rather short, often flexuous, imbricate towards the center, 0.7–1.5 mm. wide, minutely notched, glabrous, with capitate soralia at the apices of short lateral branches; beneath corticate, white, turning fuscous towards the center, sparsely rhizinate; rhizines concolorous with the thallus or becoming dark or rarely black towards the apices, irregularly or fruticosely branched. Laciniae 200–300 μ thick, uniformly thickened in transverse section, 50–120 μ thick, with a greyish surface

layer about 15 μ thick; gonidial layer continuous, about 25 μ thick, gonidia 7–10 μ in diameter; medullary layer 60–80 μ thick; lower cortex 25–40 μ thick, becoming thin or rarely evanescent near the apices.

Apothecia rare, superficial, sessile, 1–3 mm. in diameter; margins somewhat crenate but soon sorediose; disc brown to blackish brown, without pruina; hymenium colorless and hyaline, 100–130 μ high, I⁺ blue; asci cylindrical or subclavate, 20–25 \times 100–120 μ , 8-spored; spores pale fuscous, ellipsoid, constricted at the center, 12–14 \times 26–32 μ , very thick walled, 1-septate, with 2 subglobose, obovate or obconical locules.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning reddish yellow, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

Anaptychia pseudospeciosa is separated from *A. speciosa* by the presence of norstictic and salazinic acids. It also has rather short and often flexuose laciniae. By contrast, the laciniae of *A. speciosa* are linear-elongate. The margins of apothecia are nearly entire when young but soon afterwards become sorediate. The hymenium is lower than that of *A. speciosa*, correlating with the smaller spore size.

Representative specimens examined: Localities from Japan and Formosa are listed in Kurokawa (1959, p. 177). Other specimens seen follow. **Asia.** India. Darjeeling, Observatory Hill, 7000 ft., Awasthi 3860 (fertile) (Aw, Krk). Almora. Near Barechhina, 5000 ft., Awasthi 3498 (Krk). **Hawaii.** No precise locality, Eckfeldt (FH). Fiji. Viti Levu, Mt. Koroyanitu, Mba, A. C. Smith 4212 (BISH). **Mexico.** Jalisco. San Sebastian, E. of Arroyo del Cura, Sierra Madre Occidental, Y. Mexica 1382 (pr. maj. p.), 1383 (US). **South America.** Brazil. Minas Gerais, Vainio, Lich. Bras. Exs. 1265, 1531 (TUR, Vain. Herb 7767, 7750 respectively). **Africa.** French Guinea. Fouta-Djalou, at Dalaba, des Abbayes (fertile) (REN).

11b. var. *PSEUDOSPECIOSA* f. *TAGAWAE* Kurokawa
Journ. Jap. Bot. 34: 178. 1959

Holotype: Mossy rocks, Mt. Tonomine, Prov. Yamato, Honsyu, Japan, Nov. 16, 1952, Tagawa (KYO, isotype in Krk).

This form is distinguished from f. *pseudospeciosa* in having subsascending, short secondary lacinules in the central part of the thallus. The lacinules often bear capitate apical soralia.

11c. var. *TREMULANS* (Müll. Arg.) Kurokawa, comb. nov.

Physcia hypoleuca var. *tremulans* Müll. Arg. Flora 63: 277. 1880. *Anaptychia speciosa* var. *tremulans* (Müll. Arg.) Müll. Arg. Engl. Bot. Jahrb. 15: 505. 1893.

Pseudophyscia speciosa var. *tremulans* (Müll. Arg.) Müll. Arg. Bull. Soc. Bot. Belgique, 32: 130. 1893. Holotype: Near Petropolis, Rio de Janeiro, Brazil, on mosses, Deventer (G).

Physcia speciosa f. *sorediosa* Müll. Arg. Flora 66. 78. 1893. *Anaptychia speciosa* f. *sorediosa* (Müll. Arg.) Zahlbr. Cat. Lich. Univ. 7: 741. 1931. Holotype: Toowoomba, Queensland, Australia, Hartmann (G).

Physcia speciosa var. *cinerascens* f. *pulvinigera* Müll. Arg. Flora 73:340. 1890. *Anaptychia speciosa* var. *cinerascens* f. *pulvinigera* (Müll. Arg.) Müll. Arg. Engl. Bot. Jahrb. 15:506. 1893. Lectotype: Ad pedem Merou, Africa aequatoriali-orientalis, Höhnel 203 (G).

Anaptychia speciosa var. *microspora* Kurokawa, Journ. Jap. Bot. 34: 175. 1959. Holotype: New England, Tuck. Lich. Amer. Sept. Exs. 81 (As).

Anaptychia pseudospeciosa var. *inactiva* Kurokawa, Journ. Jap. Bot. 34: 178. 1959. Holotype: Amagi Pass, Suisyoti, Prov. Izu, Japan, Y. Asahina (As, isotypes in Krk, TNS, US).

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

This variety is distinguished from var. *pseudospeciosa* by different chemical constituents. It is one of the commonest lichens in tropical and temperate zones and shows extensive variation in the size of plants and the shape of thalli. The diagnostic feature of this variety is size of spores and the sorediate margin of the apothecia, by which it is separated from closely allied *A. speciosa*. Spores of *A. speciosa* are usually longer than 30 μ and the margin of the apothecia is crenate or lacinulate. The laciniae of *A. speciosa* are linear-elongate, as are those of *A. hypoleuca*, while in var. *tremulans* they are short and flexuose. On the whole, *A. pseudospeciosa* var. *tremulans* is more closely related to *A. domingensis* in external appearance and spore size than it is to *A. speciosa*.

Although the type of *A. pseudospeciosa* var. *inactiva* Kurokawa has very short and somewhat imbricate laciniae, these characters seem to be of no taxonomic importance. Therefore, the types of this variety and var. *tremulans* should be considered identical, var. *tremulans* having priority.

Representative specimens examined: Localities from Saghalien, Manchuria, Japan, China, India, Hawaii, United States, and Costa Rica are listed in Kurokawa (1959, pp. 176, 178, 179). Other localities follow. **CENTRAL AMERICA.** Mexico. Chiapas. 2 km. N. of highway 190 on road to Puebla Nueva, 1070 m., Hale 20259a (US); Lagos de Monte Bello, 1220 m., Hale 20430 (US). Oaxaca. Cerro San Felipe, 2920 m., Hale 20755 (US). Veracruz. Teocello Canyon, 1240 m., Hale 21079, 21162 (US). **SOUTH AMERICA.** Brazil. Minas Gerais. Caldas, Lindberg (UPS); Sitio, Vain. Lich. Bras. Exs. 568 (TUR, Vain. Herb. 7761); Lafayette, Vain. Lich. Bras. Exs. 247 (FH); no precise local., Vain. Lich. Bras. Exs. 687, 793, 869 (TUR, Vain. 7762-7764).

12. *ANAPTYCHIA DIADEMATA* (Tayl.) Kurokawa, comb. nov.

Parmelia diademata Tayl. Lond. Journ. Bot. 6: 165. 1847. *Physcia hypoleuca* var. *diademata* (Tayl.) Müll. Arg. Flora 63: 277. 1880. *Physcia speciosa* var. *diademata* (Tayl.) Müll. Arg. Flora 71: 197. 1888. *Pseudophyscia hypoleuca* var. *diademata* (Tayl.) Hue, Nouv. Arch. Mus., ser. 4, 1: 113. 1899. Holotype: Nepal, Wallich (FH-Tayl.).

Physcia major Nyl. Flora 41: 379. 1858. *Physcia speciosa* var. *major* (Nyl.) Müll. Arg. 70: 60. 1887. *Anaptychia major* (Nyl.) Vain. Dansk Bot. Ark. 4: 12. 1926. Holotype: Orizaba, Mexico, Müller (H, Nyl. Herb. 32160, isotype in G).

Physcia speciosa f. *cinerascens* Nyl. Syn. Lich. 1: 417. 1860. *Anaptychia speciosa* var. *cinerascens* (Nyl.) Müll. Arg. Hedw. 30: 182. 1891. Holotype: Ethiopia, Schimper, Iter Abyss. 417 (H, Nyl. Herb. 32519, isotypes in As, BM, UPS).

Anaptychia speciosa var. *esorediata* Vain. Cat. Welw. Afr. Pl. 2: 409. 1901. *A. esorediata* (Vain.) DR. et Lynge, Vidensk. I. Mat. naturv. Kl. 16: 14. 1924. Type: Mt. Morrade, Huilla, Angola, Welwitsch 35 pr. p. (BM, isotype).

Anaptychia speciosa f. *compactior* Zahlbr. Bot. Mag. (Tokyo) 41: 364. 1927. Holotype: Near Kurisugawa, Nishimuro-gun, Prov. Kii, Asahina 167 (W, isotype in As).

Chaudburia indica Zahlbr. Ann. Mycol. 30: 433. Type: India (not seen).

12a. f. *DIADEMATA*

(Fig. 25)

Thallus foliose, greyish white, forming extensive colonies up to 15 cm. or more across, composed of repeatedly dichotomously or irregularly branched laciniae; laciniae 0.5–2.5 mm. broad, linear-elongate, minutely notched, not ascending towards the apices, glabrous, without pruina, contiguous or discrete at the circumference; beneath corticate, white or sordidly brown towards the center, sparsely rhizinate; rhizines concolorous with the thallus or becoming dark brown to black towards the apices, irregularly or fruticoseously branched. Laciniae 200–300 μ thick; upper cortex more or less uniform in transverse section, 70–130 μ thick, occasionally I⁺ pale violet, with a greyish surface layer 15–20 μ thick; gonidial layer continuous, 30–50 μ thick, gonidia 5–10 μ in diameter; medullary layer 100–150 μ thick; lower cortex about 30 μ thick, partly evanescent near the apices, I⁺ pale violet.

Apothecia usually numerous, laminal, subsessile, 1.5–5 (rarely 7) mm. in diameter; margin entire or crenate, rarely lacinulate; disc brown to blackish brown; hymenium colorless and hyaline, 80–130 μ high, I⁺ blue; cortex of receptacle more or less uniformly thickened but gradually becoming thinner towards the margin, sometimes I⁺ pale violet; asci cylindrical or subclavate, 25–30 \times 90–110 μ ; spores pale fuscous, ellipsoid, not constricted or only somewhat constricted at the center, 10–15 \times 23–31 μ , very thick walled, 1-septate, with 2 subglobose, obovate or obconical locules. Pycnidia immersed in the thallus or protruding somewhat; microconidia cylindrical, colorless, about 1 \times 3 μ .

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

In external appearance this species resembles *A. hypoleuca*, but it differs in having a cortical layer on the undersurface of the laciniae. The upper cortex is more or less uniformly thickened in a transverse section, while the cortex of *A. hypoleuca* is quite variable. *A. diametada* grows on rocks and trees in the tropical and temperate zones around the world.

Representatives specimens examined: **Asia.** Japan. Honsyu. Prov. Rikutyu. Kadoma-guti, Mt. Hayatine, 600-700 m., Kurokawa 59326 (Krk). Prov. Awa. Mt. Kiyosumi, Kurokawa 56561 (Krk). Prov. Izu. Amagi-Pass, Asahina (As). Prov. Kai, Mt. Sitimen, Asahina 164 (As). Prov. Yamato. Near Iwahashi, Ukasi-mura, Uda-gun, M. Tagawa 117 (KYO). Prov. Kii. Mt. Koya, Kurokawa 56075 (Krk). Prov. Inaba. Tukyuyone, Yazu-gun, Ikoma 2116 (IkM). Kyusyu. Prov. Buzen. Yabakei, Asahina (As). Prov. Hizen. Hukue Island, Goto Islands, F. Maekawa (As). Corea. Bambutuso, Asahina (As). China. Lung T'au Mt., near Iu, Kwantung, Canton Christ. Coll. 12580 (US). Yunnan. Above Hsiangschuiho, mountain between Dali and Hodjing, Handel-Mazzetti 6509 (W). Likiang. Eastern slopes of Likiang Snow Range, J. F. Rock 11750 (US). Setschwan. Yenyüen, across Yalung river, Handel-Mazzetti 2683 (W.) Philippines. Luzon. Benguet, Cabayan, McGregor 8784 (TUR, Vain. Herb. 7776). Sikkim. Near Karponang, 8000 ft., Awasthi 147 (Aw). India. Above Kurseong, 5000-6000 ft., Awasthi 3904, 3910, 3914 (Aw). Mussoorie, 6500-7000 ft., Awasthi 697, 698 (Aw). Bengal. Khasiy Hills, 3000-6000 ft., W. Clark (M). Ceylon. No precise locality, Thwaites pr. p. (UPS). Australia. Mt. Arrarat, Sullivant (G). **Mexico.** State of Anna, Müller 1854 (G). Cuba. Wright, Lich. Cub. 84 (UPS). **South America.** Peru. Hacienda Exito, Huanuco, Churbamba, Y. Mexia 8244-a pr. p. (US). **Africa.** French Guinea. Fouta-Djalou, at Dalaba, 1200 m., des Abbayes (REN). Ethiopia. Mt. Kubbi and Mt. Saba Tensi, Schimper, Iter Abyss. 417 (As, BM, UPS).

12b. f. *BRACHYLOBA* (Müll. Arg.) Kurokawa, comb. nov.

Physcia speciosa var. *cinerascens* f. *brachyloba* Müll. Arg. Flora 73: 340. 1890. *Anaptychia speciosa* var. *cinerascens* f. *brachyloba* (Müll. Arg.) Zahlbr. Cat. Lich. Univ. 7: 741. 1931. *Anaptychia esorediata* f. *brachyloba* (Müll. Arg.) Awasthi, Journ. Ind. Bot. Soc. 39: 422. 1961. Lectotype: Khasia Hills, eastern Himalayas, Griffith et al. (G).

Physcia dispansa Nyl. Syn. Lich. 1: 418. 1860. *Heterodermia dispansa* (Nyl.) Trev. Atti Soc. Nat. Milano 11: 615. 1868. *Physcia speciosa* var. *cinerascens* f. *dispansa* (Nyl.) Müll. Arg. Flora 73: 341. 1890. *Anaptychia speciosa* var. *cinerascens* f. *dispansa* (Nyl.) Zahlbr. Cat. Lich. Univ. 7: 741. 1931. Holotype: China, no precise locality, Callery (H, Nyl. Herb. 32571).

Physcia megaloplaca Müll. Arg. Flora 63: 277. 1880. *Anaptychia megaloplaca* (Müll. Arg.) Sant. in Magn. Meddl. Göteb. Bot. Trädg. 18: 237. 1950. Lectotype: On *Salix humboldtiana*, Buenos Aires, Argentina, Schnyder 1 (G).

Anaptychia speciosa var. *lobulifera* Vain. Cat. Welw. Afr. Pl. 2: 109. 1901. Holotype: Morro de Lopolla, Huilla, Angola, Welwitsch 35 pr. p. (TUR, Vain. Herb. 7792, isotype in BM).

Pseudophyscia speciosa var. *mexicana* B. de Lesd. Lich. Mex. 1: 4. 1914. *Anaptychia speciosa* var. *mexicana* (B. de Lesd.) Zahlbr. Cat. Lich. Univ. 7: 742. 1931. Lectotype: Acatzingo, Puebla, Mexico, 2100 m., Bro. Amable 4107 (Krk, isotypes in DUKE, UPS, US).

Anaptychia speciosa f. *subtremulans* Zahlbr. in Hand. Mazz. Symb. Sin. 3: 242. 1930. Holotype: Near Kwapi, N. of Yenyüen, Setschwan, 2750 m., China, Handel-Mazzetti 2762 (W, isotypes in K, WU).

Anaptychia hypoleuca f. *minutula* Räs. Journ. Jap. Bot. 16: 139. 1940. Holotype: Prov. Kii, Japan, Yasuda 382 (H, isotype in TUR).

Anaptychia esorediata f. *subimbricata* Räs. Journ. Jap. Bot. 16: 139. 1940. *A. speciosa* var. *esorediata* f. *subimbricata* (Räs.) Sato, Index. Pl. Nipp. 4. Lich. 9, 115, 1943. Holotype: Prov. Iyo, Japan, M. Ogata (Yasuda 671) (H, isotype in TI).

This form is easily distinguished from f. *diademata* by having short, subsacending, subimbricate secondary lacinules towards the center of the thallus. The holotype of *Physcia dispansa* Nyl. is a fragmentary specimen, but it is obviously identical with this form.

Representative specimens examined: Asia. Japan. Honsyu. Prov. Hitati. Dainaka, Satomi-mura, Kuzi-gun, M. Togashi (As). Prov. Awa. Tanzyoji-Shrine, Kominato, Kurokawa 56576 (Krk). Prov. Ise. Mt. Gozaisyo, Tanaka (Tan). Prov. Yamato. Summit of Mt. Oodaigahara, Tagawa 325 (KYO). Kyusyu. Prov. Satuma. Kagosima, Tokutaro Ito (TNS). Formosa. Taityu. Keitau, Asahina (As). China. Fukien. Kushan near Foochow, Chung F 253 (W). Hong Kong. Wright (US). Yunnan, Lidjiang, near Ngulukö, Likiang, Handel-Mazzetti 8758 (W). India. Almora. Above village Bardkota, Askote, 5500 ft., Awasthi 2696 (Aw). Uttar Pradesh. Near Tanakpur, on way to Purnagiri, Kalli Valley, 1000 ft. Awasthi 3375 (Aw.).

12c. f. *ANGUSTATA* (Räs.) Kurokawa, comb. nov.

Anaptychia esorediata f. *angustata* Räs. Journ. Jap. Bot. 16: 139. 1940. *Anaptychia speciosa* var. *esorediata* f. *angustata* (Räs.) Sato, Index. Pl. Nipp. 4. Lich. 9, 115. 1943. Type: Sendai, Prov. Rikuzen, Japan, Yasuda 386 (TI, isotype).

This form is distinguished from f. *diademata* by narrower (0.5–1 mm.) and thinner (150–200 μ) laciniae. The habitat is similar to that of f. *diademata*, but f. *angustata* seems to prefer more shady and moist conditions. It has been found so far in Japan.

Specimens examined: Japan. Honsyu. Prov. Hitati. Dainaka, Satomi-mura, Kuzi-gun, M. Togashi (As, Krk); Mt. Tukuba, Asahina (As). Prov. Oomi. Mt. Hiei, Tagawa 249 (KYO).

12d. f. *CONDENSATA* (Kurokawa) Kurokawa, comb. nov. (Fig. 26)

Anaptychia esorediata f. *condensata* Kurokawa, Journ. Jap. Bot. 34: 181. 1959. Holotype: Mt. Katuodera, Prov. Settu, Japan, May 3, 1935, N. Ui (As, isotype in Krk).

This form is characterized by having numerous crowded and contiguous apothecia in the central part of the thallus.

Specimens examined: Japan. Honsyu. Prov. Awa. Mt. Kiyosumi, Kurokawa 56559 (Krk). Formosa. Taityu, Keitau, Asahina (As). Philippines. Luzon, Baguio Mt., Herre 9682 (Krk).

13. *ANAPTYCHIA RUBESCENS* (Räs.) Kurokawa, comb. nov.

Anaptychia hypoleuca f. *rubescens* Räs. Arch. Soc. Zool. Bot. Fenn. Vanamo 5: 27. 1950. *A. esorediata* f. *rubescens* (Räs.) Awasthi, Journ. Ind. Bot. Soc. 39: 423. 1961. Type: Darjeeling, India, 6000 ft., Awasthi 111 (Aw, isotype).

Thallus foliose, greyish white, forming extensive colonies 10–15 cm. or more across, lacinate, laciniae repeatedly dichotomously or irregularly branched, sublinear-elongate, subimbricate at the center but more or less discrete at the circumference, plane or somewhat convex, without isidia, soredia, or pruina; beneath corticate, white or slight sordid brown towards the center, with rhizines mainly at the margins; rhizines concolorous with the thallus or fuscous towards the apices, irregularly branched, about 2 mm. long. Laciniae about 300 μ thick; upper cortex more or less uniformly thickened in transverse section, 70–130 μ thick, I⁺ violet, with a greyish surface layer about 20 μ thick; gonidial layer continuous, 35–50 μ thick, gonidia 7–13 μ in diameter; medullary layer 100–150 μ thick; lower cortex thin, about 30 μ , I⁺ violet.

Apothecia usually numerous, laminal, substipitate, constricted basally, 1–5 mm. in diameter; margin crenate or lacinulate; disc brown to dark brown, very slightly pruinose but soon naked; hymenium colorless and hyaline, about 130 μ high, I⁺ blue; cortex of receptacle more or less uniformly thickened, gradually becoming thinner towards the margin, I⁺ violet; asci cylindrical or subclavate, 25–30 \times 90–110 μ , 8-spored; spores pale fuscous, ellipsoid, slightly constricted at the center, 11–14 \times 23–30 μ , very thick walled, 1-septate, with 2 subglobose or obovate locules.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning reddish yellow, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

This species, endemic to India, was first described by Räsänen as a form of *A. hypoleuca* from a collection by Awasthi. In his original description, Räsänen mentioned that the thallus was “totus vel pro parte intensive rubescens.” This color, of course, is not natural but is caused by the decomposition of salazinic acid in alkaline moisture. Since the undersurface is corticate, this species is actually more closely related to *A. diademata* than it is to *A. hypoleuca*.

Representative specimens examined: **Asia.** India. Above Kurseong, 5500 ft., Awasthi 3907, 3911 (Aw.) Almora. Near Dhaulek, Askote, 5500 ft., Awasthi 3966 (Aw); Takula ridge, 5500 ft., Awasthi 561 (Aw); on way to Kasardevi, 5800 ft., Awasthi 3479-B, 3480 pr. p. (Aw). Mussoorie, 7000 ft., Hiralal (Aw, as no. 462); Arnigadh, near Mussoorie, 6000 ft. W. Gollan (WU). Bengal. Rongoo, T. R. Seshadri (Aw, as no. 3405).

14. *ANAPTYCHIA ALBOPRUINOSA* Kurokawa, sp. nov.

Thallus foliaceus, cinereo-albus, 4–7 cm. diametro, irregulariter laciniatus; laciniae di-vel subtrichotome divisae, sublineares elongataeque, 0.3–1.5 mm. latae, margine subintegrae, ad apices leviter fusciscentes albo-pruinosaque; subtus corticatae, albae, centrum versus plus minusve brunnescentes, rhizinosae; rhizinae dactylino-divisae, 1–2 mm. longae, fuscae. Laciniae 60–75 μ crassae; cortex superior subirregulariter incrassatus, 10–30 μ crassus, I⁻; stratum gonidiale subcontinuum, gonidiis 5–10 μ diametro; stratum medullare ca. 25 μ crassum; cortex inferior ca. 5 μ crassus, I⁻.

Apothecia non visa.

Holotype: Eastern slope above Japata estate, Mt. Elgon, Kenya Colony, Africa, 3300 m., March 3, 1948, Hedberg 248 (UPS, isotype in Krk).

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine and zeorine.

This species is closely related to *A. diademata*, from which it differs in having a distinctly pruinose uppersurface. It also resembles *A. dactyliza* and *A. magellanica* var. *pectinata*, but the laciniae are corticate below. At the present time, *A. albopruinosa* is known only from the type specimen from Africa.

15. *ANAPTYCHIA POLYRHIZA* Kurokawa, sp. nov.

(Fig. 11)

Thallus foliaceus, albido-glaucescens, plagas 5–10 cm. raro usque ad 15 cm. latas formans, laciniatus; laciniae vulgo elongatae linearesque, crebre dichotome vel partim subpalmato-divisae, 0.7–3 mm. latae, superne planae vel leviter convexae, sorediis isidiisque destitutae, prope apiques leviter pruinosa; subtus omnino corticatae, nigrae, dense rhizinosaeque sed ambitum versus glabrae pallidaeque; rhizinae nigrae, simplices vel subsquarroso-ramosae, 1–1.5 mm. longae. Laciniae 180–230 μ crassae; cortex superior aequaliter incrassatus, 20–75 μ crassus, I⁻, parte exteriori obscure cinerea (ca. 15 μ crassa); stratum gonidiale continuum, ca. 35 μ crassum, gonidiis 6–10 μ diametro; stratum medullare ca. 100 μ crassum; cortex inferior 10–15 μ crassus, I⁻.

Apothecia superficialia, subsessilia vel substipitata, 1–4 mm. diametro, margine subtiliter crenatae, demum lacunculatae, receptaculis prope margines leviter pruinosis, discis fuscis, epruinosis; hymenium decolore et hyalinum, 100–120 μ altum, I⁺ coeruleescens; cortex receptaculi subaequaliter incrassatus, I⁻; asci oblongo-clavati, 20–25 \times 70–90 μ , 8-spori; sporae ellipsoideae, medio non aut levissime constrictae, membranis distincte incrassatis, 8–10 \times 26–30 μ , 1-septatae, 2-loculares, loculis obovatis rhomboidalibusve.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

Holotype: About 40 km. SE. of Comitán, San Lorenzo Ranch, Chiapas, Mexico, 1220 m., March 25, 1960, M. Hale 20478 (Krk, isotype in US).

This new species is very close to *A. diademata* f. *diademata*, but it has a black undersurface, except for a narrow peripheral zone, and numerous black rhizines.

Specimens examined: **Central America.** Mexico. Orizaba, C. Mohr (US). Veracruz. 7 km. N. of Fortin de las Flores, 1220 m., Hale 19664, 19700 (US); 64 km. SW. junction of highways 140 and 155, NE. of Huatusco, 1310 m., Hale 19518 (US).

16. *ANAPTYCHIA ISIDIOPHORA* (Nyl.) Vain.

Bot. Mag. (Tokyo) 32: 156. 1918

(Fig. 27)

Physcia speciosa f. *isidiophora* Nyl. Syn. Lich. 1: 417. 1860. *Physcia domingensis* f. *isidiophora* (Nyl.) Nyl. Act. Soc. Sci. Fenn. 7: 440. 1863. *Pseudophyscia speciosa* var. *hypoleuca* f. *isidiophora* (Nyl.) Müll. Arg. Engl. Bot. Jahrb. 20: 260. 1894. *Anaptychia speciosa* f. *isidiophora* (Nyl.) Zahlbr. Bot. Mag. (Tokyo) 41: 364. 1927. Holotype: Antilles, West Indies, 390–700 m., T. Husnot in 1868 (H, Nyl. Herb. 32514).

Physcia speciosa var. *cinerascens* f. *coralligera* Müll. Arg. Flora 73: 340. 1890. *Anaptychia speciosa* var. *cinerascens* f. *coralligera* (Müll. Arg.) Zahlbr. Cat. Lich. Univ. 7: 741. 1931. Holotype: Mt. Kilimanjaro, Tanganyika, Africa, H. H. Johnston in 1890 (G).

Thallus foliose, greyish white, loosely attached to the substratum, forming extensive colonies up to 20 cm. across, composed of repeatedly dichotomously or irregularly branched laciniae; laciniae 0.5–2.5 mm. broad, linear-elongate and minutely notched, somewhat discrete or contiguous at the circumference, epruinose, isidiate; isidia marginal and laminal, marginal isidia sometimes more or less dorsiventral at first, but finally cylindrical and coralloid as the laminal isidia; beneath corticate, white or sordid brown towards the center, rhizinate; rhizines mainly marginal, concolorous with the thallus or becoming dark to blackish brown towards the apices, irregularly branched. Laciniae about 300 μ thick; upper cortex more or less uniformly thickened, 50–150 μ thick, with a greyish surface layer 15–20 μ thick; gonidial layer continuous, 30–50 μ thick, gonidia 5–10 μ in diameter; medullary layer 100–200 μ thick; lower cortex about 30 μ thick.

Apothecia laminal, subsessile, 1.5–5 mm. in diameter; margin and receptacle densely isidiate at maturity; disc brown to blackish brown;

hymenium colorless and hyaline, 100–150 μ high, I+ blue; asci cylindrical or somewhat clavate, 20–25 \times 90–120 μ , 8-spored; spores pale fuscous, ellipsoid, constricted at the center, 10–15 \times 25–32 μ , very thick walled, 1-septate, with 2 subglobose, obovate or obconical locules.

Reaction: Thallus K+ yellow; med. K+ yellow, C-, KC-, PD- or PD+ pale yellow.

Chemical ingredients: Atranorine and zeorine.

Anaptychia isidiophora is closely related to *A. diademata* in size of spores and structure of thallus, but it differs significantly in having isidia. Externally it also resembles *A. microphylla*, from which it is separated by having a lower cortex and a uniformly thickened upper cortex. *A. isidiophora* is widely distributed in tropical and temperate zones of the world, occurring on rocks and trees. It has occasionally been reported in the literature as *A. corallophora*.

Representative specimens examined: **Asia.** Japan. Prov. Iwasiro. Moniwa, Iizawa-mati, Sinobu-gun, T. Higuti (As). Prov. Awa. Mt. Kiyosumi, Kurokawa 56560, 56564–66 (Krk). Prov. Izu. Amagi-Pass, Kurokawa 58606 (Krk). Prov. Kai. Taba, Kita-Turu-gun, M. Nuno (As). Prov. Mikawa. Mt. Horaiji, Kurokawa 56012, 56013, 56027 (Krk). Prov. Kii. Mt. Koya, Kurokawa 56073, 56074, 56076 (Krk). Prov. Inaba. Suetune-mura, Kedaka-gun, Ikoma 3416 (As, lkm). Kyusyu. Amakusa Islands. Honto, Asahina and Togashi (As), Manchuria. Mt. Hoo, Asahina (As). India. Darjeeling. Lloyd Botanic Garden. 6500 ft. Awasthi 3846 (Aw, Krk, M). Madura. Shembaganur forest, 6000 ft., G. Foreau (Aw, as no. 3784). **Central America.** Mexico. 18 km. SE. of San Cristobal, Chiapas, 2340 m., Hale 20258-A (US); Lagos de Monte Bello, 50 km. SE of Comitán, 1220 m., Hale 20364 (US). Michoacan, Morelia, Cerro Azul, 2200 m., Arsène 3989 (US). **South America.** Colombia, no precise locality, Lindig 2534 (H, Nyl. Herb. 32565, UPS). **Africa.** French Guinea. Fouta-Djalou, at Mamou, des Abbayes (REN). Union of South Africa. Simon's Bay Cape of Good Hope, Wright (US).

17. *ANAPTYCHIA DOMINGENSIS* (Ach.) Mass.

Mem. Lichenogr. 39. 1853

(Figs. 12, 28)

Parmelia domingensis Ach. Syn. Lich. 212. 1814. *Hagenia domingensis* (Ach.) DeNot. Giorn. Bot. Ital. 2 (1), vol. 1: 186. 1846. *Physcia domingensis* (Ach.) Nyl. Mem. Soc. Imp. Sci. Nat. Cherbourg 5: 106. 1857. *Squamaria domingensis* (Ach.) Mass. Atti I. R. Ist. Veneto, ser. 5, 5: 250. 1860. *Physcia stellaris* var. *domingensis* (Ach.) Tuck. Proc. Amer. Acad. Arts Sci. 4:396. 1860. *Heterodermia domingensis* (Ach.) Trev. Nuov. Giorn. Bot. Ital. 1: 114. 1869. Holotype: St. Domingo. West Indies (H).

Physcia ravenellii Tuck. Syn. N. A. Lich. 1: 68. 1882. *Anaptychia ravenellii* (Tuck.) Zahlbr. Cat. Lich. Univ. 7: 737. 1931. Holotype: Sullivans Island, South Carolina, U.S.A., H. W. Ravenel 203 (FH-Tuck, isotype in BM).

Anaptychia granulifera var. *farinulenta* Vain. Ann. Acad. Sci Fenn. A, 6(7): 63. 1914. Lectotype: Roseau Valley, Dominica, West Indies, W. R. Elliott 1319 pr. p. (TUR, Vain. Herb. 7733).

Thallus foliose, greyish white, 5–10 cm. in diameter, composed of repeatedly dichotomously or subirregularly branched laciniae; laciniae short and minutely notched, 0.5–1.5 mm. wide, often subimbricate at the center but more or less discrete or contiguous at the circumference, glabrous, slightly pruinose near the apices, sorediate along the margins; beneath corticate, white, sordid brown towards the center, sparsely rhizinate; rhizines concolorous with the thallus, the apices darkening, simple or irregularly to fruticosely branched. Laciniae about 200 μ thick; upper cortex uniformly thickened, 45–90 μ thick, with a greyish surface layer about 15 μ thick; gonidial layer continuous, 30 μ thick, gonidia 7–11 μ in diameter; medullary layer thin, 10–30 μ thick, hyphae forming sphaeroidal cells in places; lower cortex about 30 μ thick.

Apothecia rather rare, laminal, subsessile, 0.5–3 (5) mm. in diameter; margin sorediate; disc dark brown, epruinose; hymenium colorless and hyaline, about 100 μ high, I⁺ blue; asci cylindrical to somewhat clavate, about 20×80 μ ; spores pale brown, ellipsoid, more or less constricted in the center, 10–14×23–28 μ , very thick walled, 1-septate, with 2 subglobose or obovate locules.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and salazinic acid.

Parmelia domingensis Ach. has long been considered to be a *Physcia* by most recent lichenologists. However, the type specimen agrees morphologically with the well known North American species *A. ravenelii* and contains salazinic acid along with atranorine and zeorine. It is quite similar to *A. pseudospeciosa* var. *pseudospeciosa* in external appearance and spore size but does not contain norstictic acid. *A. domingensis* seems to be a typical North American lichen, being very common from Texas to the Carolinas in southeastern United States. It also occurs in the West Indies and Central and South America. The type of *A. granulifera* var. *farinulenta* agrees very well with North American material in spore size and other characters.

Representative specimens examined: **North America.** U.S.A. North Carolina. 3 mi. S. of Florence, Pamlico Co., Culberson 6459 (US, M, Krk). South Carolina. Base of oak in swamp, south of Hendersonville, Colleton Co., Hale 6534 (US). Georgia. Near town of Eatonton, Putnam Co., Hale 7515 (US). Florida. On live oak, 4 mi. NE. of La Belle, Glades Co., Hale 16869 (US). Kentucky. 3 mi. W. of Calvert City, Marshall Co., Hale 13101 (US). Arkansas. Near town of Crystal Spring, Garland Co., Hale 3044 (US). Texas. On red gum, Grimes Co., Hale 5356 (US). **Mexico.** Veracruz. 9 km. E. of Jalapa, 1240 m., Hale 19390, 19397 (US), 19420 (Krk, US). Chiapas. El Zapotal, Tuxtla Gutiérrez, 920 m., Hale 19974 (Krk, US). **West Indies.** St. Thomas. Signal Hill, 1400 m., Eggers 14 (TUR, Vain. Herb. 7732). Guadeloupe. Camp Jacob, 480–550 m., Duss 461 pr. p. (TUR, Vain. Herb. 7734). Dominica.

Botanical Garden, Roseau, Evans 58 (FH). **South America.** Venezuela. Merida, Los Andes, 1800 m. Mägdefrau 593 (M).

18. *ANAPTYCHIA TROPICA* Kurokawa, sp. nov.
(Fig. 29)

18a. var. *TROPICA*

Thallus sorediis isidiisque destitutus. Apothecia numerosa, marginibus sub-integris vel crenatis, sorediis isidiisque destitutis. Ceterum ut in *A. domingensis* (Ach.) Mass.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and salazinic acid.

Holotype: Road to El Suspiro, 5-7 kd. N. of Berriozábal, Chiapas, Mexico, 920 m., Hale 20214 (US).

This species differs from *A. domingensis* in lacking soredia, and from *A. diademata*, which it resembles externally, in chemical composition. It is known so far from Mexico and Costa Rica, but it probably occurs in other regions of tropical America.

Representative specimens examined: **Mexico.** Veracruz. 46 km. SW. of junction of highways 140 and 155, NE. of Huatusco, 1020 m., Hale 19466 (US). Oaxaca. 53 km. NW. of Oaxaca, 2200 m., Hale 20797 (US). Chiapas. 50 km. W. of Tuxtla Gutiérrez, Hale 19916 (US). **Costa Rica.** Vicinity of Santa Maria de Dota, San José, 1500-1800 m., Standley and Valerio 43410 (US).

18b. var. *ANTILLARUM* (Vain.) Kurokawa, comb. nov.

Anaptychia granulifera var. *antillarum* Vain. Ann. Acad. Sci. Fenn., A, 6 (7): 63. 1914. Lectotype: On *Inga laurifolia*, Camp Jacob, 500-800 m., Duss 459 pr. p. (TUR, Vain. Herb. 7737).

Anaptychia granulifera f. *pruinosa* Vain. Cat. Welw. Afr. Pl. 2: 409. 1901. Holotype: Serra de Alto, Golungo, Queta, Angola, Welwitsch 104 (TUR, Vain. Herb. 7735).

Anaptychia granulifera var. *denudata* Vain. Ann. Acad. Sci. Fenn., A, 6 (7): 63. 1914. Lectotype: On *Inga laurifolia*, Camp Jacob, 500-800 m., Duss 459 pr. p. (TUR, Vain. Herb. 7731).

This variety differs from var. *tropica* in having isidia. Although Vainio regarded this lichen as a variety of *A. granulifera*, the spores agree with those of *A. tropica* in size. However, it is very difficult to distinguish sterile specimens of var. *antillarum* from *A. granulifera*. The isidia are mainly marginal in var. *antillarum*, at least near the circumference of the thallus, and eventually become cylindrical and coralloid. Those of *A. granulifera* originate from the upper surface as papillae or granules and only rarely become cylindrical. In addition, the laciniae of *A. granulifera* are narrower, paler, and more densely pruinose than those of var. *antillarum*.

Representative specimens examined: **Mexico.** Chihuahua. Sierra Olladre, Pringle 82, 82-c (FH). Veracruz. 7 km. N. of Fortin de las Flores, 1220 m., Hale 19697 (US). Chiapas. 50 km. W. of Tuxtla Gutiérrez on highway 190, 1040 m., Hale 19931 (US). **West Indies.** Guadeloupe. Les Palmistes, Duss 1213 (TUR, Vain. Herb. 7729).

19. *ANAPTYCHIA GRANULIFERA* (Ach.) Mass.

Mem. Lichenogr. 41. 1853

(Fig. 13)

Parmelia granulifera Ach. Syn. Lich. 212. 1814 *Physcia speciosa* var. *granulifera* (Ach). Tuck. Proc. Amer. Acad. Arts. Sci. 4: 390. 1860. Holotype: North America, Muhlenberg (H, isotype in UPS).

Thallus foliose, greyish or greenish white, 3–6 cm. wide; laciniae short and minutely notched, repeatedly irregularly branched, plane, 0.3–1 mm. broad, more or less discrete to contiguous at the circumference, pruinose at least near the tips, with papillar or granular (or very rarely cylindrical) isidia; beneath corticate, pale or sordid brown towards the center, sparsely rhizinate; rhizines concolorous with the thallus or blackening, simple or irregularly branched. Laciniae 150–200 μ thick; upper cortex thin, irregularly thickened, 10–60 μ thick, I⁻; gonidial layer subcontinuous, 20–40 μ thick, gonidia 7–13 μ in diameter; medullary layer about 70 μ thick, hyphae sometimes forming sphaeroidal cells; lower cortex 20–30 μ thick.

Apothecia rather rare, laminal, subsessile, 0.5–2.0 mm. in diameter; margin minutely crenate; receptacle pruinose and isidiate; disc dark brown, epruinose; hymenium colorless and hyaline, about 100 μ high, I⁺ blue; asci cylindrical or somewhat clavate, about 20×80 μ ; spores pale brown, ellipsoid somewhat constricted at the center, 10–13 × 20–23 μ , very thick walled, 1-septate, with 2 subglobose or obovate locules.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and salazinic acid.

This is a common species in east-central North America and also occurs in Mexico. Of 48 specimens from the United States, only 2 had apothecia.

Representative specimens examined (see Fig. 13): **U.S.A.** Pennsylvania. Shawnee State Forest, Bedford Co., Hale 19245 (US). Virginia. Near Bane, Giles Co., Hale 12759 (US); Fairy Stone Park, Patrick, Hale, Lich. Amer. Exs. 51 (US, M). Ohio. Near New Marshfield, Athens Co., Hale 13249 (US). Arkansas. Near Green Forest, Carroll Co., Hale 2793 (US). **Mexico.** Veracruz. 46 km. SW. of junction of highways 140 and 155, N. E. of Huatusco, 1020 m., Hale 19483 (US). Puebla. 69 km. E. of Puebla on highway 140, Hale 19316 (US). Chiapas. 2 km. N. of highway 190, road to Puebla Nueva, 1070 m., Hale 20178 (fertile) (US).

20. *ANAPTYCHIA DISSECTA* Kurokawa

Journ. Jap. Bot. 34: 182. 1959

Holotype: Mt. Horaiji, Prov. Mikawa, Japan, Jan. 7, 1956, Kurokawa 56029 (As, isotypes in Krk and TNS).

20a. var. *DISSECTA*

Thallus foliose, greyish white, forming extensive colonies up to 10 cm. or more across; laciniae repeatedly dichotomously or partly subdigitate, 0.7–2.0 mm. wide, linear-elongate, minutely notched, loosely attached to the substratum, without pruina, more or less discrete to contiguous at the circumference, with microphyllous or subsidial marginal branchlets; beneath corticate, white and sordid brown towards the center; rhizines mainly marginal, concolorous with the thallus or darkening towards the apices, irregularly branched. Laciniae 150–300 μ thick; upper cortex more or less uniformly thickened, 50–120 μ thick, with a greyish surface layer 15–20 μ thick; gonidial layer subcontinuous, 25–40 μ thick, gonidia 7–11 μ in diameter; medullary layer 90–180 μ thick; lower cortex about 30 μ thick.

Apothecia very rare, laminal, substipitate, 1–5 mm. in diameter; margin isidiate; disc brown to blackish brown, without pruina; hymenium colorless and hyaline, about 150 μ high, I⁺ blue; asci cylindrical or somewhat clavate, about 25 \times 125 μ ; spores brown, ellipsoid, uncontracted or slightly constricted at the center, 12–16 \times 28–32 μ , very thick walled, 1-septate, with 2 subglobose or obovate locules.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻ PD⁺ deep yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids, and an unknown substance.

This species is closely related to *A. isidiophora* and *A. microphylla*, but it has different chemicals. In An the unknown substance forms fusiform, deep yellow, thin plates (along with curved needles of atranorine and the pyramids of zeorine). Rectangular parallelepiped, deep yellow crystals are formed in o-T. The PD⁺ deep yellow color test is caused by this undetermined substance.

After the publication of *A. dissecta*, I found that this species is widely distributed in India as well as in Japan.

Representative specimens examined: Localities from Japan are listed in Kurokawa (1959, p. 183). Asia. India. Darjeeling. Lloyd Bot. Gard., 6500–6800 ft., Awasthi 3484 (Aw). Barechhina, 5500 ft., Awasthi 3498 (Aw, UPS). Above Village Naret, Askote, 4500 ft., Awasthi 3313 (Aw, UPS).

20b. var. *KOYANA* Kurokawa,
Journ. Jap. Bot. 34: 183. 1959

Holotype: Mt. Koya, Prov. Kii, Japan, Kurokawa 56027 (As, isotypes in Krk, US).

It is difficult to distinguish this variety morphologically from var. *dissecta*; the main difference is that var. *koyana* produces neither norstictic or salazinic acids. Var. *koyana* has a wide distribution in subtropical regions.

Representative specimens examined: Localities in Japan and Formosa are listed in Kurokawa (1959, p. 184). Additional localities follow. **Asia.** India. Almora. Near Digtarh, 5500 ft., Awasthi 3997 (Krk). **Central America.** Mexico. Chiapas. El Sumidero, near Tuxtla Gutiérrez, Hale 20017 (US).

21. *ANAPTYCHIA ANGUSTILOBA*

(Müll. Arg.) Kurokawa, comb. nov.

Physcia speciosa var. *angustiloba* Müll. Arg. Flora 66: 78. 1883. *Pseudophyscia speciosa* var. *angustiloba* (Müll. Arg.) Müll. Arg. Engl. Bot. Jahrb. 20: 259. 1894. *Anaptychia speciosa* var. *angustiloba* (Müll. Arg.) Zahlbr. Cat. Lich. Univ. 7: 741. 1931. Holotype: Toowoomba, Queensland, Australia, Hartmann (G).

Thallus foliose, greyish white; laciniae repeatedly di- or trichotomously branched, short and narrow, 0.5–1.2 mm. wide; rather flexuose, discrete at the circumference, without pruina; beneath corticate, concolorous with the thallus or becoming somewhat sordid brown towards the center; rhizines mainly marginal, concolorous with the thallus or becoming sordid towards the apices, irregularly branched, 1–2 mm. long. Laciniae about 300 μ thick; upper cortex more or less uniformly thickened in transverse section, 70–120 μ thick, I⁺ violet, with a greyish surface layer; gonidial layer continuous, about 30 μ thick, gonidia 7–12 μ in diameter; medulla 100–150 μ thick; lower cortex about 30 μ thick, I⁺ violet.

Apothecia laminal, sessile or constricted basally, 0.5–2.5 mm. in diameter; margin more or less crenate, disc blackish brown, slightly pruinose; hymenium colorless, about 130 μ high, I⁺ blue; cortex of receptacle uniformly thickened, I⁺ violet; asci cylindrical to clavate, 23–26 \times 90–110 μ ; spores ellipsoidal, 13–15 \times 25–30 μ . very thick walled, 1-septate, with 2 subglobose or obovate locules.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning reddish yellow, C⁻, KC⁻, PD⁺ deep yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids, and an unknown substance identical with that in *A. dissecta*.

This species is well characterized by the narrow laciniae and by the production of an undetermined substance identical to that in *A. dissecta*. It occurs in eastern Asia and Australia.

Representative specimens examined: **Asia.** Japan. Honsyu. Prov. Kii. Singu, Asahina (As). Formosa. Taityu. Keitau, Asahina (As). China. Yunnan. Schilungba near Yunnanfu, Handel-Mazzetti 245, 248 (W). Setschwan. Between Yalung and Nganning-ho rivers, Handel-Mazzetti 2015 (W). Nepal. No precise locality. M. L. Banerjee (Aw, as no. 1415 pr. min. p.).

22. *ANAPTYCHIA FIRMULA* Nyl.)(Dodge et Awasthi
in Awasthi, Journ. Ind. Bot. Soc. 39: 423. 1960
(Fig. 30)

Physcia firmula Nyl. Syn. Lich. 1: 418. 1860. *Physcia obscura* var. *firmula* (Nyl.) Linds. Trans. Roy. Soc. Edinb. 22: 248. 1859. *Heteroderma firmula* (Nyl.) Trev. Atti Soc. Ital. Sci. Nat. Milano 11: 615. 1868. Holotype: Himalaya, 4000–5000 ft., Herb. Ind. Or. Hook. f. and Thoms. 2017 (H, Nyl. Herb. 32572).

Anaptychia speciosa f. *endocrocea* Zahlbr. Symb. Sin. 3: 242. 1930. Holotype: On *Schoepfia jasminodora*, on the hill at Djindjischan near Loping, Yunnan, China, 1600 m., Handel-Mazzetti 10179 (W, isotype in WU).

Thallus foliose, greyish white, 5–7 cm. across; laciniae narrow, 0.3–1 mm. broad, repeatedly irregularly branched, often somewhat flexuose, without pruina, discrete or contiguous at the circumference, imbricate or subimbricate at the center, without soredia or isidia; medulla yellow; beneath corticate, greyish white but becoming sordid brown towards the center; rhizines concolorous with the thallus, irregularly or fruticoseously branched, 1–1.5 mm. long. Laciniae about 250 μ thick; upper cortex more or less irregularly thickened in transverse section, 30–100 μ thick, with a greyish surface layer about 20 μ thick, I⁺ slightly blue; gonidial layer 30–40 μ thick, gonidia 7–12 μ in diameter; medulla 80–120 μ thick; lower cortex about 40 μ thick, I⁺ violet.

Apothecia laminal, sessile, constricted at the base, 0.5–4 mm. in diameter, with entire or minutely crenate margins; disc dark brown, concave or plane, slightly pruinose or becoming naked; hymenium colorless and hyaline, 90–130 μ high, I⁺ blue; cortex of receptacle uniformly thickened, I⁺ violet; asci cylindrical or somewhat subclavate, 20–23 \times 60–80 μ ; spores pale brown, 10–11 \times 20–27 μ , very thick walled, 1-septate, with 2 subglobose obovate locules.

Reaction: Thallus K⁺ yellow; med. K⁺ purple, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine, zeorine, and an unidentified yellow substance.

This unique species is characterized by the yellow pigment in the medulla. Judging from the color reaction with K, it is an anthraquinone similar to the one in *A. obscurata* and *A. flabellata*. Although in the holotype of *Physcia firmula* the pigment occurs only near the rhizines, it usually occurs throughout the medulla. This species is endemic to India and adjacent southwest China.

Specimens examined: India. Darjeeling. Observatory Hill, 7000 ft., Awasthi 3866 (Aw). Almora. Village Naret, 4500 ft., Awasthi 2664, 3296, 3298, 3308, 3310 (Aw). Dhaulek. Askote. 5500 ft., Awasthi 3965 (Aw). Kangra. Manoli, 6000 ft., Hoeg (Aw, as no. 1488). Uttar Pradesh. On way to Purnagiri from Tanakpur, Kali river valley, 1000 ft., Awasthi 3379 (Aw).

23. *ANAPTYCHIA RUGULOSA* Kurokawa, sp. nov.

(Fig. 31)

Thallus foliaceus, albido-glaucescens, plagas usque ca. 10 cm. formans, laciniatus; laciniae lineares elongataeque, dichotome vel partim subpalmato-divisae, superne laevigatae sed in centrum leviter rugulosae, dense albopruinosae, 0.7–2 mm. latae; subtus corticatae, leviter sordide fuscae vel nigrescentes sed ad peripheriam pallidae, rhizinosae, rhizinis brevibus, thallo concoloribus, simplicibus vel prope apices ramosis. Laciniae 360–500 μ crassae; cortex superior subirregulariter incrassatus, 80–200 μ crassus; stratum gonidiale discontinuum, gonidiis 7–13 μ diametro; stratum medullare lutescens vel fulvescens, 110–170 μ ; cortex inferior 40–80 μ crassus.

Apothecia superficialia, subsessilia, 1–6 mm. diametro, marginibus crenatis, receptaculis thallo concoloribus, laevigatis, ad marginis albo-pruinosis, discis concavis vel subplanis, nigro-fuscis, denudatis; hymenium hyalinum, ca. 100 μ altum; sporae fuscae, ellipsoideae, medio raro levissime constrictae, membranis distincte incrassatis, 11–13 \times 20–28 μ , 1-septatae, 2-loculares, loculis subglobosis obovatisque.

Reaction: Thallus K⁺ yellow; med. K⁺ purple, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine, zeorine, and an undetermined yellow substance.

Holotype: On *Bursera* trees, Guadalajara, Jalisco, Mexico, July 29, 1902, Pringle 15372 (US, isotype in Krk).

This new species is related to *A. firmula* in having an undetermined yellow pigment in the medulla, but it differs in having wide, linear-elongate laciniae and a negative I reaction in the cortex of the receptacle. The laciniae of *A. rugulosa* are also densely pruinose, while those of *A. firmula* are without pruina. *A. rugulosa* seems to be restricted to Mexico, but the distribution is incompletely known.

Specimen examined: Mexico. 69 km. E. of Puebla on highway 140, Puebla, Hale 19334 (Krk, US).

23a. *ANAPTYCHIA RUGULOSA*

var. *ISIDIOSA* Kurokawa, var. nov.

Laciniae margine isidiosae, isidiis leviter dorsiventralibus saepe divisisque. Apothecia non visa. Ceterum ut in var. *rugulosa*.

Holotype: 65 km. E. of Morelia, Michoacán, Mexico, Hale 20985 (US).

24. *ANAPTYCHIA ALBIDIFLAVA* Kurokawa, sp. nov.

(Fig. 32)

Thallus foliaceus, albido- vel glauco-cinereus, plagas 5–7 cm. latas formans, laciniatus; laciniae sublineares, crebre di- vel trichotome divisae, 1–2 mm. latae, superne laevigatae, leviter convexae, prope apices albo-pruinosae, sorediis isidiisque destitutae; subtus corticatae, leviter sordide brunnescentes, rhizinosae, rhizinis thallo concoloribus vel apices versus obfuscatis, 1–1.5 mm. longis; medulla albidiflava vel leviter sordide fulvescens. Laciniae 200–250 μ crassae; cortex superior aequaliter incrassatus, 35–80 μ crassus, I⁺ leviter violascens, parte exteriore obscure cinerea, ca. 15 μ crassa; stratum medullare ca. 100 μ crassum; cortex inferior ca. 30 μ crassus, I⁺ leviter violascens.

Apothecia superficialia, sessilia vel substipitata, marginibus crenatis vel lacinulatis, discis concavis, nigro-fuscis; hymenium decolore et hyalinum, ca. 150 μ altum, I⁺ coeruleum; cortex receptaculi aequaliter incrassatus, I⁺ violascens; asci oblongo-clavati, 24 \times 130 μ ; spores brunnescentes, ellipsoideae, membranis distincte incrassatis, 1-septatae, 2-loculares, loculis obovatis, 12–13 \times 25–33 μ .

Reaction: Thallus K⁺ yellow; med. K⁺ red, C⁻, KC⁻, PD⁺ deep yellow.

Chemical ingredients: Atranorine, zeorine, an undetermined substance identical with that in *A. dissecta*, and an unknown anthraquinone.

Holotype: Above Kurseong, Darjeeling, India, 5500 ft., on tree trunk, Oct. 8, 1957, Awasthi 3912 (Aw).

This new species is closely related to *A. formula*, from which it is distinguished by different chemical constitution. When the Ac.X. is heated with An under a coverglass, deep yellow fusiform plates are seen (along with crystals of atranorine and zeorine). The red coloration of the medulla with K indicates that the whitish brown pigment deposited in the medulla is an anthraquinone.

Specimen examined: **India**. Darjeeling, Near Manibhanjang, 5000 ft., Awasthi 148 pr. maj. p. (Aw).

25. *ANAPTYCHIA HYPOLEUCA* (Mühl.) Mass.

Atti I. R. Ist. Veneto, ser. 3, 5: 249. 1890

(Figs. 1, 4, 33)

Parmelia hypoleuca Mühl. Cat. Pl. Amer. Sept. 105. 1813. *Physcia hypoleuca* (Mühl.) Tuck. Syn. N. A. Lich. 67. 1882. Holotype: North America, Mühlberg (H, isotype in PH).

Thallus foliose, greyish or greenish white, forming extensive colonies up to 15 cm. or more across; laciniae linear-elongate, minutely notched, repeatedly dichotomously or irregularly branched, 0.5–2 mm. wide, plane or somewhat convex, glabrous, not ascending towards the apices, without pruina, contiguous or somewhat discrete at the circumference,

with subentire margins; beneath decorticate, white or sordid brown towards the center, with marginal rhizines; rhizines concolorous with the thallus or becoming dark or black towards the apices, irregularly or fruticosely branched. Laciniae 250–350 μ thick; upper cortex sometimes I⁺ pale violet, with a greyish surface layer 15–20 μ thick, irregularly thickened and the lower surface distinctly flexuose, the thickness varying from 30–200 μ , often projecting downward into the medulla; gonidial layer often interrupted by the upper cortex, gonidia 5–10 μ in diameter; medulla of loosely interwoven hyphae, becoming densely intertwined near the lower surface, 70–150 μ thick.

Apothecia laminal, substipitate, usually numerous, 3–10 mm. in diameter, with crenate or lacinulate margins, lacinules corticate on the outer side and decorticate on the inner side, rarely up to 4–7 mm. long, disc brown to dark brown; hymenium colorless and hyaline, about 100 μ high, I⁺ blue; cortex of receptacle very irregularly thickened, sometimes I⁺ violet; asci cylindrical or subclavate, 20–25 \times 80–100 μ ; spores pale fuscous, ellipsoid, sometimes constricted at the center, 10–15 \times 20–32 μ , very thick walled, 1-septate, with 2 subglobose, obovate, or obconical locules. Pycnidia immersed, with slightly indented ostioles; microconidia colorless, 0.3–0.5 \times 1–2 μ .

Reaction: Thallus K⁺ yellow; med. K⁺ yellow or occasionally deep yellow, C⁻, KC⁻, P⁺ pale yellow to yellow.

Chemical ingredients: Atranorine and zeorine, rarely also norstictic and salazinic acids.

Anaptychia hypoleuca has a typical disjunctive distribution pattern in eastern Asia and eastern North America. The range in North America has been studied by Hale (1956, p. 115). On the whole its range is almost identical with that of *A. palmulata*.

There has been much confusion among lichenologists as to the recognition of this species. Although first described from Pennsylvania, it has been reported from almost all temperate and tropical regions of the world. Most of the literature reports can be identified as *A. flabellata*, *A. obscurata*, *A. cassarettiana*, or *A. diademata*. Most of the South American specimens reported by Vainio and Lynge should be identified as *A. flabellata*, which is distinguished from *A. hypoleuca* by squarrosely branched black rhizines, larger spores, and a yellow or ochraceous undersurface.

A report of stictic acid by Hale (1956) is apparently based on abnormal forms of zeoine from o-T. Norstictic and salazinic acids are accessory components.

Representative specimens examined: **Asia.** Saghalien. Hoe, F. Fujikawa (As). Japan. Hokkaido. Osima Peninsula, Atsusawabe-mura, T. Suzuki (As). Honsyu.

Prov. Iwaki, Matukawa-ura, Kurokawa 58098 (Krk). Prov. Kozuke. Mt. Akagi, Kurokawa 550467 (Krk). Prov. Sagami. Lakeside of Asinoko, Hakone, M. Togashi (As). Prov. Izu. Amagi-Pass, Kurokawa 58603 (Krk). Kyusyu. Prov. Higo. Mt. Itibusu, Togashi (As). Corea. Siraiwa, Mt. Diamond, Asahina (As). Formosa. Mt. Taiping-san, S. Asahina (As). China. Yunnan. Near Ngulukö at Lidjiang, Likiang, Handel-Mazzetti 10063 (W). **North America.** U.S.A. Maine. Albion, J. C. Parlin (FH). Arkansas. Near Blackburn, Washington Co., Hale 2789 (US). Oklahoma. Near Talihina, Hale 5670 (US).

26. *ANAPTYCHIA MICROPHYLLA*

(Kurokawa) Kurokawa, comb. nov.

Anaptychia hypoleuca var. *microphylla* Kurokawa, Journ. Jap. Bot. 34: 123. 1959. Holotype: Sakakita-mura, Higashi-Tikuma-gun, Prov. Shinano, Japan, July 28, 1953, Yamazaki (As, isotype in Krk).

26a. f. *MICROPHYLLA*

Laciniae of the thallus with numerous squamules along the margins, squamules ascending, dorsiventral, often branched.

Receptacle of apothecia with numerous squamules.

Otherwise as in *A. hypoleuca*.

This species is closely related to *A. hypoleuca*, but it is easily distinguished by having numerous squamules along the margins of lobes. While *A. hypoleuca* shows a typical disjunctive pattern in eastern Asia and eastern North America, *A. microphylla* is restricted to Japan. It also resembles *A. squamulosa* and *A. fragilissima* in external appearance. However, the spores are smaller ($10-15 \times 20-30 \mu$) than those of the other two species, and significantly the locules never form sporoblastidia.

A. microphylla occasionally contains norstictic and salazinic acids along with atranorine and zeorine.

A Yasuda specimen (no. 64) determined by Vaino (1918, p. 156) as *A. isidiophora* can now be identified as *A. microphylla*. Similarly Räsänen's report of *A. speciosa* f. *isidiophora*, based on Yasuda 384 from Prov. Hoki, Japan, is *A. microphylla*.

This entity is now known from nearly 20 localities in Japan, which are listed in a separate article (Kurokawa, 1959a, p. 123).

26b. f. *GRANULOSA* (Kurokawa) Kurokawa, comb. nov.

Anaptychia hypoleuca var. *microphylla* f. *granulosa* Kurokawa, Journ. Jap. Bot. 34: 123. 1959. Holotype: Mt. Myoho, Mitumine, Titibu, Prov. Musasi, Japan, 1300 m., May 6, 1956, Kurokawa 56144 (As, isotype in Krk).

This form is distinguished from f. *microphylla* by having soredia along the margins of the lobes and at the tips of subsidial branches. Norstictic

and salazinic acids are demonstrated rather often. This form is known from more than 20 localities in Japan and from one locality in Corea, as listed in Kurokawa (1959a, p. 124).

27. *ANAPTYCHIA PUNCTIFERA* Kurokawa, sp. nov.

Thallus pallido-cinereascens, plagas ca. 4 cm. latas formans, laciniatus; laciniae subirregulariter divisae, breves, 0.3–0.8 mm. latae, margine subintegrae, hic illic albo-vulneratae, superne planae laevigataeque, sorediis isidiisque destitutae; subtus decorticatae, niveo-albae, in marginibus rhizinis brevibus, thallo concoloribus vel nigrescentibus, irregulariter ramosis praeditae. Laciniae 200–250 μ crassae; cortex superior subaequaliter incrassatus, 50–100 μ crassus, parte exteriori obscure cinerea, 20–25 μ crassa; stratum gonidiale subcontinuum, 30–40 μ crassum, gonidiis 7–13 μ diametro; stratum medullare ca. 130 μ crassum, ex hyphis aliquanto dense contextis formatum.

Apothecia superficialia, substipitata, 1–4 mm. diametro, marginibus albo-punctatis, demum lacinulatis, lacinulis brevissimis, discis concavis, albo-pruinosis, sed demum subplanis subnudisque; hymenium decolore et hyalinum, ca. 100 μ altum, I⁺ coerulescens; cortex receptaculi aequaliter incrassatus, I⁻; asci oblongo-clavati, 20–23 \times 80–90 μ ; spora pallido-fuscae, ellipsoidaleae, membranis distincte incrassatis, 1-septatae, 2 loculales, loculis subglobosis obovatisve, 10–12 \times 23–28 μ .

Reaction: Thallus K⁺ yellow; med. K⁺ pale yellow, C⁻, KC⁻, PD⁺ pale yellow.

Chemical ingredients: Altranorine, zeorine, norstictic and salazinic acids.

Holotype: Above Tankhu village, Mewakhola Valley, Nepal, on twigs of tree, 7500 ft., May 26, 1953, Awasthi 2217 (Aw).

The diagnostic characters of this species are the narrow, short laciniae and especially the white dots on the margins of young apothecia. These dots do not seem to be pseudocypellae, as in *Parmelia laevior*, but seem to be the initials of the lacinules, which arise at a later stage. Although the thallus is decorticate below, it resembles externally *A. diademata*, *A. angustiloba*, or *A. formula*, rather than *A. hypoleuca*. It is apparently endemic to India.

Specimens examined: Asia. India. Darjeeling. Tiger Hill, 8500 ft., Awasthi 3895 (Aw); Near Manibhauyang, 5000 ft., Awasthi 148 pr. min. p. (Aw). Almora. Ranikkat-Chaubattia, 6000 ft., Awasthi 3542-A, B (Aw).

28. *ANAPTYCHIA ERINACEA* (Ach.) Trev. Flora 44: 52. 1861

Borreria erinacea Ach. Lich. Univ. 499. 1810. *Physcia ciliaris* var. *erinacea* (Ach.) Nyl. Syn. Lich. 1: 414. 1860. *Physcia erinacae* (Ach.) Tuck. Prov. Amer. Acad. Arts. Sci 4: 388. 1860. Holotype: California, U.S.A., Menzies (H, isotype in UPS).

28a. f. *ERINACEA*

Thallus foliose, greyish white, rosulate, attached to the substratum only at the center; laciniae irregularly torn-cleft, subsascending towards the tips, imbricate, plane or somewhat convex, glabrous, 0.5–2.0 mm. wide, with marginal rhizines; beneath decorticate, white, minutely veined; rhizines (cilia) simple, concolorous with the thallus but darkening towards the apices, 2–5 mm. long. Laciniae 300–350 μ thick; upper cortex very irregularly thickened in transverse section and the lower surface distinctly flexuose, often projecting downward to the underside of the thallus without any covering of medulla; gonidial layer often interrupted by the cortex and discontinuous, gonidia 10–15 μ in diameter.

Apothecia laminal, short stalked, 0.5–2 mm. in diameter, with entire margins; disc blackish brown or black, pruinose, often becoming naked; hymenium colorless and hyaline, 80–110 μ high, I⁺ blue; asci cylindrical or somewhat clavate, 15–20 \times 75–85 μ ; spores dark brown, ellipsoid, 8–11 \times 18–26 μ , 1-septate, with 2 obovate locules.

Reaction: Thallus K⁺ yellow; med. K⁻, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine and zeorine.

This unique species is restricted to the coastal regions of California and Baja California. It occurs on the twigs of various shrubs and on cacti in dry areas as well as on rock.

Representative specimens examined. **U.S.A.** California. Pt. Labos, San Francisco, Herre 885 (FH); Pt. Lomos, San Diego, Cummings, Lich. Bor. Amer. 145 (US, M); Equestria Trail, Santa Catalina Island, Nuttall 769 (FH). **Mexico.** Baja California. 5 km. NE. of Miller's Landing, Carter and Kellogg 2991 (FH).

28b. f. *CILIATOMARGINATA* (Linder) Kurokawa, comb. nov.

Anaptychia ciliatomarginata Linder, Proc. Calif. Acad. Sci. IV, 21: 217. 1934. Holotype: South end of Guadaloupe Island, Nov. 16, 1931, Howell 47 (FH).

Cilia of the thallus marginal and laminal.

Apothecia ciliate at the margins and concolorous with the thallus. Otherwise as in f. *erinacea*.

Section 2. **POLYBLASTIDIUM** Kurokawa, sect. nov.

Thallus foliaceus, laciniatus; laciniae substrato affixae vel apices versus subsascentes aut suberectae, dorsiventrales, superne margineque corticatae sed inferne decorticatae; cortex ex hyphis sublongitudinalibus conglutinatis formatus.

Apothecia superficialia vel subterminalia, subsessilia vel pedicellata, lecanorina; hymenium hyalinum, I⁺ coerulescens; hypothecium a excipulo proprio

male limitatum; sporae fuscae, ellipsoideae, medio non aut levissime constrictae, 1-septatae, 2-loculares, loculis demum sporoblastiis parvis praeditis.

Type species: *Anaptychia obscurata* (Nyl.) Vain.

KEY TO THE SERIES OF SECTION POLYBLASTIDIUM

- 1a. Laciniae appressed to the substratum. Ser. 1 *Polyblastidium*
- 1b. Laciniae suberect or ascending at least near the tips.
 - 2a. Apothecia laminal. Ser. 2. *Palpebratae*
 - 2b. Apothecia terminal or subterminal.
 - 3a. Laciniae long, linear-elongate, ascending only near the tips
Ser. 3. *Leucomelaenae*
 - 3b. Laciniae short, suberect or ascending. Ser. 4. *Podocarpae*

Series 1. **Polyblastidium**

Thallus lacinate; laciniae appressed to the substratum, not ascending towards the apices.

Apothecia laminal; spores brown, 1-septate, with 2 locules, locules with several small sporoblastidia.

Type species: *Anaptychia obscurata* (Nyl.) Vain.

This series resembles series *Speciosae* in having the thallus appressed to the substratum. However, the spores have two main locules and several small sporoblastidia. None of the species of this series has a cortical layer on the undersurface. Yellow or ocherous pigments are often deposited on the undersurface of the thallus.

KEY TO THE SPECIES OF SER. POLYBLASTIDIUM

- 1a. Thallus sorediate.
 - 2a. Medulla K⁺ yellow, PD⁻ or PD⁺ pale yellow, atranorine and zeorine present.
 - 3a. Rhizines palmately branched; undersurface distinctly corticate along the margins. (41) *A. chilensis*
 - 3b. Rhizines simple or squarrosely branched; undersurface indistinctly corticate along the margins.
 - 4a. Undersurface yellow or ocherous, K⁺ purple. . (29) *A. obscurata*
 - 4b. Undersurface white, turning purple-black towards the central part of the thallus. (34) *A. japonica*
 - 2b. Medulla K⁺ yellow turning red, PD⁺ distinctly yellow, norstictic or salazinic acids present along with atranorine and zeorine.
 - 5a. Containing norstictic acid (o-T); salazinic acid also present with KOH⁺K₂CO₃ test.
 - 6a. Undersurface smooth to more or less roughened; Western Hemisphere. (32) *A. casarettiana*
 - 6b. Undersurface arachnoid.

- 7a. Undersurface yellow or ochreous at least near the tips of laciniae, pigment K⁺ purple; tropical and temperata
(31) *A. dendritica* var. *propagulifera*
- 7b. Undersurface white, purple black towards the center; Asia and Africa. (34) *A. japonica* var. *reagens*
- 5b. Not containing norstictic acid (o-T); salazinic acid present with o-T and KOH+K₂CO₃ tests. (33) *A. hypocaustia*
- 1b. Thallus without soredia.
- 8a. Thallus isidiate or with numerous squamules.
- 9a. Thallus isidiate.
- 10a. Undersurface pale yellow, at least near the tips of laciniae; isidia mainly laminal. (38) *A. corallophora*
- 10b. Undersurface white even at tips; isidia mainly marginal
(43) *A. magellanica* var. *pectinata* f. *isidiosa*
- 9a. Thallus with numerous squamules.
- 11a. Medulla K⁺ yellow turning reddish yellow, containing norstictic acid with atranorine and zeorine
(31) *A. dendritica* var. *dissecta*
- 11b. Medulla K⁺ yellow, atranorine and zeorine present.
- 12a. Squamules marginal and laminal; spores 11–16 × 26–37 μ; North and Central America. (35) *A. squamulosa*.
- 12b. Squamules marginal; spores 16–20 × 36–50 μ.
- 13a. Young rhizines often of the same color as the thallus; Africa. (37) *A. appendiculata*
- 13b. Rhizines jet black; thallus fragile; eastern Asia
(36) *A. fragilissima*
- 8b. Thallus without isidia or squamules.
- 14a. Undersurface pigmented, at least near tips.
- 15a. Pigment K⁻; tropical America. (39) *A. lamelligera*
- 15b. Pigment K⁺.
- 16a. Pigment K⁺ violet; endemic to Hawaii. (46) *A. obesa*
- 16b. Pigment K⁺ purple.
- 17a. Medulla K⁺ yellow turning reddish yellow, norstictic acid, atranorine, and zeorine present.
- 18a. Undersurface purple black towards the center
(36) *A. dendritica*
- 18b. Undersurface completely yellow or ochreous
(30) *A. flabellata* var. *corcovadoensis*
- 17b. Medulla K⁺ yellow, atranorine and zeorine present
(30) *A. flabellata*
- 14b. Undersurface not pigmented.
- 19a. Medulla K⁺ yellow turning red, salazinic acid present
(45) *A. coronata*
- 19b. Medulla K⁺ yellow, salazinic acid absent.
- 20a. Thallus and receptacle of apothecia spinulate
(42) *A. spinigera*
- 20b. Thallus and receptacle of apothecia without spinules.

- 21 a. Laciniae linear-elongate, distinctly corticate on the margins of the undersurface. . . (40) *A. dactyliza*
- 21 b. Laciniae indistinctly corticate on the margins of the undersurface.
- 22 a. Laciniae sparsely rhizinate along the margins; cortex of receptacle I⁻. . . (43) *A. magellanica*
- 22 b. Laciniae densely rhizinate along the margins, rhizines projecting in a mat beyond the margins; cortex of receptacle I⁺ pale violet
(44) *A. togashii*

29. *ANAPTYCHIA OBSCURATA* (Nyl.) Vain.

Acta Soc. Faun. Fl. Fenn. 7: 137. 1890

Physcia obscurata Nyl. Ann. Sci. Nat. Bot., ser. 4, 19: 310. 1863. Holotype: Colombia, South America, 2900 m., Lindig 704 (H, Nyl. Herb. 32570, isotypes in FH, M, PC).

Physcia speciosa var. *hypoleuca* f. *sorediifera* Müll. Arg. Flora 68: 502. 1885. *Physcia speciosa* var. *sorediifera* (Müll. Arg.) Müll. Arg. Lich. Socot. 355. 1888. *Anaptychia hypoleuca* var. *sorediifera* (Müll. Arg.) Vain. Phil. Journ. Sci. 8: 106. 1913. *Anaptychia sorediifera* (Müll. Arg.) DR. et Lyngé in Lyngé, Vidensk. I. Math. Naturv. Kl. 16: 12. 1924. Holotype: Comoro Islands, Africa, Hildebrandt 1866-b (G).

Pseudophyscia hypoleuca var. *colorata* Zahlbr. Sitzungsbr. Acad. Wiss. Wien. 111: 413. 1902. *Anaptychia hypoleuca* var. *colorata* (Zahlbr.) Zahlbr. Bot. Mag. (Tokyo) 41: 363. 1927. *Anaptychia sorediifera* var. *colorata* (Zahlbr.) Magn. Ark. Bot. ser. 2, 3 (10): 391. 1955. *A. dendritica* var. *colorata* (Zahlbr.) Kurokawa, Journ. Jap. Bot. 30: 255. 1955. Holotype: Botanical Garden, Rio de Janeiro, Höhnel 112 (not seen).

Anaptychia heterocbroa Vain. Bot. Mag. (Tokyo) 35: 60. 1921. Holotype: On *Pinus densifolia*, Prov. Kozuke, Japan, Yasuda 229 (TUR, Vain. Herb. 7728, isotype in FH).

Anaptychia labellifera Hillm. Fedde Repert. 49: 203. 1940. Type: S. slope of Haleakala, Lualailua, Maui, Hawaii, Forbes 2236 M (destroyed).

Anaptychia adamesii Dodge, Ann. Mo. Bot. Gard. 40: 400. 1953. Holotype: Trunk of *Elacis guineensis*, Sefadu, Sierra Leone, Africa, Sept. 22, 1952, Adames and Deighton M 4752 (K).

Thallus foliose, greyish or greenish white, sometimes partly blackened at the center, forming extensive colonies up to 15 cm. across; laciniae dichotomously or irregularly branched, 0.7–2 mm. broad, plane or somewhat convex, smooth, sublinear-elongate, minutely notched, without pruina, margin nearly entire, forming capitate soralia at the tips of lateral branchlets; beneath decorticate, arachnoid, deep or brownish yellow, with marginal rhizines; rhizines jet black, simple or squarrosely branched, 1–2 mm. long. Laciniae 200–300 μ thick; upper cortex irregularly thickened in transverse section and the lower surface distinctly

flexuose, varying from 30–200 μ , often projecting downward into the medulla, with a greyish surface layer 15–20 μ thick; gonidial layer often interrupted by the upper cortex, gonidia 8–12 μ in diameter; medulla of loosely interwoven hyphae, becoming densely intertwined near the lower surface, 50–100 μ thick.

Apothecia rather rare, laminal, substipitate, 1–5 mm. in diameter; margins subentire at first, becoming sorediate; disc blackish brown, without pruina; hymenium colorless and hyaline, 150–250 μ high, I+ blue; asci cylindrical or subclavate, about 35 \times 120; spores brown, unconstricted or somewhat constricted at the center, 15–19 \times 29–35 μ , locules urceolate or subpyriform, with 2–3 small sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or P⁺ pale yellow; undersurface K⁺ purple.

Chemical ingredients: Atranorine, zeorine, and an unknown pigment.

The holotype of *Physcia obscurata* Nyl. is a scrappy, blackened specimen with a pigmented undersurface. The pigment has almost entirely disappeared in the isotypes at FH and M. Vainio was obviously puzzled by this species but transferred it correctly to the genus *Anaptychia*. I have recently seen some specimens in the field with a blackened thallus and a caesious undersurface, caused apparently by sunburn or rotting and without taxonomic value.

Physcia speciosa var. *sorediifera* Müll. Arg. in Flora 67: 620, 1884, is a nomen nudum, validated by Müller in the next volume of this journal. This is the basionym of *Anaptychia sorediifera* (Müll. Arg.) DR. et Lynge. The type of *A. adamesii* Dodge is also identifiable as *A. obscurata*.

The type specimen of *A. labellifera* Hillm. was apparently destroyed during the Second World War. In the original description, Hillmann mentioned the following characters: "lobes ad apices saepe paululum dilatatis, rotundatis aut pro parte soralibus labriformibus albidis ornatis... subtus pallide fuscescens vel aurantiaco-latericius, ecorticatus... facies inferior KOH violaceo-rubescit." Considering these characters, I believe that *A. labellifera* can be reduced to synonymy under *A. obscurata*.

I have been unable to find the type of *Pseudophyscia hypoleuca* var. *colorata*. In his diagnosis, Zahlbruckner states "Thallus ut in var. *sorediifera* (Müll. Arg.) Hue, sed subtus ochraceous vel ochraceo-luteus et KOH violascens." On the basis of these characters, I believe it is the same as *A. obscurata*.

Anaptychia obscurata is similar to *A. casarettiana* Mass. and seems to be confused with it in the literature. In general, the undersurface of *A. obscurata* is woolly and entirely deep or brownish yellow, with an undetermined K⁺ purple pigment. The undersurface of *A. casarettiana*, on the

other hand, is usually roughened and caesious in the central part, but white and often tinged with yellow near the tips of the laciniae. The pigment is K^+ yellow or sordid yellow. Neither norstictic or salazinic acid has yet been demonstrated in *A. obscurata*. Furthermore the upper cortex of *A. obscurata* is very irregularly thickened and projects downward deeply into the medulla as in the case of *A. hypoleuca* and the gonidial layer is often interrupted. The cortex of *A. casarettiana* is uniformly thickened and the gonidial layer is continuous.

A. obscurata has been reported from Japan and Formosa (Sato, 1936) and eastern North America (Hale, 1956) as *A. heterochroa*. Vainio identified the species as *A. hypoleuca* from his Brazilian collections. Under the name *A. soreidiifera*, Lyngé included specimens of *A. casarettiana*, *A. obscurata*, and even *A. pseudospeciosa*. There are no reliable literature records from Europe, but it seems to occur in southern Europe and as far north as southern Great Britain. Thus it appears to be widely distributed in tropical and temperate zones around the world.

Representative specimens examined: **Asia.** Japan. Honsyu. Prov. Hitati, Dainaka, Satomi-mura, Kuzi-gun, Togashi (As). Prov. Musasi. Mt. Buko, Asahina 163 (As). Prov. Izu. Suisyoti. Mt. Amagi, Asahina (As, Krk). Prov. Kii. Mt. Koya, 800 m., Numaziri (As, TNS). Prov. Harima. Taisanzi, Tarumiku, Kobe City, H. Muroi, Lich. Jap. Exs. 153 (As, US). Sikoku. Prov. Tosa. Yasukura, F. Fujikawa (As). Kyusyu. Prov. Hizen. Yamanotera, Hukae-mura, Minami-Takaki-gun, Togashi (As). **Corea.** Keiki. Kaizyo, Koda 4 (TI). **Formosa.** Mt. Arisan, Zyuziro, Sato 4, 32 (TI). **Philippines.** Luzon. Prov. Bontoc. Banco, 1300 m., Vanoverberg 61 (TUR. Vain. Herb. 7997). **India.** Almora. On way to Askote, 5500 ft., Awasthi 3981 (Aw). Kangra. By the roadside, Kulu, 4000–45000 ft., Höeg (Aw, as no. 1457). **New Zealand.** No local., Knight (UPS). **Australia.** Toowoomba, Hartmann (G). **Fiji.** Viti Levu. Eastern base of Mt. Evans Range, Mba of Nalotawa, 550–600 m., Smith 4459 (US, BISH). **Hawaii.** Oahu. Kaliuwaa Valley, Rock 85 (FH). Kauai. Between Hanapepe and Wahiawa river, Heller 2577 (US). **North America.** Canada. Ottawa, Macoun Canad. Lich. 54 (Krk). U.S.A. Maryland. 7 mi. W. of Hancock, Washington Co., Hale 14427 (US). Missouri. Near Shortbend, Dent Co., Hale 4199-a (US). **Central America.** Mexico. Between Colipa and Miscentla, Palenque, Liebman 175-a pr. min. p. (UPS). Chihuahua. Mojarachio, Knobloch (US). Chiapas. 50 km. W. of Tuxtla Gutiérrez on highway 190, 1040 m., Hale 19940 (Krk, US). **South America.** Peru. Hacienda Exito, Churubamba, Huanuco, 1165 m., Mexia 8245-a pr. p. (FH). Chile. Puerto Aysén, Terr. Aysén, Santesson 6972 (Krk, S, UPS). Brazil. Minas Gerais. Caldas, on rocks, H. Mosén (UPS). Rio grande, do sul, near Porto Alegre, Malme 535 (S). **Europe.** Great Britain. Ireland. On mossy rocks at Killarney, Mitchell (M). Portugal. Póvoa de Lanhoso S. Gens, Sampaio, Lich. Port. 204 (M). Spain. Halfway between Algeciras and Rarifa, J. Poelt (M); W. of santuario, Covadonja, Prov. Asturias, Santesson 13098-c (UPS). Italy. Liguria, between Genova and Rapallo, T. E. Hasselrot (S); Mold, Varazze, Presino (S). **Africa.** Socotra Island. Over Wadi Keschen, 1000 m., on granite, Schweinfurth (G). Mauritius. Robillard (US, M).

30. *ANAPTYCHIA FLABELLATA* (Fée) Mass.

Mem. Lichenogr. 41. 1853

Parmelia flabellata Fée, Suppl. Essai Crypt. Ecorc. Officin. 122. 1837. Holotype: South America (G).

Anaptychia hypoleuca var. *fulvescens* Vain. Phil. Journ. Sci. 8: 106. 1913.
A. heterochroa var. *fulvescens* (Vain.) Sato, Journ. Jap. Bot. 12: 429. 1936.
A. fulvescens (Vain.) Kurokawa, Journ. Jap. Bot. 35: 93. 1960. Lectotype: Benguet, Luzon, Philippines, 1500 m., May, 1911, E. D. Merrill 7935 (TUR, Vain. Herb. 7961, isotypes in BM, K, US).

30a. var. *FLABELLATA*

(Fig. 34)

Thallus foliose, greyish white but sometimes darkening at the center, forming extensive rosettes up to 15 cm. or more in diameter; laciniae dichotomously or irregularly branched, linear-elongate, minutely notched, 0.7–2.5 mm. broad, plane or somewhat convex, smooth, without soredia, isidia, or pruina, at times rather discrete at the circumference; beneath decorticate, stuppeous and deep or brownish yellow, with marginal rhizines; rhizines jet black, simple or squarrosely branched, 1–2 mm. long. Laciniae 200–300 μ thick; upper cortex of variable thickness in transverse section, with a greyish surface layer about 20 μ thick; gonidial layer often interrupted by the upper cortex, gonidia 7–12 μ in diameter; medulla of loosely interwoven hyphae, more or less densely intertwined near the lower surface, about 100 μ thick.

Apothecia laminal, substipitate, 1–6 mm. in diameter; margin crenate at first, lacinate at maturity; lacinules corticate on the outside; disc blackish brown, sometimes slightly pruinose; hymenium colorless and hyaline, 150–250 μ high, I⁺ blue; cortex of receptacle irregularly thickened, I⁺; asci cylindrical or somewhat clavate, 30–40 \times 120–150 μ ; spores brown, somewhat constricted at the center, 13–18 \times 30–45 μ , very thick walled, locules urceolate or subpyriform, with 2–3 small sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻. PD⁻, or PD⁺ pale yellow; pigmented undersurface K⁺ purple.

Chemical ingredients: Atranorine, zeorine, and an unidentified yellow pigment.

Since 1853, when Massalongo transferred *Parmelia flabellata* to *Anaptychia*, few lichenologists have used the name *Anaptychia flabellata*. Type material preserved at G consists of three specimens. The largest specimen, which is fertile and has an ochreous yellow undersurface, K⁺ purple, is the obvious choice as the lectotype of *Parmelia flabellata*. The smallest specimen is too fragmentary to identify. The third specimen, annotated as *Physcia speciosa* var. *angustiloba* by Müller, can be identified as *A. diademata*.

A. flabellata closely resembles *A. obscurata* in producing the same undetermined yellow pigment, but it differs in lacking soredia. Externally it also resembles *A. hypoleuca*, but the spores are larger, and the undersurface is pigmented. The rhizines are jet black and simple or squarrosely branched, as in *A. obscurata*, whereas in *A. hypoleuca* the rhizines are of the same color as the thallus or darkening at the apices and irregularly branched. Since Vainio's publication on the lichens of Brazil, *A. flabellata* has been reported as *A. hypoleuca* by many authors and recorded from all over the world. As far as we know now, *A. flabellata* is restricted to tropical and subtropical regions and does not extend into temperate areas.

Representative specimens examined: **Asia.** Java. Batavia. Mt. Megamendong, V. Schiffner 3341 (As). India. Almora. Chaubattia, Ranikhet, 6500 ft., Awasthi 3535 (Aw). Madras, Wight 83 (FH). Ceylon. No precise local., Thwaites (UPS). Fiji. Viti Levu, Smith 5233, 5454 (US, BISH). New Caledonia. No precise local., Vieillard in 1873 (BM). **Central America.** Mexico Totula, Liebmann 185-b pr. p. (UPS). Chiapas. El Sumidero Canyon, 1220 m., Hale 20047 (US). Costa Rica. Hacienda Santamari, Dodge and Thomas 6790 (US). **West Indies.** Cuba. Wright, Lich. Cub. Ser. II. 8-a (FH, UPS, US). **South America.** Colombia. La Cabrera, Paudi, E. Perez (US). Venezuela. Way to waterfall, Canaima, Caroni, Mägdefrau 535 (M). Brazil. Minas Gerais. Vain. Lich. Bras. Exs. 540 pr. p., 749, 791, 1141 (TUR, Vain. Herb. 7966 pr. p., 7967, 7999, 7964 respectively). St. Catarina. Pabet (FH). **Africa.** French Guinea. Fouta-Djalou, at Dalabe, des Abbayes (REN). Ivory Coast. Mt. Tonkoui, 1100 m., Santesson 10645-c (Krk, UPS).

30b. var. *ROTTBOLLII* (Vain.) Kurokawa, comb. nov.

Anaptychia hypoleuca var. *rottbollii* Vain. Phil. Journ. Sci. 8: 106. 1913. *A. fulvescens* var. *rottbollii* (Vain.) Kurokawa, Journ. Jap. Bot. 35: 94. 1960. Holotype: Mt. Tonglon, Benguet, Luzon, Philippines, E. D. Merrill 7984 (TUR, Vain. Herb. 7960, isotypes in FH, K).

Anaptychia dendritica var. *colorata* f. *hypoflavescens* Kurokawa, Journ. Jap. Bot. 30: 255. 1955. Holotype: Mingetsu, Mt. Arisan, Formosa, Sato 6 pr. maj. p. (TI).

This variety is distinguished from var. *flabellata* by the color of the undersurface. In the typical plant it is entirely yellow or ochraceous, but in this variety it is white or caesious, and the yellow pigment is deposited only in the apical part of the lobes. It resembles *A. hypoleuca* closely but differs in having larger spores and in producing the yellow pigment.

Representative specimens examined: **Asia.** China. Yunnan. Eastern slopes of Likian Snow Range, Likiang, Rock 11746 (US). Phillipines. Luzon. Mt. Tonglon, M. Ramos 5480 (TUR, Vain. Herb. 7983). Java. No precise local., Flascher 25 (FH). Malay. Salang Island, Goebel (M). **South America.** Brazil. Minas Gerais. Sao Joao d'el Ray, Malme 307 (S). Rio Grande do Sul, Vain. Lich. Bras. Exs. 855 (TUR, Vain. Herb. 7969). Argentina. Lorentz and Hieronymus (UPS).

30c. var. *CORCOVADOENSIS* Kurokawa, var. nov.

Statura thalli ut in var. *flabellata*, sed differt ab ea acidum norsticticum et acidum salazinicum continente. Ceterum ut in var. *flabellata*.

Holotype: Corcovado, Rio de Janeiro, Brazil, South America, Aug. 14, 1892, G. A. Malme 60 (S).

Morphologically this new variety is similar to var. *flabellata* but it produces norstictic and salazinic acids, as well as atranorine and zeorine. The laciniae are entirely yellow below.

31. *ANAPTYCHIA DENDRITICA* (Pers.) Vain.

Acta Soc. Faun. Fl. Fenn. 7: 134. 1890

Borrera dendritica Pers. in Gaud. Voy. Uran. Bot. 207. 1826. Holotype: Mariannes, Gaudichaud 90 (PC, isotypes in G and H).

Anaptychia dendritica var. *colorata* f. *esorediosa* Kurokawa, Journ. Jap. Bot. 30: 256. 1955. Holotype: Formosa, M. Ogata (As).

Anaptychia subheterochroa Kurokawa, Journ. Jap. Bot. 35: 240. 1960. Holotype: Suisyoti, Amagi Pass, Prov. Izu, Japan, Aug. 9, 1955, M. Togashi (Krk, sotypes in As, TNS, US).

31a. var. *DENDRITICA*

(Fig. 35)

Thallus foliose, greyish or greenish white, sometimes blackened at the center, forming extensive colonies up to 15 cm. or more in diameter; laciniae dichotomously or subdigitately branched, 0.7–2 mm. wide, plane, smooth, often lightly pruinose near the apices, sublinear-elongate, minutely notched; beneath decorticate, arachnoid, purple-black in the center but white and often yellow or ochereous towards the apices, with marginal rhizines; rhizines jet black, more or less shiny, simple or squarrosely branched, 1–3 mm. long. Laciniae 150–230 μ thick; upper cortex uniformly thickened, 30–80 μ thick, with a greyish surface layer 15–25 μ thick; gonidial layer continuous, gonidia 6–11 μ in diameter; medulla 100–130 μ thick.

Apothecia rather rare, laminal, substipitate, 1–4 mm. in diameter, lacinulate along the margins; lacinules decorticate and partly yellow on the underside; disc blackish brown, slightly pruinose; hymenium colorless and hyaline, 180–200 μ high, I⁺ blue; cortex of the receptacle uniformly thickened, I⁻; asci cylindrical or somewhat clavate, 29–33 \times 150–180 μ ; spores brown, somewhat constricted at the center, 16–20 \times 35–46 μ , very thick walled, locules urceolate or subpyriform, with 2–3 spore-blastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning reddish yellow C⁻, KC⁻, PD⁺ yellow; pigment on undersurface K⁺ purple.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids and an undetermined yellow substance.

The yellow pigment is not visible in the type of *Borrera dendritica* but norstictic and salazinic acids were proved. *A. dendritica* var. *dendritica* is similar to *A. flabellata* var. *rottbollii* and is distinguished from it by producing the two K⁺ acids. The apical parts of the laciniae are often faintly pruinose and yellow below, containing the same pigment found in *A. flabellata* and *A. obscurata*, which is K⁺ purple.

Representative specimens examined: **Asia.** Japan. Honsyu. Prov. Izu. Amagi Pass, Kurokawa 58609, 58610 (Krk). Sikoku. Prov. Tosa. Gozaisyonomori, Hata-gun, Yoshimura 136 (Yosh). Kyusyu. Prov. Tikuzen. Mt. Hikosan, 800 m., Omura 903 (As). Yakusima Island, Kosugidani, 700 m., Omura 690, 691, 695 (As). Formosa. Sinsuiei, T. Masuda (As). Philippines. Luzon. Mt. Data, Lefants, 1000 ft., E. D. Merrill 4996 (FH). Mindanao. Buturn, Weber 1398 (TUR, Vain. Herb. 8008). Thailand. Hase, T. Tuyama (As). India. Darjeeling. Above Kurseong, Awasthi 3915 (Aw, Krk, M) and 3917 (Aw).

31b. var. *PROPAGULIFERA* Vain. Phil. Journ. Sci. 8: 107. 1913
(Fig. 36)

Anaptychia subheterochroa var. *propagulifera* (Vain.) Kurokawa, Journ. Jap. Bot. 35: 241. Holotype: Baguio, Benguet, Luzon, Philippines, 2150 m., May, 1911, C. B. Robinson 14071 (TUR, Vain. Herb. 8003, isotypes in BM, FH).

The laciniae of this variety are arachnoid below, and the K⁺ purple pigment is deposited in the apical part of the lobes as in var. *dendritica*. It differs, however, in having soralia at the tips of short lateral branchlets. Closely related *A. obscurata* differs in not producing norstictic and salazinic acids. The presently known range of var. *propagulifera* is the tropical and subtropical regions around the world.

Representative specimens examined: **Asia.** Japan. Honsyu. Prov. Rijkutyu. Mt. Sisigahanadake, Izawa, Suzuki 523 (Krk). Prov. Musasi, Mt. Oodake, Kurokawa 59149. (Krk). Prov. Kii. Mt. Koya, 800 m., Kurokawa 56081 (As, Krk, TNS), 56082, 56083, 57288 (Krk). Java. Batavia. Buitenzorg. 260 m., Schiffner 2894 (As). **Hawaii.** W. Maui, Mann and Brigham (FH). Hanaley. Faurie 62a (KYO). **North America.** U.S.A. West Virginia. On aoks, near Judy Gap, Pendleton Co., Hale 10063 (US). **South America.** Venezuela. Federal Dist. Cordillera between Caracas and La Guaira, west of Silla de Caracas, 1700–1900 m., Santesson 6643 (S). **Europe.** France. Finistère, forêt de Cranan, des Abbayes (REN). Canary Islands. Teneriff, Blanco del Rio, 900 m., Pitard 62 (M). **Africa.** French Guinea. Fouta-Djalou, at Dalaba, 1150 m., des Abbayes (REN).

31c. var. *DISSECTA* (Kurokawa) Kurokawa, comb. nov.

Anaptychia subheterochroa var. *dissecta* Kurokawa, Journ. Jap. Bot. 35: 242. 1960. Holotype: Mt. Koya, Prov. Kii, Japan, 800 m., Nov. 7, 1957, Kurokawa 57286 (Krk, isotype in As).

This variety is distinguished from var. *dendritica* in having microphyllous or subsidial branches at the margins of laciniae.

Specimen examined: **Asia.** Japan. Honsyu. Prov. Sagami. Mt. Kamiyama, Hakone, Kurokawa 58052 (Krk).

32. *ANAPTYCHIA CASARETTIANA* Mass.

Mem. Lichenogr. 39. 1853

(Fig. 37)

Heterodermia casarettiana (Mass.) Trev. Atti Soc. Ital. Sci. Nat. Milano 11: 624. 1868. Type: Serra dos Orgaos, Rio de Janeiro, Casaretto (M, UPS, isotypes).

Anaptychia hypoleuca f. *abbreviato-sorediata* C. Sambo. Ann. di Bot. 22: 38. 1940. Holotype: Rio de Janeiro, Brazil. Casaretto 2434 bis (RO).

Thallus foliose, greyish or greenish white, forming extensive colonies 15 cm. or more across; laciniae dichotomously or subdigitately branched, 0.5–3 mm. broad, almost plane, smooth and rather shiny, rarely faintly pruinose near the apices, sublinear-elongate, minutely notched, contiguous or somewhat discrete at the circumference; beneath decorticate, purple black in the center, white to pale or lemon-yellow towards the apices, smooth to somewhat roughened but not arachnoid; rhizines marginal, black, 1–3 mm. long, simple or squarrosely branched. Laciniae 200–300 μ thick; upper cortex uniformly thickened, 35–95 μ thick, with a greyish surface layer about 15 μ thick; gonidial layer continuous, gonidia 6–10 μ in diameter; medulla about 100 μ thick.

Apothecia laminal, substipitate, 1–7 mm. in diameter, margins lacinate, lacinules becoming sorediate; disc brown, sometimes lightly pruinose; hymenium colorless and hyaline, 150–200 μ high, I+ blue; cortex of the receptacle more or less uniformly thickened, I-; asci somewhat clavate or cylindrical, 30–33 \times 150–180 μ ; spores brown, more or less constricted at the center, 16–20 \times 33–47 μ , very thick walled, locules urceolate or subpyriform, with 2–3 small sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning reddish yellow, C⁻, KC⁻, PD⁺ yellow; pigment on undersurface K⁺ yellow or brownish yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids and an undetermined yellow substance.

Anaptychia casarettiana, long overlooked, was first described by Massalongo in 1853. As far as I could determine, the holotype is not preserved in NAP, PAV, FER, or VER. There are, however, at least two specimens collected by Casaretto in Brazil and labeled "Hagenia casarettiana DNot." One of them, preserved at M, probably represents an isotype

and agrees with the original description. The other specimen at UPS and determined by Lynge as *A. sorediifera* is also an isotype.

A. casarettiana seems to be closely related to *A. dendritica* var. *propagulifera* since it has capitate soralia and black rhizines and produces norstictic and salazinic acids. *A. dendritica* var. *propagulifera*, however, is clearly differentiated from *A. casarettiana* by the woolly or arachnoid undersurface and a K⁺ purple pigment. The pigment in *A. casarettiana* is K⁺ brownish yellow and is apparently a pulvic acid derivative and not an anthraquinone.

This species is very common in the West Indies, Central and South America, less common in southeastern United States. It is not yet known from Africa or Asia.

Representative specimens examined: **North America.** U.S.A. Virginia. Base of white oak, 8 mi. NE. of Charlottesville, Albemarle Co., Hale 18602 (G, US). North Carolina. Cleveland, Rowan Co., Culbertson 6369 (US). Kentucky. 3 mi. E. Cumberland Falls, Whiteley Co., Hale 13490 (US). Florida. 5 mi. S. Silver Glenn, Marion Co., Hale 17559 (US); Mississippi. Morton, Scott Co., Hale 7906 (US). **Central America.** Mexico. Veracruz. Teocelco Canyon, 1240 m., Hale 21147 (US), 21221 (Krk, US). Michoacán. Jesus del Monte, Morelia, Arsène 4452 (US). Tabasco. Between Colipa and Miscentla, Palenque, Liebmann 175a pr. p. (UPS). Chiapas. El Suspiro, 10 km. N. of Berriozábal, Hale 20228A (US). Costa Rica. San José. Cerro de Piedra Blanca, above Escasú, Standley 32493 (FH, US). Panama. East side of volcano, Chiriqui, Scholander (US). **West Indies.** Cuba. Wright Lich. Cub. 80 pr. p. (UPS), 80, 81 pr. p. (FH). Jamaica. St. Helens, St. Andrews, 1475 m., Maxon and Killip 617 (FH, US). Haiti. Furcy, Leonhard 4063 (FH, US). **South America.** Colombia. Venecia, Paudi, Perez 638 (US). Venezuela. Caracas. Guayabitos, 1350 m., Mägdefrau 511 (M). Peru. San Martin. Tingo Maria, 625–1100 m., Allard 22254, 22582b (US), 22572, 22578 (US, Krk). Brazil. Minas Gerais. Sitio, Vain. Lich. Bras. Exs. 723 (M, TUR, Vain. Herb. 8001), 1037 (TUR, Vain. Herb. 7765). Bolivia. Vic. Mapiri, Bang 1757 (UPS, US). Paraguay. Colonia Risso near Rio Apa, Malme 1862Ca (S).

33. *ANAPTYCHIA HYPOCAESIA*

Yasuda in Räs. Journ. Jap. Bot. 16: 139. 1940

Holotype: Hakone, Prov. Sagami, Japan, Oct. 15, 1922, Y. Asahina (as Yasuda 674) (H, isotypes in As, TI).

Thallus foliose, greyish to greenish white, forming extensive colonies up to 7 cm. or more in diameter; laciniae dichotomously or subdigitately branched, sublinear-elongate, minutely notched, 0.7–3 mm. wide, plane or somewhat concave, slightly pruinose towards the apices, sorediate at the tips of short lateral branches; beneath decorticate, arachnoid, purple black in the center but white and often yellow or ocherous towards the apices; rhizines marginal, jet black, more or less shiny, simple or squarrosely branched, 1–3 mm. long. Laciniae about 200 μ

thick; upper cortex uniformly thickened, 30–80 μ thick, with a greyish surface layer about 15 μ thick; gonidial layer continuous, gonidia 6–9 μ in diameter; medulla 100–130 μ thick.

Apothecia rare, superficial, substipitate, 1–4 mm. in diameter, marginally lacinulate, lacinules decorticate and often partly yellow on the innerside and becoming apically soresiate; disc blackish brown, lightly pruinose; hymenium colorless, about 150 μ high, I+ blue; asci cylindrical or somewhat clavate, 29–33 \times 120–150 μ ; spores brown, somewhat constricted at the center, 16–18 \times 35–46 μ , very thick walled, locules urceolate or subpyriform, with 2–3 small sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and salazinic acid.

As the present author has pointed out (1960a), this species is characterized by producing salazinic acid. It ranges from northern India and Japan into the Pacific as far east as Hawaii.

Representative specimens examined: **Asia.** Japan. Honsyu. Prov. Izu. Yugasima, Asahina (As). Prov. Mikawa. Mt. Horaiji. Kurokawa 56011, 56015b (Krk). Kyusyu. Prov. Higo, Danto, F. Fujikawa (As). Philippines. Luzon. Mt. Pulog, Benguet, Merrill 6430 (TUR, Vain. Herb. 7984). Java. Preanger. Mt. Pangerango, near Tjibodas, 1420 m., Schiffner 3270 (As). Batavia. Botanical Gard., Buitenzorg, 260 m., Schiffner 3146 (As). Sikkim. Gangtok, 6000 ft., Awasthi 138 (Aw). India. Darjeeling. Above Kurseong, 5500 ft. Awasthi 3905 (Aw). Almora. Dharamghar near school. Askote, 5500 ft., Awasthi 2661 (Aw, Krk). Madura. Palni Hills, Kodaikanal, Leigh (Aw, as no. 3615). Imphal. Manipur, J. Watt (K). **Hawaii.** Maui, Faurie 573 (KYO).

34. *ANAPTYCHIA JAPONICA* (Sato) Kurokawa,
Journ. Jap. Bot. 35: 353. 1960

Anaptychia dendritica var. *japonica* Sato, Journ. Jap. Bot. 12: 427. 1936. Holotype: Mingetsu, Mt. Arisan, Formosa, Jan. 24, 1936, M. Sato (Taiwan 10) (TI).

34a. var. *JAPONICA*

Thallus foliose, greyish or greenish white but often darkening in the center, forming extensive colonies 15 cm. or more across; laciniae dichotomously or sometimes subdigitately branched, sublinear-elongate, minutely notched, 0.7–2 mm. wide, plane or somewhat convex, often slightly pruinose towards the apices, contiguous or imbricate, forming capitate soralia at the tips of short lateral branches; beneath decorticate, arachnoid, white but often turning purple black in the center; rhizines marginal, jet black, simple or becoming squarrosely branched, 1–3 mm. long. Laciniae 150–250 μ thick; upper cortex uniformly thickened 30–

90 μ thick, with a greyish surface layer about 20 μ thick; gonidial layer continuous, 20–40 μ thick, gonidia 6–10 μ in diameter; medulla 70–110 μ thick.

Apothecia rather rare, laminal, substipitate, 1–8 mm. in diameter, margins lacinulate, lacinules corticate only on the outside; disc concave, dark brown or blackish brown, lightly pruinose; hymenium colorless, about 150 μ high, I⁺ blue; asci cylindrical or subclavate, 29–33 \times 120–150 μ ; spores brown, somewhat constricted at the center, 15–20 \times 30–46 μ , very thick walled, locules urceolate or subpyriform, with 2–3 small sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁺ pale yellow or PD⁻.

Chemical ingredients: Atranorine and zeorine.

Externally this species resembles *A. obscurata* (Nyl.) Vain. in having similar laciniae and soralia. However, the apothecia of *A. japonica* are marginally lacinulate, as mentioned by Sato in his original description, while those of *A. obscurata* are sorediate. In addition, the undersurface of *A. japonica* is white, at least apically, and no pigment is deposited. Although at first considered to be endemic to eastern Asia, a specimen from Uganda extends the range to Africa.

Representative specimens examined: **Asia.** Japan. Honsyu. Prov. Musasi. Hikawa, M. Sato (TI). Prov. Sinano. Mt. Mikuni, Minami-Saku-gun, Kurokawa 58560 (Krk). Prov. Suruga. Subasiri-guti, Mt. Fuji, Asahina (As). Sikoku. Prov. Tosa. Nokawa, F. Fujikawa (As). Kyusyu. Prov. Higo. Mt. Itibusu. F. Fujikawa (As). Yakusima Island. Kosugi-dani, R. Furuto (Sato). **Africa.** Uganda. Mt. Muhavura, Kigezi distr., about 3400 m., Hedberg 2097b (Krk, UPS).

34b. var. *REAGENS* Kurokawa, Journ. Jap. Bot. 35: 354. 1960

Holotype: Mt. Kintoki, Hakone, Prov. Sagami, Japan, April 26, 1958, Kurokawa 58064 (Krk, isotypes in As, M, TNS, US).

This variety is morphologically identical with var. *japonica*, but differs in producing salazinic and norstictic acids in addition to atranorine and zeorine. The thallus reacts K⁺ yellow, the medulla K⁺ yellow turning reddish yellow and PD⁺ yellow.

Representative specimens examined: **Asia.** Japan. Honsyu. Prov. Simotuke. Nikko, H. Suzuki (Krk). Prov. Kozuke. Mt. Akagi, Kurokawa 58585 (Krk). Prov. Musasi. Mt. Mitumine, Titibu, Kurokawa 56145 (Krk). Prov. Sinano. Mt. Kokusi, Kurokawa 59211 (Krk). **Africa.** Kenya. Mt. Elgon, 3760 m., Hedberg 960a (Krk, UPS). French Guinea. About 6 km. SE. of Zouépo (Zigueta), Mts. Nimba, 1550 m., Santesson 10593b (Krk, UPS) and 10594f (UPS). Ivory Coast. Mt. Tonkoui, 1100–1200 m., Santesson 10617b, 10618j, 10656a (UPS).

35. *ANAPTYCHIA SQUAMULOSA* Degel.

Ark. Bot. 30A (3): 76. 1941

Holotype: Newfoundland Gap, Great Smoky Mountains, North Carolina, U.S.A., Degelius in 1939 (Degelius Herb., isotypes US).

Thallus foliöse, greyish white to glaucous, 5–12 cm. in diameter, laciniate; laciniae dichotomously or subirregularly branched, sublinear-elongate, 0.2–1.2 mm. wide, with numerous squamules mainly along the margins but also on the uppersurface; beneath decorticate, white but becoming caesious in the central part, with rhizines along the margins, rhizines black, densely squarrosely branched, 1–1.5 mm. long, often very dense and forming a mat under the thallus, young rhizines simple and often of the same color as the thallus. Laciniae 120–170 μ thick; upper cortex uniformly thickened, 25–50 μ thick; gonidial layer continuous, about 25 μ thick, gonidia 6–10 μ in diameter; medulla about 100 μ thick.

Apothecia laminal, sessile, 1–3 mm. in diameter; margins and receptacle densely squamulose; disc dark brown, epruinose; hymenium 130–160 μ high; cortex of the receptacle more or less uniformly thickened, I–; asci 20–23 \times 90–120 μ ; spores dark brown, 11–16 \times 26–37 μ , locules with sporoblastidia at each end at maturita.

Reaction: Thallus K⁺ yellow; medulla K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

This species is clearly distinguished from related ones by having laminal and marginal squamules. Apothecia are very rare in North America, but a few fertile specimens are known from Mexico. In the United States it is almost completely restricted to the dry oak woods of the Blue Ridge Mountains.

Representative specimens examined: **North America.** U.S.A. West Virginia. Eglon, Preston Co., Hale 12387 (US). Virginia. Mile 77, Blue Ridge Parkway, Bedford Co., Hale 17799 (US). **Central America.** Mexico. Veracruz. 36 km. SW. of Orizaba, 2380 m., Hale 19590 (US). Oaxaca. Cerro San Felipe, 2920 m., Hale 20758 (US). Chiapas. 18 km. SE. of San Cristobal, Hale 20279 (US).

36. *ANAPTYCHIA FRAGILISSIMA* Kurokawa, sp. nov.

(Fig. 38)

Anaptichya dendritica var. *japonica* f. *microphyllina* Kurokawa, Journ. Jap. Bot. 30: 255. 1955. Holotype: Mt. Koya, Prov. Kii, Japan, Numaziri 679 (As).

Thallus foliaceus, adhaerens, cinerascens aut glaucescens sed saepe partim obscurascens, 7–15 cm. latus, laciniatus; laciniae saepe dichotome vel irregulariter divisae, lineares elongataeque, raro levissime dilatatae, planae aut leviter concavae, 0.7–2.3 mm. latae, margine squamuloso- aut microphyllino-dissectae, squamulis dorsiventralibus, crenato-incisis, ascendentibus; subtus

decorticatae, albae aut leviter brunnescens sed centrum versus saepe sordide coeruleascens, arachnoideae, rhizinis marginalibus, nigris, nitidis, simplicibus vel squarroso-ramosis, 2–5 mm. longis. Lacinae 100–150 μ crassae; cortex superior aequaliter incrassatus, 25–60 μ crassus, parte exteriori obscure cinerea, ca. 15 μ crassa; stratum gonidiale continuum, 25–40 μ crassum, gonidiis 6–11 μ diametro; stratum medullare 60–90 μ crassum.

Apothecia superficialia, substipitata, 1–4 (raro 6) mm. diametro, marginibus et receptaculis squamulosis, discis fusco-brunnescentibus, saepe pruinosis; hymenium hyalinum, 150–180 μ altum, I⁺ coeruleascens; cortex receptaculi aequaliter incrassatus, I⁻; asci oblongo-clavati, 30–33 \times 140–160 μ ; spores fusco-brunnescentes, ellipsoideae, medio leviter constrictae, 16–20 \times 36–50 μ , 2-loculares, loculis 2–3 sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine, zeorine, and sometime a brownish substance.

Holotype: Mt. Koya, Prov. Kii, Japan, about 800 m., Dec. 17–18, 1960, Kurokawa 60238 (Krk, isotypes in As, TNS, US).

When I published an article (1960b) on some Japanese *Anaptychia*, I identified this species with the North American *A. squamulosa*. However, *A. fragilissima* is clearly distinguished from *A. squamulosa* by long, jet black rhizines, wider and thinner lacinae, and larger spores. In addition, the squamules of *A. fragilissima* are formed only along margins, and the thallus is far more fragile. The rhizines are jet black even in earlier stages of development. Räsänen (1940, p. 140) reported *A. obscurata* var. *serpens* from Japan, based on a Yasuda collection (673); this specimen is identical with *A. fragilissima*. This species seems to be restricted to eastern Asia. The northernmost locality is Mt. Kiyosumi in the Boso Peninsula, Japan.

Representative specimens examined: Asia. Japan. Honsyu. Prov. Awa. Mt. Kiyosumi, Kurokawa 56567 (Krk). Prov. Izu. Amagi Pass, Kurokawa 58611 (Krk). Hachijo Island. H. Kirihara (Sato, as no. 1974). Prov. Ise. Mt. Asama, Yasuda 673 (II). Prov. Kii. Mt. Koya, 800 m., Kurokawa 56086 (Krk, US). Sikoku. Prov. Iyo. Nametoko, Uwazima, 900 m., Nakanishi 2106 (Krk, Nak). Prov. Satuma. Mt. Kaimon, F. Fujikawa (As). Amami Islands. Mt. Amagi, Tokunosima Island, Tagawa and Iwatsuki 2637 (KYO, Krk). China. Kwantung. Mt. Lung T'an, near Iu, Canton Christian Coll. 12581 (US).

37. *ANAPTYCHIA APPENDICULATA* Kurokawa, sp. nov. (Fig. 39)

Thallus foliaceus, albo-cinereascens, coriaceus, 5–12 cm. diametro, laciniatus; lacinae dichotome aut subdigitatim divisae, sublineares elongataeque, 1–2.5 mm. latae, squamulis marginalibus numerosis irregulariter incisae ornatae; subtus albae sed centrum versus plus minusve caesio-fuscae, margine rhizinosae, rhizinis simplicibus thallo concoloribusque, demum mox nigris squarroso-

ramosisque, 2–4 mm. longis. Laciniae 120–150 μ crassae; cortex superior aequaliter incrassatus, 35–50 μ crassus, I⁻, parte exteriori fusco-cinerea, 15–20 μ crassa; stratum gonidiale continuum, ca. 20 μ crassum, gonidiis 6–10 μ diametro; stratum medullare 70–120 μ crassum.

Apothecia superficialia, subsessilia, 1–4 mm. diametro, marginibus receptaculisque squamosis numerosis ornatis, discis albo-pruinosis, brunnescentibus concavisque, demum mox fusco-brunnescentibus planisque; hymenium 120–145 μ altum, I⁺ coeruleus; asci oblongo-clavati, 25–32 \times 130–140 μ ; sporae fuscae, ellipsoideae, medio leviter constrictae, 16–18 \times 37–40 μ , 1-septatae, 2-loculares, loculis cellulis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

Holotype: On *Hymenodictyon floribundum* in the “Rocher aux Sacrifices,” Cercle of Man, Mont Tonkoui, Ivory Coast, Africa, Aug. 14, 1954, Santesson 10645a (UPS, isotype in Krk).

This new species is closely related to both *A. squamulosa* and *A. fragilissima* in having numerous squamules on the laciniae. As in *A. hypoleuca*, the younger rhizines are often of the same color as the thallus, and as in *A. fragilissima*, the squamules are formed only along the margins.

Specimens examined: **Africa.** French Guinea. Cercle of N'Zérékoré. Mts. Nimba, about 6 km. SE. of Zouépa (Zigueta), about 1550 m., Santesson 10594h, 10595b (UPS). Ivory Coast. Cercle of Man. Mont. Tonkoui, near Cinchona Station, 1100–1200 m., Santesson 10618a (Krk, UPS).

38. *ANAPTYCHIA CORALLOPHORA* (Tayl.) Vain.

Acta Soc. Faun. Fl. Fenn. 7: 135. 1890

(Fig. 40)

Parmelia corallophora Tayl. Lond. Journ. Bot. 6: 164. 1847. *Pseudophyscia hypoleuca* var. *corallophora* (Tayl.) Hue, Nouv. Arch. Mus., ser. 4, 1: 110. 1899. Holotype: Casapi, Peru, Mathews (FH-Tayl, isotype in K).

Thallus greyish to greenish white, 10 cm. or more across; laciniae linear-elongate, dichotomously or subdigitately branched, plane or somewhat convex, with numerous cylindrical isidia, contiguous or somewhat discrete at the circumference; beneath decorticate, smooth to more or less roughened, purple black at the center but white or sometimes lemon-yellow near the apices, with marginal rhizines; rhizines black, simple or squarrosely branched, 2–3 mm. long. Laciniae 250–300 μ thick; upper cortex more or less uniformly thickened, 26–70 μ thick, with a greyish surface layer about 15 μ thick; gonidial layer continuous, 15–30 μ thick, gonidia 6–10 μ in diameter; medullary layer thickened, about 200 μ thick, hyphae densely intertwined near the lower surface.

Apothecia laminal, 2–6 mm. in diameter; margins and receptacle isidiate, disc brown to blackish brown, without pruina; hymenium

colorless and hyaline, 200–260 μ high, I⁺ blue; cortex of receptacle more or less irregularly thickened, I⁻; asci cylindrical or subclavate, 30–36 \times 150–180 μ ; spores brown, more or less constricted at the center, 16–20 \times 33–46 μ ; locules urceolate or subpyriform, with 2–3 sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow; yellow part of undersurface K⁺ yellow or sodid yellow.

Chemical ingredients: Atranorine, zeorine, and an undetermined pale yellow substance.

This remarkable lichen is easily distinguished from related species by having numerous isidia. It seems to be restricted to Central and South America and the West Indies.

Representative specimens examined: **Central America.** Mexico. Chiapas. Lagos de Monte Bello, 1220 m., Hale 29390 (US). Costa Rica. San José. Vicinity of Santa Maria de Dota, 1500–1800 m., Standley and Valerio 43151, 43161 (US). **West Indies.** Cuba. Wright, Lich. Cub. 80, 81 pr. p. (FH), 81 (UPS). **South America.** Colombia. Andes, near Bogota, Weir 57 (BM). Peru. Cardill. Ostabhang, Lechler (M). Huanuco. Churubamba, Hacienda Exito, Mexia 8244a (US), 8245 (FH); Ridge east of Tingo Maria, 625–1100 m., Allard 22582a (US, Krk). Brazil. Minas Gerais. Sitio, Vain. Lich. Bras. Exs. 851 (FH, M); Pameira near Barbatona, Warming 207 (M). Paraguay. Guarapi, Balansa 4205 (G).

39. *ANAPTYCHIA LAMELLIGERA* (Tayl.) Kurokawa,
comb. nov.
(Figs. 14, 41)

Parmelia lamelligera Tayl. Lond. Journ. Bot. 6: 169, 1847. *Anaptychia dendritica* var. *lamelligera* (Tayl.) Vain. Phil. Journ. Sci. 8: 107. 1913. Holotype: Casapi, Peru, Mathews (FH-Tayl. isotypes in G, H, K).

Thallus foliose, greyish or greenish white, 10 cm. or more across; laciniae 1–2 mm. wide, linear-elongate, minutely notched, dichotomously or subirregularly branched, plane, with subentire margins, contiguous at the circumference but often imbricate at the center; beneath decorticate, sordid brown or purple black at the center but white or often yellow near the apices, with marginal rhizines; rhizines black, simple or squarrosely branched, 1–2 mm. long. Laciniae 250–300 μ thick; upper cortex more or less uniformly thickened, 40–75 μ thick, with a greyish surface layer about 15 μ thick; gonidial layer continuous, 15–40 μ thick, gonidia 6–10 μ in diameter; medulla thickened, 200–250 μ thick.

Apothecia laminal, substipitate, 1–3 mm. in diameter, with marginal lacinules; lacinules corticate on the inner side, decorticate on the outer (lower) side, 0.3–0.5 mm. broad, 1 mm. or more long; disc dark brown, epruinose; hymenium colorless and hyaline, 160–200 μ high, I⁺ blue;

cortex of receptacle uniformly thickened, I⁻; asci cylindrical or subclavate, 30–35 × 130–180 μ; spores brown, more or less constricted at the center, 16–20 × 35–44 μ, locules urceolate or subpyriform, with 2–3 sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow; yellow part of undersurface K⁺ yellow or sordid yellow.

Chemical ingredients: Atranorine, zeorine, and an undetermined yellow substance.

This species is closely related to *A. corallophora* in structure of the thallus and spores, but is distinguished by the absence of isidia. The medullary layer in both species is quite thick, often 230 μ or more. It is also remarkable that the apothecial lacinules of *A. lamelligera* are corticate on the side facing the disc, whereas in most other lacinulate species of *Anaptychia* the lacinule surface facing the disc is decorticate. This species is also restricted to tropical America.

Specimens examined: **Central America.** Mexico. Michoacán. 65 km. E. of Morelia on highway 190, 2560 m., Hale 21002 (US). Oaxaca. Trail to Cerro San Felipe, 2900 m., Hale 20677, 20767 pr. p. (US). **West Indies.** Jamaica. No precise local., Hart (FH); St. Thomas, Farm Hill, Orcutt 5393b. (US).

40. *ANAPTYCHIA DACTYLIZA* (Nyl.) Zahlbr.
in Skotts. Nat. Hist. Juan Fernan. 2: 404. 1924

Physcia speciosa var. *dactyliza* Nyl. Syn. Lich. 1: 417. 1860. *Pseudophyscia speciosa* var. *dactyliza* (Nyl.) Müll. Arg. Hedw. 34: 28. 1895. Holotype: Organ Mtns., Brazil, Weddell in 1844 (H, Nyl. Herb. 32492, isotype in PC).

Anaptychia speciosa var. *lineariloba* Müll. Arg. Engl. Bot. Jahrb. 15: 508. 1893. *Parmelia speciosa* var. *lineariloba* (Müll. Arb.) Jatta, Nuov. Giorn. Bot. Ital. NS., 9: 471. 1902. Holotype: Kanesse, west Nyasa region, Africa, Stuhlmann (G, isotype in BM).

40a. f. *DACTYLIZA*
(Fig. 42)

Thallus foliose, rather rigid, greyish white to brownish grey; laciniae linear-elongate, dichotomously branched, 0.5–1.3 mm. wide, glabrous, without isidia or soredia, epruinose, discrete at the circumference; beneath decorticate but distinctly corticate at the margins, white to sordid brown at the center; rhizines digitately or fruticosely branched, dark or black but concolorous with the thallus at the base, 1–2 mm. long. Laciniae 300–450 μ thick; upper cortex irregularly thickened, the lower surface flexuose, often penetrating into the medulla, I⁻, with a greyish surface layer 15–23 μ thick; gonidial layer often interrupted by the cortex and discontinuous, gonidia 7–10 μ in diameter; medulla rather thin.

Apothecia laminal, substipitate, 1–4 mm. in diameter, with crenate or lacinulate margins; disc blackish brown, epruinose; hymenium colorless and hyaline, about 130 μ high, I⁺ blue; cortex of receptacle irregularly thickened, I⁺ blue; asci cylindrical or subclavate, 25–28 \times 110–130 μ ; spores brown, ellipsoid, sometimes slightly constricted at the center, 13–17 \times 30–35 μ , thick walled, locules subglobose, with several sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; medulla K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine and zeorine.

The holotype of *Physcia speciosa* var. *dactyliza* is a rather fragmentary specimen, as already pointed out by Santesson (1944). Although Santesson felt that it seems to be only form or variety of *A. hypoleuca*, it is obviously different because of the spore structure (*A. hypoleuca* lacks sporoblastidia) and the more delicate, convex, and linear laciniae. Müller's type of *A. speciosa* var. *lineariloba* is identical with *A. dactyliza*.

Representative specimens examined: **South America.** Brazil. Minas Gerais. Serra Caraca, Ule 295 (G). Ecuador. Prov. Chimborazo, E. Asplund (S). **Africa.** Tanganyika. On rocks in Brachystegia woodland, Nchisi Mt., 1400 m., Brass 16921 (K, US).

40b. f. *SERPENS* (Vain.) Kurokawa, comb. nov.

(Fig. 15)

Anaptychia obscurata var. *serpens* Vain. Acta Soc. Faun. Fl. Fenn. 7: 137. 1890. Holotype: Carassa, Minas Gerais, Brazil, Vain. Lich. Bras. Exs. 1242 (TUR, Vain. Herb. 7825, isotypes in BM, FH, K, M).

Except for the almost entirely blackened thallus, the type of *A. obscurata* var. *serpens* is identical with *A. dactyliza* f. *dactyliza* in structure of laciniae and I reaction in the cortex of the apothecia. Vainio recognized it as a variety of *A. obscurata* because of the color.

41. *ANAPTYCHIA CHILENSIS* Kurokawa, sp. nov.

Thallus foliaceus, adnatus, albo-cinereus sed saepe fusco-brunnescens, 2–5 cm. diametro, laciniatus; laciniae lineares elongataeque, dichotome aut subdigitatim divisae, leviter convexae, 0.7–1.5 mm. latae, margine integrae, ad apicem saepe leviter pruinosae, in apicibus crispatae sorediosaeque, subtus albae, canaliculatae, arachnoideae, margine distincte corticatae et rhizinosae, rhizinis thallo concoloribus aut fusco-nigris, dactylino-divisis, 0.7–2 mm. longis. Laciniae 200–300 μ crassae; cortex superior irregulariter incrassatus, 50–220 μ crassus, parte exteriori obscure cinerea, ca. 30 μ crassae; stratum gonidiale discontinuum, gonidiis 8–14 μ diametro; stratum medullare 50–75 μ crassum.

Apothecia sessilia aut substipitata, superficialia, 1–1.5 mm. diametro, margine subintegra, receptaculis pruinosis, discis fusco-nigrescentibus; hymenium 140–160 μ altum, I⁺ coeruleus; asci oblongo-clavati, 30–35 \times 120–150 μ ; sporae fusco-brunnescens, ellipsoideae, 11–15 \times 22–30 μ .

Reaction: Thallus K⁺ yellow; medulla K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ yellowish.

Chemical ingredients: Atranorine and zeorine.

Holotype: On naked earth at a rivulet in a creek, Alto del Puerto, Valparaiso, Prov. Valparaiso, Chile, Aug. 14, 1940, R. Santesson 2919 (S, isotypes in Krk and UPS).

Anaptychia chilensis is very similar to *A. dactyliza*, from which it differs in having terminal soralia and in producing smaller spores. It is known so far only from Chile.

Specimens examined: **South America**, Chile. Prov. Valparaiso. Alto del Puerto, Valparaiso, Santesson 3015 (Krk, S, UPS); Vina del Mar, Valparaiso, Dusén 63 (S).

42. *ANAPTYCHIA SPINIGERA* Kurokawa, sp. nov.

Thallus foliaceus, adhaerens ad saxa, stramineo-albus, fere opacus, ca. 6 cm. diametro, laciniatus; laciniae lineares elongataeque, dichotome divisae, superne convexae, spinulis brevibus thallo concoloribus ornatae, 0.7–1.2 mm. latae; laciniae subtus decorticatae, albae, leviter canaliculatae, arachnoideae, margine distincte corticatae, rhizinis marginalibus, thallo concoloribus aut apices versus fuscis sed haud nigris praeditae. Laciniae 260–350 μ crassae; cortex superior irregulariter incrassatus, 75–210 μ crassus; stratum gonidiale discontinuum, gonidiis 10–15 μ diametro; medulla ca. 100 μ crassa.

Apothecia superficialia, subsessilia, 1–3 mm. diametro, marginibus et receptaculis spinulosis, discis nigro-fuscis, leviter albo-pruinosis, concavis; cortex receptaculi I⁻; hymenium 135–155 μ altum; asci oblongo-clavati, 30–36 \times 110–125 μ ; spores brunneo-fuscae, medio constrictae, 1-septatae, 2-loculares, 16–19 \times 33–39 μ .

Reaction: Thallus K⁺ yellow; medulla K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine and zeorine.

Holotype: On rocks, no precise local., Peru, W. Lobb (BM, isotype in Krk).

While this new species is closely related to *A. dactyliza*, it is very peculiar in having spinules on the upper surface of the thallus and on the receptacle of the apothecia.

43. *ANAPTYCHIA MAGELLANICA* Zahlbr.

Kgl. Sv. Vet.-Akad. Handl. 57 (6): 54. 1917

Holotype: Felix Islands, Straits of Magellan, South America, May 14, 1908, Skottsberg (UPS, isotypes in S, W).

43a. var. *MAGELLANICA*

(Fig. 16)

Thallus foliose, greyish white; laciniae very short, visible only at the circumference, 0.3–1 mm broad, faintly pruinose at the tips, almost

entirely covered with subsascending lacinules, without soredia or isidia; beneath decorticate, white, with marginal rhizines; rhizines short, darkening or black but concolorous with the thallus at the base, digitately or fruticoseously branched. Laciniae 230–270 μ thick; upper cortex more or less irregularly thickened, 50–130 μ thick, with a greyish surface layer 20–25 μ thick; gonidial layer subcontinuous, sometimes interrupted by the cortex, gonidia 6–12 μ in diameter; medulla 100–130 μ thick.

Apothecia laminal, substipitate, with crenate or lacinulate margins, 0.3–5 mm., in diameter; margins pruinose; disc blackish brown, lightly pruinose; hymenium hyaline, about 200 μ high, I⁺ blue; cortex of receptacle irregularly thickened, I⁻; asci cylindrical or subclavate, about 40×150 μ ; spores brown, 17–21×28–36 μ , more or less constricted at the center, locules subglobose or urceolate, with several sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine and zeorine.

The holotype consists of several fragments which are composed chiefly of subsascending secondary lacinules. Santesson (1944) found rather small spores (14–18×28–30 μ).

43b. var. *PECTINATA* (Zahlbr.) Kurokawa, comb. nov.

Anaptychia dactyliza f. *pectinata* Zahlbr. in Skottsberg. Nat. Hist. Juan Fernandez: 2: 403. 1924. *A. pectinata* (Zahlbr.) Sant. Ark. Bot. 31 A (7): 14. 1944. Holotype: Massatierra, Cerro de la Damajuana, Juan Fernandez, Jan. 29, 1917, C. and I. Skottsberg 138 (UPS, isotypes in S, W).

f. *PECTINATA*

(Fig. 43)

Thallus foliose, greyish white, 5–10 cm. across; laciniae linear-elongate, di- or trichotomously branched, 0.7–1.5 mm. wide, sparsely pruinose at the apices. Otherwise as in *A. magellanica* var. *magellanica*.

At first glance, var. *pectinata* seems to be amply distinct from var. *magellanica*. Indeed, Santesson, who recognized it as a proper species, concluded that “*A. magellanica* is a species nearly related to *A. pectinata*.” The laciniae of var. *pectinata* are linear-elongate and lack secondary lacinules, whereas the thallus of var. *magellanica* is almost entirely covered with secondary lacinules. The same type of variation is known for *A. diademata* f. *diademata* and *A. diademata* f. *brachyloba*.

Representative specimens examined: **Central America**, Mexico. Veracruz. 33 km. NW. of Perote on highway 140, 2320 m., Hale 20875 (US). Mexico. Just W. of Rio Frio, 3100 m., Hale 19282, 19287 (US) and 19298 (Krk, US). Chiapas. 18 km. SE. of San Cristobal on highway 190, 2340 m., Hale 20257,

20533 (US). **South America**, Chile. Valdivia. Lago Rinihue, Santesson 3727 (UPS). Canal Whiteside, Tierra del Fuego, Santesson 6009, 6038 (UPS). Uruguay. Minas-Cerro Arequita, Osorio 3116 (MVM).

f. *SUBSIDIOSA* Kurokawa, f. nov.

Thallus laciniis in marginibus subsidioideo-dissectis. Ceterum ut in f. *pectinata*.

Holotype: 8 km. E. of Teopisca, Chiapas, Mexico, on deciduous tree, 2020 m., March 24, 1960, Hale 20354 (Krk, isotype in US).

44. *ANAPTYCHIA TOGASHII* Kurokawa, sp. nov.

Thallus adnatus, plagas 6–10 cm. latas formans, glaucescens aut fusco-glaucescens; laciniae subirregulariter divisae, lineares elongataeque, 0.5–2 mm. latae, interdum imbricatae, isidiis sorediisque destitutae, subtus decorticatae, albae, margine dense rhizinosae, rhizinis dense ramosis, thallo concoloribus, apices versus brunneo-fuscis aut nigris, 1–2 mm. longis. Laciniae 280–320 μ crassae; cortex superior subirregulariter incrassatus, 70–140 μ crassus, parte exteriore obscure cinerea, 15–20 μ crassa; stratum gonidiale subcontinuum, gonidiis 9–18 μ diametro; stratum medullare 110–190 μ crassum.

Apothecia sessilia, 2–8 mm. diametro, margine lacinulata, lacinulis inferne decorticatis, 1–3 mm. longis, saepe divisis, interdum ciliatis, discis brunneo-fuscis; cortex receptaculi subaequaliter incrassatus, I⁺ violascens; hymenium 130–160 μ altum; asci oblongo-clavati; spores ellipsoideae, medio leviter constrictae, brunneo-fuscae, 16–20 \times 33–43 μ , 1-septatae, 2-loculares, loculis sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ faint yellow.

Chemical ingredients: Atranorine and zeorine.

Holotype: Jongri, Sikkim, 4000 m., May 21, 1960, M. Togashi (TI, isotypes in Krk and US).

This new species resembles *A. hypoleuca* in external appearance, but it belongs to a different section of the genus because of the spore structure. It is also very close to *A. magellanica* var. *pectinata*, from which it is distinguished by dense, richly branched rhizines and by the I⁺ reaction in the cortex of apothecia. It seems to be restricted to high elevations (3000–4000 m.) in the Himalayas.

Specimens examined: **Asia**, Sikkim. Orotang-Jongri, Togashi (TI); Jongri-Gamotang, Togashi (TI); Gamotang, Togashi (TI); Migotang, Togashi (TI).

45. *ANAPTYCHIA CORONATA* Kurokawa, sp. nov.

Thallus foliaceus, cinereo-glaucescens, usque ad 5–10 cm. latus; laciniae crebre dichotome divisae, 0.7–2 mm. latae, sublineares elongataeque, margine integrae, superne planae laevigataeque, prope apices saepe leviter pruinosae, sorediis isidiisque destitutae, contiguae aut discretae, subtus decorticatae, albae, in marginibus rhizinis thallo concoloribus vel apices versus obfuscatis,

irregulariter ramosis, 1–2 mm. longis praeditae. Laciniae 150–200 μ crassae; cortex superior aequaliter incrassatus, 35–70 μ crassus, I⁺ levissime violascens; stratum gonidiale continuum, ca. 30 μ crassum, gonidiis 7–12 μ diametro; stratum medullare 60–80 μ crassum.

Apothecia superficialia, subsessilia, 0.5–3 mm. diametro, margine lacinulata, lacinulis intus (superne) corticatis thallo concoloribusque, extus (inferne) decorticatis albidisque, 0.2–0.5 \times 1–1.5 mm., discis fusco-brunnescentibus; epruinosis; hymenium decolare et hyalinum, ca. 200 μ altum, I⁺ coeruleascens; cortex receptaculi aequaliter incrassatus, I⁺ leviter violascens; asci subclavati, ca. 30 \times 150 μ ; spores fuscae, medio non aut levissime constrictae, 17–18 \times 33–40 μ , 1-septatae, 2-loculares, loculis demum sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and salazinic acid.

Holotype: On tree trunk with mosses, above Kurseong, Darjeeling, India, 5500–6000 ft., Oct. 8, 1957, Awasthi 3916 (Aw, isotype in Krk).

This remarkable lichen is clearly differentiated from related species by the chemical components and by the external appearance of the apothecia. The lacinules are corticate on the side facing the disc, as in *A. lamelligera*.

Specimens examined: Asia, India. Darjeeling. Above Kurseong, 6000 ft., Awasthi 3908 (Aw). Almora. Digtarh to Askote, 5500 ft., Awasthi 3982 (Aw).

46. *ANAPTYCHIA OBESA* (Pers.) Zahlbr.

Cat. Lich. Univ. 7: 734. 1931

(Figs. 17, 44)

Parmelia obesa Pers. in Gaudich. Voy. Uran. Bot. 207. 1826. *Physcia obesa* (Pers.) Nyl. Syn. Lich. 1: 418. 1860. *Physcia speciosa* var. *obesa* (Pers.) Tuck. Proc. Amer. Acad. Arts Sci. 7: 224. 1866. Holotype: Hawaiian Islands, Gaudichaud 74 (PC, isotype in H).

Parmelia papulosa Mont. Ann. Sci. Nat. Bot., ser. 2, 18: 137. 1843. *Physcia papulosa* (Mont.) Nyl. Mem. Soc. Imp. Sci. Nat. Cherbourg 5: 107. 1857. Holotype: Hawaiian Islands, Gaudichaud (PC, isotype in H).

Physcia obesa f. *caesiocrocata* Nyl. Syn. Lich. 1: 418. 1860. *Anaptychia obesa* f. *caesiocrocata* (Nyl.) Zahlbr. Cat. Lich. Univ. 7: 734. 1931. Holotype: Hawaiian Islands, Menzies 316 (H, Nyl. Herb. 32575).

Anaptychia spectabilis Zahlbr. Ann. Mycol. 10:383. 1912. Holotype: Haleakala, Maui, Hawaiian Islands, Rock 155 (W, isotype in FH).

Thallus foliose, greyish white, 3–7 cm. across; laciniae irregularly branched, 2–5 mm. wide, convex and somewhat obese, with rounded apices, pruinose at the tips, without soredia or isidia; beneath decorticate, subcanaliculate, yellowish to reddish orange; rhizines simple or irregularly branched, darkened but concolorous with the thallus at the base, 0.7–2 mm. long. Laciniae 160–250 μ thick; upper cortex irregularly thickened and sometimes projecting downward into the medulla to the

lower surface, I⁻, with a greyish surface layer about 30 μ thick; gonidial layer discontinuous, gonidia 6–12 μ in diameter; medulla 30–50 μ thick, sometimes interrupted by the upper cortex and deficient, with an ochraceous outermost layer.

Apothecia laminal, sessile, 1–5 mm. in diameter, with sinuate margins; disc blackish brown, concave or plane, without pruina; hymenium colorless and hyaline, about 200 μ high, I⁺ blue; cortex of the receptacle more or less irregularly thickened; asci cylindrical or somewhat clavate, 33–36 \times 140–170 μ ; spores brown, unstricted or slightly constricted at the center, very thick walled, locules pyriform or urceolate, with 2–3 sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻; under-surface K⁺ violet.

Chemical ingredients: Atranorine, zeorine, and an undetermined orange substance.

This species is immediately distinguished from other species of *Anaptychia* by the conspicuous orange pigment on the undersurface of the thallus. Zahlbruckner misinterpreted this species, for in 1912 he described *A. spectabilis* and at the same time identified as specimen of *Physcia albicans* as *A. obesa* (cf. Faurie 521 in KYO). This species is endemic to Hawaii.

Specimens examined: **Hawaii**, Oahu. Palehua, Waianae Mts., 650 m., Skottsberg 1220 (BISH). Maui. Haleakala, 1000 m., Faurie 567 (KYO). W. Maui. Puu Kukui Trail, Honokawai, N. side, 3000–5788 ft., Lambertson 1518, 1659, 1666 (BISH). Molokai. Kawela, below Puu Kolekole, 3500 ft., Lambertson 1291 (BISH). Lanai. On west part of marine ridge, Fagerline and Skottsberg 7031 (S).

Series 2. *Palpebratae* Kurokawa, ser. nov.

Thallus foliaceus; laciniae substrato laxae affixae sed apices versus ascendentes.

Apothecia superficialia; sporae fuscae, 1-septatae, 2-loculares, loculis demum sporoblastidiis parvis praeditis.

Type species: *Anaptychia palpebrata* (Tayl.) Vain.

KEY TO SPECIES OF SERIES PALPEBRATAE

- 1a. Laciniae distinctly ciliate along the margins; apothecia ciliate on the margins. (49) *A. multiciliata*
- 1b. Laciniae indistinctly ciliate or rhizinate marginally; apothecia only rarely ciliate.
 - 2a. Laciniae with verrucae above; undersurface distinctly veined. (47) *A. palpebrata*
 - 2b. Laciniae without verrucae; not veined below. (48) *A. congoensis*

47. *ANAPTYCHIA PALPEBRATA* (Tayl.) Vain.

Hedwigia 37: 38. 1898

(Figs. 18, 45)

Parmelia palpebrata Tayl. Lond. Journ. Bot. 6: 173. 1847. Lectotype: Peru, Cuming 1467 (FH-Tayl).

Parmelia leucomela var. *latifolia* Mey. et Flot. Nov. Act. Acad. Leop. Carol. 19 (Suppl.): 221, tab. 3, fig. 8. 1843. *Anaptychia latifolia* (Mey. et Flot.) Mass. Atti. I. R. Instit. Veneto, ser. 3, 5: 249. 1860. Type: On rocks, St. Christoval, near Lima, Peru (not seen but based on illustration).

Anaptychia ciliaris var. *peruwiana* Müll. Arg. Hedw. 34: 28. 1895. Holotype: Peru, ex herb. Hampe (G).

Thallus foliose, 7 cm. or more across, greyish white to sordid grey, loosely attached; laciniae irregularly branched, 2–8 mm. wide, with more or less incised margins and numerous laminal verrucae often brownish or blackish at the tips, more or less apically ascending; beneath decorticate, arachnoid and irregularly veined, marginally rhizinate; rhizines concolorous with the thallus or darkening towards the apices, sparsely branched, about 3 mm. long. Laciniae 200 μ thick; upper cortex very irregularly thickened, 30–200 μ thick, often projecting down into the medulla to the lower surface, appearing superficially as nervose veins, with a greyish surface layer; gonidial layer often interrupted by the upper cortex and discontinuous, gonidia 8–12 μ in diameter; medulla thin or in part lacking.

Apothecia laminal, substipitate, 1–5 mm. in diameter, with crenate or lacinulate margins; lacinules short, often ciliate; disc blackish brown, slightly pruinose but becoming naked; hymenium colorless and hyaline, about 170 μ high, I⁺ blue; asci cylindrical or subclavate, 26–33 \times 130–160 μ ; spores brown, unstricted or somewhat constricted at the center, thick walled, 16–20 \times 33–40 μ , locules with sporoblastidia at each end.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁺ pale yellow or PD⁻.

Chemical ingredients: Atranorine and zeorine.

This species is closely related to *A. echinata* except for the laminal apothecia. It also resembles *A. ciliaris* f. *verrucosa*, form which it is easily distinguished by chemical characters and structure of the spores.

Although described by Taylor more than 100 years ago, most lichenologists have overlooked this species. *Parmelia leucomela* var. *latifolia* Mey. et Flot. has often been applied to specimens of *A. leucomelaena*. The type specimen has not been located, but the excellent illustration leaves little doubt that it is the same as *A. palpebrata*. It is known only from Peru.

Specimens examined: **South America**, Peru. Lima. Wawra (M). Trujillo. Cerro Chipatur, La Libertad, 425 m., Miranda 0727 (US). Woods of Timbara, 3000–3500 ft., Krause pr. p. (M).

48. *ANAPTYCHIA CONGOENSIS* Kurokawa, sp. nov.

Thallus foliaceus, plagas 3–5 cm. latus formans, cinerascens; laciniae subimbricatae, saepe dichotome et partim subdigitatim divisae, prope apices subascendentes, 0.7–1.5 mm. latae, margine saepe leviter dissectae, superne glabrae epruinosaque, subtus albae vel partim leviter obfuscatae, decorticatae, margine rhizinosae, rhizinis thallo concoloribus vel versus apices fusciscentibus, irregulariter ramosis, 1–3 mm. longis. Laciniae 130–200 μ crassae; cortex superior subirregulariter incrassatus, 50–120 μ crassus, parte exteriori cinerea, ca. 15 μ crassa; stratum gonidiale discontinuum, gonidiis 7–11 μ diametro; stratum medullare ca. 70 μ crassum.

Apothecia superficialia, substipitata, 1–3.5 mm. diametro, margine dentato-crenata vel breviori lacinulata, discis fuscis vel nigro-fuscis, leviter albo-pruinosis sed demum nudis, receptaculis thallo concoloribus epruinosisque; hymenium hyalinum, ca. 160 μ altum, I⁺ coerulescens; cortex receptaculi subaequaliter incrassatus, I⁻; asci oblongo-clavati, 29–33 \times 130–150 μ ; sporae brunnescentes, medio levissime constrictae, 17–20 \times 36–43 μ , loculis sporoblastidiis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

Holotype: Massif of Ruwenzori, Ituri, Africa, 4000–4500 m., July 1929, H. Humbert (REN).

This new species is very close to *A. hypoleuca* in external appearance but it differs in having subascending laciniae and larger spores with sporoblastidia. It differs from *A. palpebrata* in having rather narrow laciniae without verrucae. The absence of veins is the most reliable way to distinguish it from *A. palpebrata*.

Specimen examined: **Africa**, Angola. Cuanza Sul Amboin, Capir, Carloa-ongo-Cuvo., 850 m., Gossweiler 9856 (US).

49. *ANAPTYCHIA MULTICILIATA* Kurokawa, sp. nov.

(Fig. 46)

Thallus foliaceus, stramineo-cinerascens, 3–6 mm. latus, laciniatus; laciniae lineares elongataeque, dichotome divisae, ascendentes, 1–2 mm. latae, superne convexae, verrucis thallo concoloribus ornatae, margine subintegrae, subtus albae, canaliculatae, arachnoideae reticulataeque, rhizinis marginalibus (rarissime superficialibusve), nigris, demum irregulariter divisis ornatae. Laciniae 280–400 μ crassae; cortex superior irregulariter incrassatus, saepe fere usque ad inferiorem attingens; stratum gonidiale discontinuum, gonidiis 10–15 μ diametro; stratum medullare discontinuum, partim deficiens.

Apothecia superficialia, substipitata, 1–3 mm. diametro, margine subintegra aut leviter crenata, ciliis simplicibus, 0.3–1 mm. longis, rhizinis concoloribus ornata, discis concavis, fusco-nigris; hymenium 120–160 μ altum; cortex receptaculi I⁻; asci oblongo-clavati, 33–40 \times 100–140 μ ; sporae brunneo-fuscae, ellipsoideae, 17–20 \times 32–40 μ .

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine and zeorine.

Holotype: On *Cereus* and various shrubs (*Oxalis*, etc.) in dry hill, La Cerena, Cerro los Loros, Coquimbo, Chile, June 27, 1940, Santesson 2521 (S, isotypes in Krk and UPS).

This species is very similar to *A. palpebrata* in having more or less ascending laciniae and laminal apothecia but is clearly distinguished by the distinctly ciliate (or rhizinate) laciniae and ciliate apothecia.

Specimens examined: **South America**, Chile. Santiago. Cartagena, Santesson 2482 (Krk, S, UPS). Atacama. Copiapó, Santesson 2661 (Krk, S, UPS). Valparaiso. Valparaiso, Santesson 2745, 2918 (Krk, S, UPS). No precise local., s. c., ex herb. Mont. (K).

Series 3. *Leucomelaenae* Kurokawa, ser. nov.

Thallus foliaceus, laciniatus; laciniae substrato laxae affixae sed apices versus subsascentes, vulgo dichotome divisae, lineares elongataeque; rhizinae simplices vel squarrosae-ramosae.

Apothecia prope apices laciniarum enata, demum mox apicibus laciniarum recurvis; sporae fuscae, 1-septatae, loculis demum sporoblastidiis parvis saepe numerosis praeditis.

Type species: *Anaptychia leucomelaena* (L.) Mass.

KEY TO SPECIES OF SERIES LEUCOMELAENAE

- 1a. Medulla K⁺ yellow turning red, salazinic acid present. . . (50) *A. leucomelaena*
- 1b. Medulla K⁺ yellow, not containing salazinic acid.
 - 2a. Undersurface white, no pigments present (51) *A. neoleucomelaena*
 - 2b. Undersurface pigmented.
 - 3a. Rhizines white or of the same color as the thallus.
 - 4a. Undersurface partly yellow; pigment K⁻. (50) *A. albicans*
 - 4b. Undersurface variegated brown or dark brown; pigment K⁺ purple (55) *A. loriformis*
 - 3b. Rhizines black, at least towards the apices.
 - 5a. Laciniae with capitate soralia. (57) *A. appalachensis*
 - 5b. Laciniae without capitate soralia.
 - 6a. Pigment K⁻.
 - 7a. Undersurface partly pale yellow. (52) *A. lutescens*
 - 7b. Undersurface variegated brown or dark brown
. (57) *A. usambarensis*
 - 6b. Pigment K⁺ purple.
 - 8a. Undersurface partly yellow to orange-yellow; endemic to Hawaii. (58) *A. fauriei*
 - 8b. Undersurface variegated purple to sordid violet; Central and South America. (54) *A. vulgaris*

50. *ANAPTYCHIA LEUCOMELAENA* (L.) Mass.

Mem. Lichenogr. 35. 1835 (Corr. Vainio, Acta Soc. Faun. Fl.

Fenn. 7: 128. 1890)

(Fig. 19)

Lichen leucomelos L. Sp. Pl. ed. 2, 2: 1613. 1763. *Parmelia leucomela* (L.) Ach. Meth. Lich. 256. 1803. *Borreria leucomela* (L.) Ach. Lich. Univ. 499. 1810. *Physcia leucomelos* (L.) Michx. Fl. Bor. Amer. 326. 1803. Holotype: America meridionalis (LINN).

Parmelia leucomela var. *angustifolia* Mey. et Flot. Nov. Act. Acad. Leop. Carol. 19 (Suppl.): 221, tab. 3, fig. 6. 1843. Type: St. Christoval, near Lima, Peru, 6–8000 ft., (not seen, based on illustration).

Parmelia leucomela var. *angustifolia* f. *multifida* Mey. et Flot. loc. cit., tab. 3, fig. 7. Type: St. Christoval, near Lima, Peru, 6–800 ft. (not seen, based on illustration).

Parmelia ophioglossa Tayl. Lond. Journ. Bot. 6: 172. 1847. *Anaptychia leucomelaena* var. *ophioglossa* (Tayl.) Zahlbr. Cat. Lich. Univ. 7: 733. 1931. *Anaptychia ophioglossa* (Tayl.) Kurokawa, Journ. Bot. 35: 354. 1960. Holotype: Monterrey, California, U.S.A., Beechey (FH-Tayl Herb., isotypes in G, K).

Anaptychia hypochrocodes Vain. Dansk Bot. Ark. 4: 11. 1926. Lectotype: Chinantla, Mexico, May 1841, Liebmann 6468 pr. p. (TUR, Vain. Herb. 7923).

50a. f. *LEUCOMELAENA*

Thallus foliose, greyish to greenish white, 5–15 cm. across; loosely attached to the substratum; laciniae dichotomously branched, linear-elongate, more or less ascending towards the apices, 0.5–4 mm. wide; beneath decorticate, plane or somewhat canaliculate, white or in the herbarium often pale pinkish brown near the tips, occasionally sorediate near the apices, with marginal rhizines; rhizines black, 5–9 mm., long, simple or sparsely branched. Laciniae 130–180 μ thick; upper cortex irregularly thickened, 30–150 μ thick, with a greyish surface layer 15–20 μ thick; gonidial layer often interrupted by the upper cortex and discontinuous, gonidia 6–9 μ in diameter; medulla quite thin or sometimes lacking.

Apothecia very rare, 1–5 mm. in diameter, originating near the apices, soon causing the apex to curve under, the apothecia then appearing subterminal or terminal at maturity; margins lacinulate, lacinules corticate on the outside and decorticate on the innerside, 1–3 mm. long, rarely with marginal cilia; disc dark brown, pruinose; hymenium colorless and hyaline, 150–200 μ high, I⁺ blue; asci cylindrical or subclavate, 30–35 \times 130–160 μ ; spores brown, somewhat constricted at the center, 17–23 \times 31–46 μ , locules pyriform or subglobose, with several sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and salazinic acid.

Anaptychia leucomelaena is easily distinguished from related species (*A. neoleucomelaena*, *A. vulgaris*, *A. lutescens*, etc.) by the production of salazinic acid. Morphologically it is very close to *A. neoleucomelaena* but in general the apices of laciniae are not circinately revolute. The undersurface is more or less roughened while in *A. neoleucomelaena* it is more or less arachnoid.

In the herbarium, the undersurface of *A. leucomelaena* is often pale pinkish brown. I formerly considered the color to be caused by the deposition of a pigment, but this color is more probably caused by the decomposition of salazinic acid.

When Linnaeus described *Lichen leucomelos*, he based it on a single specimen which is now preserved in the herbarium of the Linnaean Society of London. Because of the rules of this society, the type specimen can neither be chemically tested or sectioned for spores. Since the type has a pinkish undersurface, we can probably assume that it contains salazinic acid, and it is fairly certain that no pigment is produced. Morphologically it can be identified with the description above. The lobes are not circinately revolute and the undersurface is more or less roughened.

An undetermined violet pigment which can be extracted from the rhizines of some specimens with acetone appears to have no taxonomic importance.

The holotype specimens of *Parmelia leucomela* var. *angustifolia* and var. *angustifolia* f. *multifida* were destroyed at Berlin in the Second World War. The epithet *angustifolia* presumably implies that the laciniae are narrow, at least in comparison with those of var. *latifolia* (= *Anaptychia palpebrata*), which are up to 8 mm. wide. It does not necessarily imply that var. *angustifolia* actually has extremely narrow laciniae, and in any event the illustrations in Meyen and Flotow suggest that these two taxa are identical with typical *A. leucomelaena*.

Anaptychia leucomelaena is widely distributed in tropical and temperate zones, and it seems to be one of the commoner lichens in Central and South America. It is less common in Africa and Asia. Only one specimen of f. *leucomelaena* (Kurokawa 56070) has been collected in Japan, and only one from India (Awasthi 2567). This species is largely replaced in Africa by *A. neoleucomelaena* and *A. neoleucomelaena* f. *squarrosa*. All specimens reported under the name *leucomelaena* from Europa are correctly identified as *A. leucomelaena* even though they have rather short laciniae. In North America *A. leucomelaena* occurs as far north as Massachusetts in the east and California in the west.

Representative specimens examined: Localities from Japan, Formosa, the Philippines, Java, Hawaii, North America, Central America, Jamaica, Ecuador, Venezuela, Brazil, Madeira, Switzerland, France, Belgian Congo, Uganda, and Tanganyika are listed in Kurokawa (1960c, p. 356, under *A. ophioglossa* f. *ophioglossa*). Additional localities follow. **Central America.** Mexico. San Luis, V. Aoust (PC). Veracruz. 7 km. N. of Fortin de las Flores, 1220 m., Hale 19689 (US). Michoacán. 65 km. E. of Morelia on highway 190, 2560 m., Hale 20968 (US). Oaxaca. Trail to Cerro San Felipe, 3000 m., Hale 20668, 20686, 20689 (Krk, US). Chiapas. El Sumidero, Tuxtla Gutiérrez, 1220 m., Hale 20010 (US), 20015 (Krk, US). Guatemala. Finca Mocca, Alta Verapaz, Johnson 171j (US). Costa Rica. San José. Santa Maria de Dota, 1500–1800 m., Standley and Valerio 43195 (US). **South America.** Colombia. Anarco, Cartago, Rojas 133 (US). Venezuela. Los Guayabitos, 1350 m., Mägdefrau 28 (M). Chile. Chiloé. Isla Chiloé, Santesson 4239 (S, UPS). **Europe.** Spain. Cangos, Salicia, Degelius (S). Portugal. Estremadura Cinbra, Degelius (S). **Africa.** Tanganyika. Chenga Hill, 1600 m., Brass 17607 (US). Kenya. Mt. Elgon, 2500 m., Hedberg 83a. pr. p. (Krk, UPS). Union of South Africa. Transvaal. Zoutpansberg, Almborn (UPS).

50b. f. *ALBOCILIATA* (Nyl.) Hue,
Nouv. Arch. Mus. ser. 4, 1: 107. 1899

Physcia leucomela f. *albiciliata* Nyl. Ann. Sci. Nat. ser. 4, 19: 309. 1863. *Anaptychia ophioglossa* f. *albiciliata* (Nyl.) Kurokawa, Journ. Jap. Bot. 35: 357. 1960. Holotype: Colombia, Lindig 2508 (H, Nyl. Herb. 2227, isotypes in FH, G, K, M, PC, S).

This form is separated from f. *leucomelaena* by the color of the cilia. Most of the cilia are of the same color as the thallus or turn slightly darker only near the apices. It is also difficult to demonstrate salazinic acid in all specimens with Asahina's microchemical methods, probably because there is too small a quantity in the thallus.

Representative specimens examined: Localities in India, Australia, North America (Florida), Mexico, and Colombia are listed in Kurokawa (1960c, p. 357, under *A. ophioglossa* f. *albiciliata*). **Asia.** India. Mysore, Awasthi 3584 (Aw). **Central America.** Mexico. Oaxaca. 77 km. NW. of Tehuantepec at km. 719 on highway 190, 640 m., Hale 20617 (US). Chiapas. El Zapotal, Tuxtla Gutiérrez, 920 m., Hale 19994 (Krk, US). Guatemala. Ciudad Vieja, Tejada 22 (US). Honduras. Comayagua. Near Siguateque, 1050 m., Dawson and Youse (US). **South America.** Venezuela. Near Barguisimeto, Lara, Saer 45 (US). Wugenes, s. c. ex herb. v. d. Bosch (M). Peru. Woods of Timbara, 3000–3500 ft., Krause (M). Brazil. Rio de Janeiro, Glaziou 991 (M). Chile. No precise local. Chamigso (M).

50c. f. *VERRUCIFERA* Kurokawa, f. nov.

Laciniae verruciferae, verrucis hemiglobosis et saepe confluentibus, thallo concoloribus vel in apicibus nigrescentibus. Apothecia non visa. Ceterum ut in f. *leucomelaena*.

Holotype: Fence row near ranch, 9 km. N. of Berriozábal, Chiapas, Mexico, 920 m., March 22, 1960, Hale 20160 (US).

Specimens examined: Mexico. Chiapas. 14 km. W. of San Cristóbal, 2340 m., Hale 20554 (US). Jamaica. No precise local. Wright (K). Colombia. No precise local. Lindig 2874 (M).

50 d. f. *PALMIFORMIS* Kurokawa, f. nov.

Laciniae quin etiam angustatae, 0.3–1 mm. latae, ad peripheriam saltem subpalmato-divisae; subtus prope apices saepe solediosae. Apothecia non visa. Ceterum ut in f. *leucomelaena*.

Holotype: On deciduous tree, 61 km. NW. of Zitácuaro. Km. 223 on highway 190, Michoacán, Mexico, 2130 m., April 5, 1960, Hale 20846 (US).

It is often difficult to demonstrate salazinic acid in this form by microchemical methods. An undetermined violet pigment is deposited in the rhizines of all specimens examined.

Specimens examined: Mexico. Oaxaca. Km. 686 on highway 190, NW. of Tehuantepec, 1160 m., Hale 20651 (Krk, US). Chiapas. 2 km. N. of highway 190 on road to Puebla Nueva, 1070 m., Hale 20260 (US).

51. *ANAPTYCHIA NEOLEUCOMELAENA* Kurokawa,
Journ. Jap. Bot. 36: 51. 1961
(Fig. 6)

Holotype: Below Jamnotri Tehri Gormal, India 9000–9500 ft., on tree trunks, June 6, 1951, Awasthi 902 (Aw).

Physcia leucomela β *crinalis* Hepp in Zoll. Syst. Verz. Ind. Arch. Pfl. 10. 1854. *Anaptychia leucomelaena* f. *crinalis* (Hepp) Zahlbr. Cat. Lich. Univ. 7: 732. 1931. Type: Lembanb near Bandung, Java, 4000 ft., Hepp 1989 (not seen).

Anaptychia leucomelaena var. *soredobullata* Awasthi, Journ. Ind. Bot. Soc. 39: 432. 1960. Holotype: Darjeeling, India, 7000 ft., Oct. 3, 1957, Awasthi 3862 (Aw).

51 a. f. *NEOLEUCOMELAENA*

Thallus loosely adnate on bark or rock, greyish to greenish white, often turning black in part, 5–15 cm. or more in diameter; laciniae dichotomously branched, linear-elongate, more or less ascending and gradually becoming narrower towards the apices, 0.2–1.5 mm. wide, apices circinate-revolute; beneath decorticate, more or less canaliculate, white, sometimes solediate, rhizinate along the margins, rhizines black, simple or sometimes branched, 5–15 mm. long. Laciniae 150–200 μ thick; upper cortex more or less irregularly thickened, with a greyish outermost layer; gonidial layer continuous, gonidia 8–15 μ in diameter.

Apothecia subterminal, sessile or substipitate, 1–5 mm. in diameter, with lacinules at the margins; lacinules up to 2 mm. long, often with

sparse short black cilia along the margins; disc dark brown, white pruinose, soon naked; hymenium 160–200 μ high, I⁺ blue; cortex of receptacle I⁻; asci 30–35 \times 130–150 μ ; spores brown, with a median constriction, locules with many sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

Anaptychia neoleucomelaena has previously been identified as *A. leucomelaena* (Vainio, 1918; Awasthi, 1960) or as *A. leucomelaena* var. *multifida* (Zahlbruckner, 1933; Asahina, 1934; Sato, 1934) or var. *angustifolia* (Sato, 1936; Awasthi, 1960), especially from Africa and eastern Asia. However, it differs from *A. leucomelaena* in lacking salazinic acid. The laciniae become narrow gradually towards the tips and are usually uncinately or circinately revolute.

Since soredia are sometimes produced on the undersurface of older laciniae of *A. neoleucomelaena*, *A. leucomelaena*, *A. lutescens*, etc., I do not believe that *A. leucomelaena* var. *soredobullata* Awasthi deserves taxonomic recognition.

This species seems to be widely distributed in temperate and tropical zones, growing over mosses on bark or rock.

Representative specimens examined: Localities from Japan, Corea, Formosa, the Philippines, Burma, India, Fiji, Mexico, Colombia, Argentina, and Africa are listed in Kurokawa (1961, p. 53). Additional localities follow. **Asia.** China. Kangting, Sikang, 2700 m., Smith 14082 (Krk, UPS). **South America.** Chile. Coquimbo. Cerro Los Loros, La Serena, Santesson 2526 (Krk, UPS). Africa. Uganda. Bujuku Valley, Mt. Ruwenzori, 3500 m., Hedberg 6851 (Krk, UPS).

51 b. f. *SQUARROSA* (Vain.) Kurokawa, comb. nov.

Anaptychia leucomelaena f. *squarrosa* Vain. Cat. Welw. Afr. Pl. 2: 408. 1901. *A. neoleucomelaena* var. *squarrosa* (Vain.) Kurokawa, Journ. Jap. Bot. 36: 53. 1961. Holotype. Serra da Xella, Huilla, Angola, Welwitsch 34 (TUR, Vain. Herb. 7918, isotype in BM).

Anaptychia leucomelaena var. *mannagacensis* C. Sambo, Nuov. Giorn. Bot. Ital. NS., 46: 453. 1939. Holotype: Bosco Mannagaccia, Oletta, Shoa Prov., Ethiopia, 2800 m., Giordano 8 (FI).

Anaptychia leucomelaena var. *multifida* f. *stellato-ciliata* C. Sambo, loc. cit. p. 454. Holotype: Ambo, Shoa Prov., Ethiopia, Giordano 114 (FI).

This form differs from f. *neoleucomelaena* in having squarrosely branched rhizines. The holotype of f. *squarrosa* Vain. is a fragmentary plant, but the thallus on the whole is well developed and there are subterminal apothecia. The form has a very broad pantropical distribution, rather common in Africa and India, less common in tropical America.

Representative specimens examined: Localities from Formosa, China, India, Nepal, Hawaii, Mexico, Costa Rica, and Africa are listed in Kurokawa (1961,

p. 54). Additional localities follow. **Africa.** French Guinea. Mt. Nimba, cercle de N^oZérékoré, 1550 m., Santesson 10593c (Krk, UPS). Ivory Coast. Cercle of Man, Mt. Tonkoui, 1100–1200 m., Santesson 10655a (Krk, UPS). Uganda. Bujuku Valley, Ruwenzori, Hedberg 345n, 383 (Krk, UPS). Tanganyika. Above Marangu, Kilimanjaro, Hedberg 1157e, 11571, 1366g, 1374 (Krk, UPS).

51 c. f. *SOREDIOSA* (Jatta) Kurokawa,

Journ. Jap. Bot. 36: 53. 1961

Parmelia leucomela var. *sorediosa* Jatta, Ann. di Bot. 6: 407. 1908. *Anaptychia leucomelaena* var. *sorediosa* (Jatta) Zahlbr. Cat. Lich. Univ. 7: 733. 1931. Type: Sulle rupi alla Punta Sella presso del Colle e al campo dello stresso (4300–4600 m.) (not seen).

This form is distinguished by producing soredia on the upper surface.

Representative specimens examined: Localities from Japan, India, and the Congo are listed in Kurokawa (1961, p. 53).

51 d. f. *CIRCINALIS* (Zahlbr.) Kurokawa, comb. nov.

Anaptychia leucomelaena var. *multifida* f. *circinalis* Zahlbr. Beih. Bot. Centr. 19 (2): 84. 1905. Lectotype: Paramo region, El Altar, Ecuador, 4200 m., Meyer 399 (W).

Anaptychia leucomelaena f. *filiformis* Dix, Bryol. 52: 65. 1949. Type: Cinchona, Jamaica, W. Seifríz in 1919 (UPS, isotype).

This form is characterized by narrow filamentous laciniae (usually less than 0.2 mm. wide). In external appearance it seems to be a completely different species, but it has in part the same dorsiventral laciniae as in *f. neoleucomelaena*.

52. *ANAPTYCHIA LUTESCENS* Kurokawa,

Journ. Jap. Bot. 36: 55. 1955

Holotype: Monte Ovando, Chiapas, Mexico, March 25, 1932, Matuda 46 (As, isotype in Krk).

Thallus foliose, greyish to whitish green, up to 10 cm. wide; laciniae dichotomously branched, linear-elongate, apically subascending, margins subentire, with some short narrow secondary lacinules; beneath decorticate, plane or somewhat canaliculate, partly yellow, sorediate near tips of laciniae; rhizines black, simple, 4–7 mm. long. Laciniae 90–130 μ thick; upper cortex irregularly thickened, 25–90 μ thick, I⁻, with a greyish surface layer; gonidial layer discontinuous, gonidia 7–13 μ in diameter; medulla thin, in part deficient.

Apothecia very rare, substipitate, about 2 mm. in diameter, originating near tips of laciniae, margins lacinulate, disc concave, brownish black, pruinose; hymenium hyaline, about 180 μ high, I⁺ blue; cortex of receptacle irregularly thickened, I⁻; asci oblong clavate, 30–35 \times 150–

170 μ ; spores brown, slightly constricted in the center, 20–21 \times 36–43 μ , locules subglobose, with sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻; pigmented undersurface K⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and an undetermined lemon yellow substance.

Anaptychia lutescens is characterized by the lemon yellow pigment deposited on the undersurface. It has in the past been identified with *A. leucomelaena* var. *multifida* or var. *angustifolia*. The yellow substance does not give any crystals with microchemical tests, but it is apparently a pulvic acid derivative.

This species is widely distributed in tropical and subtropical regions.

Specimens examined: Localities from Formosa, China, Hawaii, Central America, Jamaica, South America, and Africa are listed in Kurokawa (1961, p. 56).

53. *ANAPTYCHIA ALBICANS* Kurokawa, sp. nov.

Thallus foliaceus, substrato laxe adnatus, cinereo-albicans, 5–8 cm. diametro; laciniae dichotome divisae, lineares elongataeque, 1–1.2 mm. latae, superne opacae, planae, margine subintegrae, subtus albae, partim araneosae pallidolutescentesque, plus minusve canaliculatae, margine distincte corticatae rhizinosaeque, rhizinis albidis, simplicibus vel saepe squarroloso-ramosis, 2–6 mm. longis. Laciniae 170–220 μ crassae; cortex superior subirregulariter incrassatus, 40–110 μ crassus, parte exterior obscure cinerea, 15–20 μ crassa; stratum gonidiale subcontinuum, gonidiis 5–11 μ diametro; stratum medullare 50–100 μ crassum.

Apothecia subterminalia, stipitata, 2–7 mm. diametro, margine lacinulata ciliataque, disco brunneofusco, albopruinoso; hymenium 140–170 μ altum; cortex receptaculi aequaliter incrassatus, I⁻; asci oblongo-clavati, 35–40 \times 130–160 μ ; sporae ellipsoideae, medio leviter constrictae, 15–22 \times 35–42 μ , loculis sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻; yellow pigment on undersurface K⁻.

Chemical ingredients: Atranorine, zeorine, and an undetermined yellow substance.

Holotype: Hacienda Choquelhuauca, on coffee, Dept. Cuzco, 2200 m., March 1919, C. Bues 692 (FH, isotype in Krk).

The yellow pigment deposited on the undersurface is K⁻ and does not give any crystals with microchemical tests. However, it can be identified with the pigment in *A. lutescens*. The two species are easily separated because *A. albicans* has an almost entirely white thallus and rhizines and thicker, more rigid laciniae.

Specimens examined: **South America.** Peru. On low tree in dry woods, about 7000 ft., Muna, G. S. Bryan (FH). Cuzco, Bues 684, 1588 (FH); Valle de Lacco, Cuzco Herrera 2065 (US).

54. *ANAPTYCHIA VULGARIS* (Vain.) Kurokawa, comb. nov.

Anaptychia leucomelaena var. *vulgaris* Vain. Acta Soc. Faun. Fl. Fenn. 7: 128. 1890. Lectotype: Lafayette, Minas Gerais, Brazil, Vain. Lich. Bras. Exs. 289 (TUR, Vain. Herb. 7855).

Thallus foliose, greyish to greenish white, forming colonies up to 8 cm. or more across; laciniae dichotomously branched, linear-elongate, 0.7–2.5 mm. broad, with subentire margins, more or less ascending near the apices; beneath decorticate, somewhat canaliculate or plane, white and variegated purple to dark violet, with marginal rhizines; rhizines simple or sparsely branched, sometimes squarrosely branched, concolorous with the thallus at the base but turning blackish brown to black towards the apices, 4–14 mm. long. Laciniae 90–130 μ thick; upper cortex irregularly thickened, 30–70 μ thick, with a greyish surface layer about 15 μ thick; gonidial layer subcontinuous, 20–30 μ thick, gonidia 7–10 μ in diameter; medulla rather thin, 5–15 μ thick.

Apothecia substipitate, 1–5 mm. in diameter, originating near the apices of the laciniae, soon causing the apical part to become revolute, at maturity appearing subterminal or terminal; margins lacinulate; lacinales corticate on the outside, decorticate and variegated purple on the innerside, with marginal cilia; disc dark brown, pruinose; hymenium hyaline, 150–200 μ high, I⁺ blue or greenish blue; cortex of receptacle more or less uniformly thickened, I⁻; asci cylindrical or subclavate, 30–36 \times 150–180 μ ; spores brown, somewhat constricted at the center, 16–21 \times 36–43 μ , locules obovoid to ellipsoid, with sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻; pigmented undersurface K⁺ purple.

This South American species has been frequently confused with *A. leucomelaena*, but it is separated by the undetermined purple pigment deposited on the undersurface. This pigment is probably an anthraquinone. *A. leucomelaena* produces salazinic acid and has no pigment on the undersurface.

Specimens examined: Localities from Mexico, Peru, Bolivia, and Brazil, are listed in Kurokawa (1960b, p. 358, under *A. leucomelaena*).

55. *ANAPTYCHIA LORIFORMIS* Kurokawa, sp. nov.

Thallus foliaceus, substrato laxe adnatus, albidus aut stramineo-albus, 4–6 cm. diametro, laciniatus; laciniae dichotome divisae, lineares elongataeque, 1–1.2 mm. latae, planae, margine integrae; laciniae subtus decorticatae, albae, hic illic ochraceo- vel fusco-brunnescentes, arachnoideae levissime reticulataeque, margine distincte corticatae rhizinosaeque, rhizinis thallo concoloribus, simplicibus, 2–4.5 mm. longis, Laciniae 160–200 μ crassae, cortex superior

irregulariter incrassatus, 45–200 μ crassus, parte exteriore obscure cinerea, 15–20 μ crassa; stratum gonidiale discontinuum, gonidiis 7–12 μ diametro; stratum medullare partim deficiens.

Apothecia stipitata, subterminalis, 1–3.5 mm. diametro, margine laciniata ciliataque, discis brunnescentibus, dense albo-pruinosis, receptaculis saepe pruinosis; hymenium 100–140 μ altum, cortex receptaculi I⁻; sporae maturae non visae.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻; pigmented undersurface K⁺ purple.

Chemical ingredients: Atranorine, zeorine, and an undetermined yellow pigment.

Holotype: Mazumbei, West Usambara, East Africa, 1200 m., Aug. 19, 1909, J. Brunthaler (WU).

This species is characterized by producing a yellowish brown pigment on the undersurface which is K⁺ purple. In external appearance, it resembles *A.usambarensis*, but it is easily distinguished by the whitish rhizines and the K⁺ pigment. It is also similar to *A.albicans*, except that it produces a different pigment.

56. *ANAPTYCHIA USAMBARENSIS* Kurokawa, sp. nov.

(Fig. 47)

Thallus foliaceus, cinerascens, 3–5 cm. latus, substrato laxe affixus; laciniae crebre dichotome divisae, elongatae linearesque, sorediis isidiisque destitutae, subtus decorticatae, albiae vel partim sordide fusciscentes; rhizinae nigrae, simplices vel squaroso-ramosae, 5–10 mm. longae. Laciniae 120–150 μ crassae; cortex superior irregulariter incrassatus, infernus dentato-flexuosus, 30–150 μ crassus, parte exteriore obscure cinerea, ca. 15 μ crassa; stratum gonidiale discontinuum, gonidiis 6–10 μ diametro; stratum medullare tenue, partim deficiens.

Apothecia substipitata, 2–4 mm. diametro, prope apices laciniarum enata, demum apicibus recurvis, in marginibus lacinulata, lacinulis intus decorticatis, extus corticatis thallo concoloribusque, margine fibrillis atris simplicibus rarissime ornatis, discis fusco-brunnescentibus; hymenium hyalinum, ca. 200 μ altum, I⁺ coeruleus; asci oblongo-clavati, ca. 30 \times 150 μ ; sporae fuscae, medio leviter constrictae, 17–19 \times 38–45 μ , 2-loculares, loculis sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine, zeorine, and an undetermined brown substance.

Holotype: Usambara, Tanganyika, Africa, 1894, Holst 2646 pr. p. (G).

This species is almost identical with *A.vulgaris* (Vain.) Kurokawa in external appearance; it differs principally in containing a different pigment which is K⁻.

57. *ANAPTYCHIA APPALACHENSIS* Kurokawa, sp. nov.

(Fig. 48)

Thallus cinerascens vel glaucescens, ca. 6 cm. latus; laciniae crebre dichotome vel partim subpalmato-divisae, lineares elongataeque, 0.5–2 mm. latae, centrum versus subimbricatae sed ambitu saepe discretae, prope apicibus partim pruinosa, margine subintegrae, in apicibus soralii capitatis labelliformibusve saepe ornatae, subtus decorticatae, arachnoideae, albae sed partim sordide ochraceae vel lutescentes, margine rhizinosae; rhizinae simplices, thallo concolores vel apice leviter sordide fusciscentes aut nigrescentes, 1–2 mm. longae. Laciniae 180–230 μ crassae; cortex superior irregulariter incrassatus, 45–150 μ , I⁻, parte exteriore obscure cinerea, ca. 15 μ crassa; stratum gonidiale discontinuum, gonidiis 7–14 μ diametro; stratum medullare vulgo ca. 100 μ crassum sed partim tenuissimum.

Apothecia non visa.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻; pigmented undersurface K⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and an undetermined yellow substance.

Holotype: Base of chestnut oak, Fabius, Hardy Co., West Virginia, U.S.A., July 1956, Hale 12069 (US).

Anaptychia appalachensis has previously been identified as *A. leucomelaena* by American lichenologists. Both species occur in the Appalachian Mountains, but *A. appalachensis* may be identified by the capitate or labri-form soralia and by the yellow pigment on the undersurface. When the Ac.X. of *A. appalachensis* is treated with K without heat, fine colorless needles radiating from a point appear, and they may actually be the potassium salt of the pigment.

Representative specimens examined: **North America** U.S.A. West Virginia. Near Green Sulphur Springs, Summer Co., Hale 11421 (US); near Bickmore, Clay Co., Hale 11434 (US); near Bluefield, Mercer Co., Hale, 11467 (US). Virginia. Crescent Rocks, Page Co., Hale 18164 (US). North Carolina. Vic. of Eagles Nest, near Waynesville, 900–1500 m., Standley 5781 (US); Huckleberry Art Camp, Henderson Co., Schallert 256, 259 (lkm). Tennessee. Backbone Rec. Area, Johnson Co., Hale 18025 (US).

58. *ANAPTYCHIA FAURIEI* Kurokawa, sp. nov.

Thallus foliaceus, cinereo-glaucescens sed centro partim saepe fusciscentes, usque 2–3.5 cm., quin etiam rigidulus; laciniae breviores sed lineares, 0.2–1.2 mm. latae, crebre dichotome divisae, margine subintegrae sed interdum lacinulis secundalibus angustissimis brevissimisque ornatae, prope apices interdum leviter pruinosa, subtus decorticatae, leviter canaliculatae, prope apices saepe sorediosae, albae sed prope apices partim lutescentes et ad centrum partim miniatae, margine distincte corticatae et centrum versus nigrescentes; rhizinae simplices, nigrae, 1–3 mm. longae. Laciniae ca. 130 μ crassae, margine distincte incrassatae (usque ad 300 μ); cortex superior sub-

aequaliter incrassatus, 45–85 μ crassus, I⁻, parte exteriori cinerea, 15–20 μ crassa; stratum gonidiale subcontinuum, 25 μ crassum, interdum fere usque ad superficiem attingens, gonidiis 6–10 μ diametro; stratum medullare 30–45 μ crassum.

Apothecia non visa.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻; yellow pigment on undersurface K⁺ yellow; miniate pigment K⁺ violet.

Chemical ingredients: Atranorine, zeorine, and undetermined pigments.

Holotype: Haleakala, Maui, Hawaii, 1000 m., July 1909, Faurie 505 (KYO).

This new species resembles *A. lutescens*, but it differs in producing a miniate pigment on the undersurface, which reacts K⁺ purple. *A. lutescens* produces only a yellow pigment. A duplicate of Faurie 505 was determined by Zahlbruckner as *A. leucomelaena* var. *multifida* and was reported under this name by Magnusson and Zahlbruckner (1945) and Magnusson (1955). The species is known only from the type locality.

Series 4. **Podocarpae** Kurokawa, ser. nov.

Thallus foliaceus, saepe rosulatus, vulgo centro solum substrato affixus, laciniae ascendentes vel suberectus.

Apothecia subterminalia vel terminalia; sporae fuscae, 1-septatae, 2-loculares, loculis demum cellulis parvis (sporoblastidiis) praeditis.

Type species: *Anaptychia podocarpa* (Bél.) Mass.

KEY TO SPECIES OF SERIES PODOCARPAE

- 1a. Laciniae without laminal cilia or hairs.
 - 2a. Receptacle of apothecia without cilia or hairs.
 - 3a. Laciniae without soredia.
 - 4a. Undersurface yellow or ochreous, K⁺ purple.
 - 5a. Medulla PD⁺ deep yellow, unknown substance present (68) *A. pandurata*
 - 5b. Medulla PD⁻ or PD⁺ pale yellow, no unknown substance present (67) *A. hypochraea*
 - 4b. Undersurface white.
 - 6a. Medulla PD⁻ or PD⁺ faint yellow; only atranorine and zeorine from o-T.
 - 7a. Cortex of receptacle I⁻.
 - 8a. Rhizines simple and elongate (64) *A. ecbinata*
 - 8b. Rhizines at first simple but soon branching irregularly, rather short (63) *A. stellata*
 - 7b. Cortex of receptacle I⁺ violet
 - 9a. Medulla I⁺ pale violet or blue; locules with numerous sporoblastidia at maturity (66) *A. pellucida*

- 9b. Medulla I⁻; locules with 2–3-sporoblastidia at maturity..... (65) *A. incana*
- 6b. Medulla PD⁺ distinctly yellow to deep yellow; norstictic or salazinic acids present.
- 10a. Salazinic acid present; norstictic acid absent..... (62) *A. arsenei*
- 10b. Norstictic acid present; salazinic also present with KOH+K₂CO₃ test.
- 11a. Cortex of receptacle I⁻.
- 12a. Uppersurface smooth; rhizines sparsely branched, not forming a mat along the margins..... (59) *A. podocarpa*
- 12b. Uppersurface with numerous verrucae; rhizines densely branched, forming a mat along the margins..... (72) *A. barbifera*
- 11b. Cortex of receptacle I⁺ violet.
- 13a. Laciniae short imbricate (60) *A. himalayensis*
- 13b. Laciniae sublinear-elongate (61) *A. awasthii*
- 3b. Laciniae with capitate soralia.
- 14a. Medulla K⁺ yellow turning red, PD⁺ yellow, norstictic acid present..... (71) *A. allardii*
- 14b. Medulla K⁺ yellow, PD⁻ or PD⁺ faint yellow, not containing norstictic acid.
- 15a. Undersurface yellow, pigment K⁺ purple; eastern Asia (69) *A. subascendens*
- 15b. Undersurface white; Western Hemisphere (70) *A. galactophylla*
- 2b. Receptacle of apothecia ciliate or spinulate; usually fertile.
- 16a. Rhizines densely branched, forming a mat below (72) *A. barbifera*
- 16b. Rhizines infrequently branched.
- 17a. Cilia of receptacle long and simple, usually more than 2 mm. long (73) *A. subcomosa*
- 17b. Cilia of receptacle shorter, usually less than 2 mm.
- 18a. Medulla PD⁺ yellow to deep yellow, norstictic acid or unknown crystals in o-T.
- 19a. Receptacle short ciliate; medulla PD⁺ yellow, norstictic acid present..... (75) *A. trichoporoides*
- 19b. Receptacle spinulate; medulla PD⁺ deep yellow, unknown substance present.... (76) *A. spinulosa*
- 18b. Medulla PD⁻ or PD⁺ faint yellow, only atranorine and zeorine from o-T.
- 20a. Cortex of receptacle I⁻..... (74) *A. trichophora*
- 20b. Cortex of receptacle I⁺ violet..... (77) *A. indica*
- 1b. Laciniae ciliate.

- 21a. Medulla K⁺ yellow, PD⁻ or PD⁺ faint yellow; only atranorine and zeorine from o-T..... (78) *A. comosa*
 21b. Medulla K⁺ yellow turning red, PD⁺ yellow, norstictic acid from o-T. (with atranorine and zeorine)..... (79) *A. cubensis*

59. *ANAPTYCHIA PODOCARPA* (Bél.) Mass.

Atti I. R. Inst. Veneti, ser. 3, 5: 249, pl. 13, fig. 1. 1860

(Figs. 5, 49)

Parmelia podocarpa Bél. Voy. Ind. Orient. Bot. II. Crypt. 122. pl. e, fig. 1. 1840. Type: On trunk of rotten tree, forest of Sainte-Suzanne, Bourbon (not seen, but based on illustration).

Physcia podocarpoides Nyl. in Cromb. Journ. Linn. Soc. Lond. Bot. 16: 225. 1877. *Physcia barbifera* var. *podocarpoides* (Nyl.) Müll. Arg. Flora 67: 616. 1884. *Anaptychia podocarpoides* (Nyl.) Zahlbr. Cat. Lich. Univ. 7: 737. 1931. Holotype: Tahiti, Sept. 1875, H. N. Mosley (H. Nyl. Herb. 32445).

Anaptychia podocarpa var. *conferta* Vain. Ann. Acad. Sci. Fenn. A., 6 (7): 61. 1914. Holotype: On *Callandra petiolaris*, near Bains-Jaunes, Guadeloupe, 900–1000 m., Duss 1163 (TUR, Vain. Herb. 7939).

Thallus foliose, greyish white; laciniae short imbricate, irregularly branched, 0.3–3 mm., broad, ascending towards the apices; beneath decorticate, arachnoid, white, more or less canaliculate; rhizines simple but soon branching irregularly, more or less concolorous with the thallus, 1–2 mm. long. Laciniae about 150 μ thick; upper cortex irregularly thickened 35–95 μ thick, with a somewhat flexuose lower surface, I⁻; gonidial layer subcontinuous, gonidia 6–11 μ in diameter; medulla 35–95 μ thick.

Apothecia substipitate or pedicellate, 0.5–5 mm. in diameter, originating near the apices of laciniae, becoming terminal; margins crenate or lacinulate, lacinules short and eciliate; disc brown to dark brown, pruinose but often becoming naked; hymenium hyaline and colorless, about 200 μ high, I⁺ blue; cortex of the receptacle irregularly thickened, I⁻; asci subclavate or cylindrical, 30–36 \times 150–180 μ ; spores brown, somewhat constricted in the center, 17–23 \times 36–51 μ , locules ellipsoid, pyriform or subpandriiform, with 2–3 sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning reddish yellow, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

Anaptychia podocarpa has been frequently miscomprehended in the literature and it is obvious that several species have been reported under this name. The type specimen has unfortunately not been available for comparison. In the original description Bélanger says "Le thalle de ce beau lichen est composé de frondes lineares rayonnecetes... obtuses, d'un

beau rouge de safran foncé en dessus. Les apothécies... supportées par des pédicelles d'un rouge clair." The illustration of the type (tab. 13, fig. 1) is colored beautifully red. This color appears to be caused by the decomposition of salazinic acid along with norstictic acid. The following additional observations can be made from the illustrations: (1) the laciniae have simple marginal rhizines; (2) the rhizines are rather short and concolorous with the thallus; (3) the apothecia are crenate along the margins and lack cilia; and (4) the laciniae are short and imbricate. I believe that the species can be typified from the illustration and the description.

The type of *Physcia podocarpoides* Nyl. is so fragmentary that its original form cannot be determined. However, norstictic and salazinic acids were demonstrated from it, and the receptacle is I⁻.

Representative specimens examined: **Asia.** Formosa. Taityu, Keitau, Asahina (As); Masuda (As). Java. Mt. Pangerango, near Tjibodas, Botanical Garden, Preanger, 1420 m., Schiffner 2945 (FH). **Hawaii.** Kauai. Kilauea, 10 m., Faurie 99 (KYO). Oahu. Bailey (FH). Molokai, C. N. Forbes (FH). W. Maui. Honokawai Gulch, Puu Kukui Trail, 3000-5788 ft., Lambertson 1649, 1660, 1665 (BISH). Hawaii. Hilo, 50 m., Faurie 958 (KYO). **North America.** U.S.A. Florida. Highlands Hammock State Park, Highlands Co., Hale 16959 (US). **Central America.** Guatemala. Near the Finca Sepacuite, Alta Vera Paz, Cook and Griggs 474 (US). Panama. Cerra de Punta, Chiriqui Volcano, Scholander pr. p. (US). **West Indies.** Cuba. Wright Lich. Cub. 82 (M, UPS). Jamaica. Second Breakfast Spring, near Tweedside, 2000 ft., Maxon 887-A (US). **South America.** Peru. San Martin. At. Fundo Cinchona, 4 mi. W. of Divisoria, 59 km. from Tingo Maria on highway to Pucallpa, 1290 m., Allard 21808 pr. p. (US). Brazil. Minas Gerais. Sitio, Vain. Lich. Bras. Exs. 627, 1043, 1109 (TUR, Vain. Herb. 7943, 7948, 7949). **Africa.** Madagascar. Andrangloaka, Imerina, Hildebrandt 2169 (FH, M). Uganda. Kipayo, Dümmer 942 (K).

60. *ANAPTYCHIA HIMALAYENSIS* Awasthi

Proc. Ind. Acad. Sci. 45: 134. 1957

Holotype: Below Village Naret, Askote, Almora, India, 4000-4500 ft., May 28, 1954, Awasthi 2653 (Aw).

Thallus foliose, greyish white to sordid grey at the center, about 5 cm. in diameter; laciniae imbricate, dichotomously or irregularly branched, rather short, subsascending towards the apices, 1-2 mm. wide, sparsely pruinose near the apices, without soredia or isidia; beneath decorticate, canaliculate, white, arachnoid, with marginal rhizines; rhizines concolorous with the thallus, distally brownish, irregularly branched, 2-4 mm. long. Laciniae 200-250 μ thick; upper cortex irregularly thickened, sometimes projecting downward into the medulla, 40-200 μ thick, I⁺ violet, with a greyish surface layer 15-20 μ thick;

gonidial layer often interrupted by the upper cortex and discontinuous, gonidia 6–11 μ in diameter; medulla rather thin, 30–50 μ thick.

Apothecia substipitate or pedicellate, 1.5–7 mm. in diameter, laminal at first but becoming subterminal; disc brown, pruinose; margins membranaceous and sinuate, rarely becoming ciliate; hymenium colorless and hyaline, 150–180 μ high, I⁺ blue; cortex of receptacle more or less uniformly thickened, I⁺ violet; asci cylindrical or subclavate, 20–25 \times 120–140 μ ; spores brown, 16–20 \times 32–40 μ , somewhat constricted at the center, thick walled, locules with sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning reddish yellow, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

This species is similar to *A. podocarpa* but is distinguished by the I⁺ reaction of the cortex of the receptacle and the shorter more closely interlaced laciniae. When he described this species, Awasthi mentioned that the “disc (is) brown pruinose with an inner rim-like orange colored margin.” This color however is not a natural pigment as in *A. podocarpa* and *A. leucomelaena*. The I⁺ blue or violet blue reaction is diagnostic for the species; it is more stable in the cortex of the receptacle than in the laciniae.

Specimens examined: **Asia.** Sikkim. Tongloo, Watt 7044 (GLAM). India. Darjeeling. Darjeeling, 7000 ft., Awasthi 3133 (Aw). Almora. Near Village Naret, 4500 ft., Awasthi 3299-B (Aw). Mussoorie. Landour, 7000 ft., Awasthi 1443 (Aw).

61. *ANAPTYCHIA AWASTHII* Kurokawa, sp. nov.

Thallus subrosulatus vel subradiatus, albido-cinereascens et centrum versus obfuscatus, 2–4 cm. latus; laciniae subimbricatae, suberectae ascendentesve, subirregulariter divisae, superne convexae, 1–3 mm. latae, sorediis isidiisque destitutae, epruinosa, subtus decorticatae, araneoso-stuppeae, albae, margine rhizinosae; rhizinae thallo concolores vel apices versus obfuscatae, irregulariter ramosae, 1–3 mm. longae. Laciniae 180–300 μ crassae; cortex superior irregulariter incrassatus, saepe fere usque ad inferiorem attingens, I⁺ leviter violascens; stratum gonidiale discontinuum, gonidiis 6–10 μ diametro; stratum medullare tenue et partim deficiens.

Apothecia pedicellata, subterminalia, 1–5 mm. diametro, margine crenatolacinulata, lacinulis demum raro ciliatis, discis concavis, fusco-brunnescentibus, albopruinosus sed demum saepe subnudis; hymenium decolore et hyalinum, 180–250 μ altum; I⁺ coeruleascens; cortex receptaculi subirregulariter incrassatus, I⁺ violascens; asci oblongo-clavati, ca. 25 \times 130 μ ; spores fuscae, medio non aut leviter constrictae, 18–21 \times 38–47 μ , loculis lacrymaeformibus panduriformibusve, demum sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning reddish yellow, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

Holotype: Tiger Hill, Darjeeling, India, 8500 ft., D. D. Awasthi 3896-B (Aw).

This new species differs from *A. podocarpa* in its positive I reaction on the cortex of the receptacle and from *A. himalayensis* in its sublinear-elongate laciniae and subrosulate thallus. The innerside of the lacinules and the undersurface of the laciniae are often tinged orange-red in the herbarium, but this is not a natural pigment but the decomposition of norstictic and salazinic acids.

Specimens examined: **Asia.** Burma. Paghum, Upper Burma, Anderson (M). Sikkim. Gantok, 6000 ft., Awasthi 129 (Aw). India. Darjeeling. Near Sandakh-poo, 10,000 ft., Awasthi 2506 (Aw); Darjeeling, 7000 ft., Awasthi 3163 (Aw); Lloyd Bot. Gard., 6500–6800 ft., Awasthi 3845-B (Aw). Almora. Village Naret, Askote, 4500 ft., Awasthi 3299-A (Aw); near Singali, Askote, 5500 ft., Awasthi 3435 (Aw). Mussorie, 6500–7000 ft., Awasthi 3795 (Aw). Nepal. No precise local., Banerjee in 1952 (Aw, as no. 1414).

62. *ANAPTYCHIA ARSENEI* Kurokawa, sp. nov.

Thallus foliaceus, subrosulatus, cinereo-glaucescens, 2–3.5 cm. latus; laciniae suberectae vel ascendentes, crebre dichotome vel raro palmato-divisae, quasi flexuoso-tremulantes, superne leviter convexae, vulgo distincte albopruinosae, 1–1.5 (raro 2) mm. latae, subtus decorticatae albidaeque, arachnoideae, leviter canaliculatae; rhizinae simplices vel raro ramosae, thallo concolores sed apices versus vulgo nigrescentes, 1–3 mm. longae. Laciniae 130–210 μ crassae; cortex superior irregulariter incrassatus, 25–120 μ crassus, I⁻, parte exteriore obscure cinerea, ca. 15 μ crassa; stratum gonidiale discontinuum, gonidiis 7–15 μ diametro; stratum medullare quin etiam tenue, ca. 30 μ crassum.

Apothecia numerosa, prope apices laciniarum enata sed demum mox terminalia, 1–6 mm. diametro, margine crenata aut breviter lacinulata et ciliis brevibus praeditae, discis nigro-fuscis, dense albopruinosi sed demum subnudi; hymenium decolore et hyalinum, 110–130 μ altum, I⁺ coeruleum; cortex receptaculi subirregulariter incrassatus, quin etiam tenuis, I⁻; asci subclavati, 26–30 \times 95–115 μ ; spores fuscae, medio non aut leviter constrictae, 16–19 \times 30–36 μ , loculis sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, and salazinic acid.

Holotype: Esperanza, Puebla, Mexico, 2400 m., 1907, Arsène 8089 (US).

This species has usually been identified as *A. galactophylla* or *A. podocarpa* in the literature. Vainio's (1890) report of *A. galactophylla* from Mexico is this species, as is Bouly de Lesdain's report of *A. podocarpa* from Mexico. *A. arsenei* differs from related species in producing salazinic acid alone (along with atranorine and zeorine). It is endemic to Mexico.

Specimens examined: Mexico. Valley of Mexico, Bourgeau in 1865 (PC). Puebla. Esperanza, 2400 m., Arsène 4264 pr. p., 8091 (US); Rancho Guadalupe, 2130 m., Arsène (US); 69 km. E. of Puebla on highway 140, Hale 19341 (US).

63. *ANAPTYCHIA STELLATA* (Vain.) Kurokawa, comb. nov.

Anaptychia podocarpa var. *stellata* Vain. Acta Soc. Faun. Fl. Fenn. 7: 131. 1890. Holotype: Sitio, Minas Gerais, Brazil, Vain. Lich. Bras. Exs. 1080 (TUR, Vain. Herb. 7938, isotype in BM).

63a. var. *STELLATA*

Thallus foliose, greyish white, 3–5 cm. in diameter; laciniae dichotomously branched, rather short, 0.8–2 mm. broad, suberect or ascending, sometimes distinctly imbricate; beneath decorticate and arachnoid, white, canaliculate, with marginal rhizines; rhizines concolorous with the thallus but becoming slightly darker brown towards the apices, simple but soon branching, 1–3 mm. long. Laciniae 200–320 μ thick; upper cortex irregularly thickened, 55–260 μ thick, often projecting into the medulla, I⁻, with a greyish surface layer about 15 μ thick; gonidial layer discontinuous, gonidia 7–14 μ in diameter; medulla 60–90 μ thick.

Apothecia numerous, originating near the apices of laciniae and appearing terminal at maturity, 1–7 mm. in diameter; margins crenate or short lacinulate, eciliate; disc dark brown, lightly pruinose or epruinose; hymenium hyaline, 150–200 μ high, I⁺ blue; cortex of receptacle irregularly thickened, I⁻; asci cylindrical or subclavate, 30–33 \times 130–170 μ ; spores brown, unstricted or slightly constricted at the center, 18–22 \times 36–51 μ , locules pyriform or pandriform, with 2–3 sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

Anaptychia stellata is not easily told from *A. podocarpa* by external appearance; it differs chiefly in chemical components. *A. stellata* also has a more restricted range, in the West Indies and South America, whereas *A. podocarpa* is pantropical. The different chemistry and the geographical distribution seem to indicate that they are separate species.

Specimens examined: **West Indies.** Cuba, Wright Lich. Cub. 82 pr. min. p. (M). **South America.** Peru. Woods of Timbara, 3000–3500 ft., Krause 11 pr. maj. p. (M). Bolivia. No precise local., Bang 1934 pr. p. (UPS). Brazil. Minas Gerais. Sitio, Vain. Lich. Bras. Exs. 796, 978 (TUR, Vain. Herb. 7945, 7944); Serra da Mantiquera, Warming 214 (M). Rio de Janeiro, Glaziou 1814 pr. p., 1818 (M).

63b. var. *SQUARROLOSA* Kurokawa, var. nov.

Laciniae margine rhizinis simplicibus vel squarroloso-ramosis, obfuscatis vel nigrescentibus praeditis. Ceterum ut in var. *stellata*.

Holotype: Hamburgerberg, Rio Grande do Sul, Brazil, Oct. 20, 1892, G. A. Malme (S).

64. *ANAPTYCHIA ECHINATA* (Tayl.) Kurokawa, comb. nov.

Parmelia echinata Tayl. Lond. Journ. Bot. 6: 166. 1847. Lectotype: Pennsylvania, U.S.A., T. Drummond (FH-Tayl).

64a. var. *ECHINATA*

(Fig. 50)

Thallus greyish white, growing on twigs, rigid; laciniae suberect or ascending, di- or trichotomously branched, convex, without isidia of soredia, 0.5–2 mm. wide; beneath decorticate, white, more or less canalliculate, arachnoid and often reticulately veined, with marginal rhizines; rhizines simple or very rarely branched, of the same color as the thallus or darkening towards the apices, 2–3 mm. long. Laciniae 200–300 μ thick; upper cortex irregularly thickened and the lower surface distinctly flexuose, often projecting downwards into the lower surface; gonidial layer often interrupted by the cortex, gonidia 7–13 μ in diameter; medulla in part very thin.

Apothecia numerous, pedicellate, subterminal, 1–4 mm. in diameter, margins crenate or lacinulate, lacinules sometimes with simple short cilia; disc dark brown, white pruinose; hymenium 140–180 μ high; cortex of receptacle more or less irregularly thickened, I⁻; asci 30–33 \times 120–150 μ ; spores brown, ellipsoid, with a median constriction, 13–17 \times 30–42 μ , locules with 2–3 small sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine and zeorine.

The name *Anaptychia galactophylla* (Tuck.) Trev. (*Parmelia ciliaris* var. *galactophylla* Tuck.) has long been applied to this species in North America. However, the earliest valid name of this species is *A. echinata*, which has long been considered to be a synonym of *A. comosa*. The Taylor's type is based on two specimens. One collected by Drummond in Pennsylvania is here designated as the lectotype; it is a large well developed specimen. The other collected in Brazil (ex herb. Leyland) can be identified as *A. comosa*.

Anaptychia echinata is closely related to *A. arsenei* in external appearance, but it lacks salazinic acid. It also resembles *A. podocarpa* and *A. stellata*,

but it is clearly separated from them by the long simple rhizines. *A. echinata* seems to be a typical North American species, distributed from Massachusetts south to Florida and Texas with two localities known from Mexico. Although widely distributed, it is not a common species. It is most commonly collected on junipers in open glades.

Representative specimens examined: **North America.** U.S.A. Massachusetts. Cambridge, Tuckerman (FH). Pennsylvania. Lancaster, Lancaster Co., Porter (FH). Virginia. Near Millsboro Springs, Bath Co., Hale 12932 (US). North Carolina. Near Yadkin Valley, Caldwell Co., Culberson 6074 (US). South Carolina. Otrondi, Chesle, H. A. Green (M). Georgia. Near McRae, Telfair Co., Hale 7514 (US). Tennessee. Nashville, Gattinger (M). Iowa. Fayette Co., Fink (US). Arkansas. Marble Falls, Newton Co., Hale, Lich. Amer. Exs. 11 (M, US). Louisiana. No precise local., J. Hale, Tuck. Lich. Amer. Sept. Exs. 82 (As). Texas. Corpus Christi, Nueces Co., Palmer 11212c (US). **Mexico.** Veracruz. 9 km. E. of Jalapa, 1240 m., Hale 19413 (US). Puebla. Malinche, Nicholas (M).

64b. var. *PTEROCARPA* Kurokawa, var. nov.

(Fig. 51)

Laciniae 2–5 mm. latae. Apothecia margine lacinulis sat latioribus praeditis, lacinulis 1–3×2–5 mm. Ceterum ut in var. *echinata*.

Holotype: Honey Station, Puebla, Mexico, Oct. 6, 1909, Pringle 10872 (US).

65. *ANAPTYCHIA INCANA* (Stirt.) Zahlbr.

Cat. Lich. Univ. 7: 727. 1931

Physcia incana Stirt. Proc. Phil. Soc. Glasgow 11: 322. 1879. Holotype: Darjeeling, India, J.A.Thomson 13 (BM, isotype in GLAM).

Thallus foliose, 3–6 cm. in diameter, greyish white or darkening at the center, attached only at the central part; laciniae suberect or ascending, dichotomously branched, 1–4 mm. wide, convex, epruinose or sometimes slightly pruinose at the tips, without soredia or isidia; beneath decorticate and white, arachnoid, more or less reticulately veined, with marginal rhizines; rhizines concolorous with the thallus or darkening apically, squarrosely or fruticosely branched, 1–3 mm. long. Laciniae 180–300 μ thick; upper cortex irregularly thickened, often projecting downward to the lower surface, I⁺ violet; gonidial layer discontinuous, often approaching the upper surface, gonidia 7–14 μ in diameter; medulla quite thin, 30–40 μ thick, in part lacking or evanescent.

Apothecia numerous, pedicellate, subterminal, 1–8 mm. in diameter; margins membranous or lacinulate, sometimes ciliate; disc dark brown, densely pruinose; hymenium colorless and hyaline, 170–250 μ high, I⁺ blue; cortex of receptacle more or less irregularly thickened, I⁺ violet;

asci subclavate or cylindrical, $30-38 \times 160-180 \mu$; spores brown, more or less constricted at the center, locules obovoid, with 2-3 small sporoblastidia at maturity.

Reaction: Thallus K^+ yellow; med. K^+ yellow, C^- , KC^- , PD^- or PD^+ pale yellow.

Chemical ingredients: Atranorine and zeorine.

This species is closely related to *A. himalayensis*, but it is distinguished by more elongate, suberect laciniae and by chemical components. *A. himalayensis* contains norstictic and salazinic acids, in addition to atranorine and zeorine.

Representative specimens examined: **Asia.** Formosa. Taityu, Keitau, T. Masuda (As). Mt. Daibu, Matsuda (TI, as Yasuda 675). Thailand. Hase, T. Tuyama (As). Java. Preanger. Mt. Pangerango, Schiffner Iter. Ind. 3286 (M). Sikkim. Between Punkabaree and Kurseong, 3-4000 ft., s. c. (M). India. Darjeeling. Lloyd Bot. Gard., 6500-6800 ft., Awasthi 3844 (Aw, M), 3845-A (Aw); below Sonada, 5500-6000 ft., Awasthi 3856 (Aw, Krk, M). Anamalai, S. India, s. c. (Aw, as no. 2614). Nepal. Mewakhola Valley near Odyar, 8500 ft., Awasthi 2237 (Aw). Ceylon. Matélé, A. C. Broche (M). Comoro. Massif de Mafondrodjo, Mohéli, 620 m., s. c. (REN).

66. *ANAPTYCHIA PELLUCIDA* Awasthi,

Prov. Ind. Acad. Sci. 45: 136. 1957

(Fig. 20)

Holotype: Tiger Hill, Darjeeling, India, on twigs of shrubs, 8000 ft., Oct. 10, 1954, Awasthi 3136 (Aw).

Thallus foliose, greyish or greenish white, often darkening at the center, 3-3.5 cm. wide, attached to the substratum only at the center; laciniae ascending or suberect, dichotomously or irregularly branched, 2-5 mm. wide, convex or plane; beneath decorticate, white or sordid white, more or less arachnoid and finely reticulately veined; rhizines marginal, rarely laminal, concolorous with the thallus and often darkening towards the apices, fruticosely or subsquarrosely branched, 2-3 mm. long. Laciniae $180-300 \mu$ thick; upper cortex irregularly thickened, often projecting downward to the lower surface, I^+ violet or bluish violet; gonidial layer discontinuous, often approaching the upper surface, gonidia $6-12 \mu$ in diameter; medulla quite thin, in part deficient or evanescent, I^+ faint bluish violet.

Apothecia laminal at first, becoming terminal, subpedicellate, 1-4 mm. in diameter, with subentire to more or less crenate margins, cilia lacking; disc blackish brown, naked; hymenium colorless and hyaline, $200-300 \mu$ high, I^+ blue; cortex of receptacle irregularly thickened, I^+ violet; medulla of receptacle I^+ faint bluish violet; asci cylindrical or subclavate,

40–50×200–260 μ ; spores large, more or less constricted at the center, 23–27×50–70 μ , with 2 locules but many celled at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ faint yellow.

Chemical ingredients: Atranorine and zeorine.

This unique species is characterized by having the largest spores in the genus. The spores at maturity have many small sporoblastidia around the main locules, as noted by Awasthi in the original description. It was first described from a single collection from India but Awasthi (1960) later added a locality from Sikkim. It also occurs in southern China and Nepal.

Specimens examined: **Asia.** China. Setschwan. Mt. Lungdschu-schan, near Huili, 3000–3730 m., Handel-Mazzetti 980 (W). Yunnan. Mt. Tsang-schan, Delavay 1572 (PC). Sikkim. Near Chhangu, 11000 ft., Awasthi 128, 130 (Aw). India, Darjeeling. Tiger Hill, 8000–8500 ft., Awasthi 3894 (Aw, Krk, M). Nepal. Phurtee, T. Ogawa (As).

67. *ANAPTYCHIA HYPOCHRAEA* Vain.

Bot. Mag. (Tokyo) 35: 59. 1921

Anaptychia podocarpa var. *hypochraea* (Vain.) Sato, Journ. Jap. Bot. 12: 431. 1936. Holotype: Mt. Sensoku, Prov. Inaba, Japan, Sept. 25. 1915, Yasuda 151 (TUR, Vain. Herb. 7958).

Thallus foliose, forming rosettes or irregularly spreading colonies, 3–6 cm. across, greyish white, centrally attached; laciniae suberect or ascending, dichotomously to irregularly branched, 0.5–2 mm. wide, convex, sometimes with semiglobose laminal verrucae; beneath decorticate, arachnoid, white but variegated yellow to brownish yellow, canalliculate; rhizines simple, becoming irregularly branched, concolorous with the thallus, 1–4 mm. long. Laciniae 160–230 μ thick; upper cortex more or less irregularly thickened, 40–150 μ thick, often projecting into the medulla, I⁺ faint violet, with a greyish surface layer 20–30 μ thick; gonidial layer subcontinuous, about 60 μ thick, gonidia 7–14 μ in diameter; medulla 50–80 μ thick.

Apothecia numerous, subterminal, 1–5 mm. in diameter, with crenate or short lacinulate margins; disc dark brown to blackish brown, lightly pruinose or naked; hymenium colorless and hyaline, 160–200 μ high, I⁺ blue; cortex of the receptacle irregularly thickened, I⁺ faint violet; asci cylindrical or subclavate, 27–35×130–180 μ ; spores brown, somewhat constricted at the center, 17–19×30–42 μ , locules pyriform, with 2–3 sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow.

Chemical ingredients: Atranorine, zeorine, and an unidentified yellow substance.

This species has been confused with *A. podocarpa* in Japan, but it has quite different chemical composition. The K⁺ purple pigment on the undersurface is probably identical with that in *A. obscurata* and *A. flabellata*.

The thallus is rather variable in size and form. The apothecia originate near the apices, after which the tip becomes revolute and appears to cease further elongation. Thalli with numerous apothecia are therefore almost stellate, with short laciniae. When most of the lobes are sterile, the laciniae are elongate and the thallus reaches 5 cm. or more in diameter, forming irregular colonies. Among some collections from Uruguay kindly sent by Dr. H. S. Osorio (MVM), I noted two collections which can be identified as *A. hypochraea*. These records are quite unusual since the species is otherwise known only from Asia.

Representative specimens examined: **Asia.** Japan. Hokkaido. Sapporo. K. Miyabe (FH). Prov. Rikutyu. Kadoma-guti, Mt. Hayatine, Kurokawa 59258 (Krk). Prov. Musasi. Mt. Buko, Asahina (As). Prov. Sagami. Hakone, Asahina 14, 68a (As). Prov. Sinano. Mt. Akadake, Yatugatake Mts., Kurokawa 520675 (Krk). Prov. Kai. Lakeside of Yamanaka, Asahina (As). Prov. Oomi, Hira Pass, Mt. Hiradake, M. Togashi (As). Prov. Yamasiro, Mt. Daihi, Atago-gun, Togashi, Lich. Jap. Exs. 101 (As, US). Prov. Kii. Yanoko Pass, Kumano, Kurokawa 59118 (Krk). Prov. Aki, Daizyusan, Yamagata-gun, 500 m., T. Seki 2504 (Nak). Sikoku. Prov. Tosa. Mt. Hi-uti, Takaoka-gun, Yoshimura 209 (Yosh). Prov. Awa. Sawatani-mura, Naka-gun, Togashi (As). Kyushu. Prov. Satuma. Mt. Kaimon-dake, Asahina (As). Formosa. Urai, Taipei, M. Ogata (As). China. Hunan. Mt. Yünschan near Wukang, 1200 m., Handel-Mazzetti 12161 (W). Yunnan. Schilungba, near Yünnanfu, Handel-Mazzetti 248 pr. p. (W). **South America.** Uruguay. Estancia Madeiros, Osorio 3758 (MVM); Rivera-Subida de Mendez-Campo Los Potreros, Osorio 1083 (MVM).

68. *ANAPTYCHIA PANDURATA* Kurokawa, sp. nov.

Thallus foliaceus, cinerascens, subcaespitosus, 4–6 cm. latus; laciniae suberectae vel ascendentes, crebre dichotome divisae, quasi flexuoso-tremulantes, superne convexae, interdum verrucis superficialibus semiglobosis et saepe confluentibus instructae, epruinosae, 0.5–2 mm. latae; subtus decorticatae, canaliculatae, arachnoideae, albae sed partim fulvescentes, margine rhizinosae, rhizinis thallo concoloribus sed apices versus leviter sordide fuscis, simplicibus vel crebre ramosis, 2–5 mm. longis. Laciniae 150–180 μ crassae; cortex superior 30–150 μ crassus, saepe fere usque ad inferiorem attingens, I⁺ leviter violascens, parte exteriori obscure cinerea, 15–20 μ crassa; stratum gonidiale discontinuum, gonidiis 6–13 μ diametro; stratum medullare sat tenue, partim subdeficiens.

Apothecia subterminalia, pedicellata, 1–6 mm. diametro, margine crenata vel breviora lacinulata, disco fusco, leviter pruinoso, demum subnudo; hymenium decolore et hyalinum, 120–150 μ altum, I⁺ coeruleascens; cortex receptaculi subirregulariter incrassatus, I⁺ leviter violascens; asci oblongo-clavati, 30–36 \times 100–130 μ ; spores fuscae, ellipsoideae, medio non aut levissime con-

strictae, 16–20×35–44 μ , 1-septatae, 2-loculares, loculis pandriformibus, demum sporoblastidiis parvis praeditis.

Reaction: Thallus K^+ yellow; med. K^+ yellow, C^- , KC^- , PD^+ deep yellow; yellow part of undersurface K^+ purple.

Chemical ingredients: Atranorine, zeorine, an undetermined yellow substance and an undetermined substance identical with that of *A. dissecta*.

Holotype: Mt. Koya, Prov. Kii. Japan, April 18, 1926, Y. Numaziri 597 (As, isotype in TNS).

A. pandurata is very similar to *A. hypochraea*; the chemical components however are different. When the Ac.X. of *A. pandurata* is heated with An reagent, slender yellow curved needles of atranorine and colorless double pyramid crystals of zeorine appear. After as much as 2–3 hours, deep yellow fusiform plates of an undetermined substance appear. This species occurs from Thailand to Japan.

Specimens examined: **Asia.** Japan. Honsyu. Prov. Rikuzen. Mt. Taihaku-zan, near Sendai, A. Yasuda (As). Prov. Hitati. Dainaka, Satomi-mura, Kuzi-gun, M. Togashi (As). Prov. Musasi. Mt. Takao, Asahina (As). Prov. Sagami. Lakeside of Asinoko, Hakone, Asahina (As). Prov. Mikawa. Mt. Chausuyama, Kita-Sitara-gun, N. Takaki 335 (Krk). Sikoku. Prov. Tosa. Gozaisyonomori, Hata-gun, Yoshimura (Yosh). Kyusyu. Prov. Hyuga. Iino, Mayebara 203 (As). Bonin Islands. Titizima Island, M. Sato (TI). Formosa. Raisha, Asahina F 109 pr. p. (As). Thailand. Hase, T. Tuyama (As).

69. *ANAPTYCHIA SUBASCENDENS* Asahina,

Journ. Jap. Bot. 33: 325. 1958

(Fig. 52)

Holotype: Kubota, Kaya-mati, Misima, Prov. Izu, Japan, July 1929, Asahina 208 (As).

Thallus foliose, greyish white to glaucous grey, colonies in rosettes or irregularly spreading, 3–5 cm. in diameter; laciniae suberect or ascending, more or less imbricate, dichotomously or in part irregularly branched, more or less linear-elongate but dilated towards the apices, appearing spathuliform, 2–5 cm. or more wide, epruinose; beneath decorticate, arachnoid, more or less reticulately veined at the center, distinctly sorediate near the apices, variegated white and yellow; rhizines at first simple but finally sparsely branched, concolorous with the thallus, darkening towards the apices, 1–3 mm. long. Laciniae 160–210 μ thick; upper cortex irregularly thickened, 25–200 μ thick, often projecting to the undersurface, I^- or I^+ pale violet, with a greyish surface layer about 15 μ thick; gonidial layer often interrupted by the cortex and discontinuous, gonidia 7–18 μ in diameter; medulla 30–40 μ thick, in part deficient.

Apothecia very rare, pedicellate, 1–3 mm. in diameter, originating near apices of laciniae and soon appearing terminal; margins membranous, sorediate, not ciliate; disc dark brown, lightly pruinose; hymenium colorless and hyaline, about $130\ \mu$ high, I⁺ blue; cortex of receptacle more or less irregularly thickened, I⁺ pale violet; asci cylindrical or subclavate, $27\text{--}35 \times 110\text{--}135\ \mu$; spores brown, ellipsoid, somewhat constricted at the center, $16\text{--}20 \times 34\text{--}41\ \mu$, locules pandriform or pyriform, with sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ pale yellow; yellow pigment on undersurface K⁺ purple.

Chemical ingredients: Atranorine, zeorine, and a yellow substance.

This species is characterized by spatuliform laciniae, a sorediate undersurface, and a yellow pigment on the undersurface. Apothecia are known from only one specimen. This species often is collected on twigs of various shrubs, such as *Morus bombycis* and *Thea sinensis*. It is endemic to Japan and Formosa.

Specimens examined: Asia, Japan. Honsyu. Prov. Mutu. Kuroishi, Faurie 1178 (FH). Prov. Rikutyu. Ozawa-Koyama, Suzuki 1019 (Krk). Prov. Kazusa-Ichinomiya, Asahina 42 (As). Prov. Musasi. Hinata-Ooya, Ryogami-mura. Kurokawa 550541 (Krk). Prov. Sinano. Azusayama, Minami-Saku-gun, Kurokawa 59188 (Krk). Prov. Izu. Simoda, Asahina (fertile) (As). Prov. Totomi, Kawasaki, Haibara-gun, Asahina and Kurokawa (As). Prov. Etyu. Minami. Yamada-mura, Higasi-Tonami-gun, Nishizima 186 (As). Prov. Oomi. Oonomura, Koga-gun, Kurokawa 520021 (Krk). Prov. Ise. Aoyama Heights, K. Nisimura (Krk). Prov. Yamato. Bunze, Gose City, Tanaka (Krk). Prov. Aki. Wada, Mizuuti-mura, Saheki-gun, 200 m., Nakanishi 3791 (Nak). Sikoku. Prov. Iyo. Tonaru, Kakuno-mati, Arai-gun, Ochi 57 (As). Formosa. Keitau. T. Masuda (As).

70. *ANAPTYCHIA GALACTOPHYLLA* (Tuck.) Trev.

Flora 44:52. 1861

(Fig. 53)

Parmelia ciliaris var. *galactophylla* Tuck. Proc. Amer. Acad. Arts Sci. 1: 224. 1848. Holotype: Maine, U.S.A. ex herb. Oakes (FH-Tuck).

Anaptychia speciosa f. *spathulata* Vain. Acta Soc. Faun. Fl. Fenn. 7: 137. 1890. Holotype: Sitio, Minas Gerais, Brazil, ad corticem, 1885, Vain. Lich. Bras. Exs. 709 (TUR, Vain. Herb. 7791).

Thallus foliose, greyish white to glaucous grey, colonies rosette-shaped or irregular, 3–5 cm. wide; laciniae ascending apically, more or less imbricate, dichotomously or partly irregularly branched, distinctly dilated apically with round apices, appearing strap-shaped or spatuliform, 0.5–1.5 mm. wide at the base, 2–8 mm. wide at the tips; beneath decorticate, distinctly sorediate at the apical parts, with marginal rhi-

zines; rhizines simple, becoming thyrsoïdly branched, 0.5–1.5 mm. long, concolorous with the thallus, darkening towards the apices. Laciniae 190–330 μ thick; upper cortex irregularly thickened, 40–100 μ thick, I⁻, with a greyish surface layer about 25 μ thick; gonidial layer subcontinuous, about 30 μ thick, gonidia 8–12 μ in diameter; medulla 80–160 μ thick.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine and zeorine.

The species has been misinterpreted by most lichenologists, including Tuckerman himself. Material distributed in Tuck. Lich. Amer. Sept. Exs. no. 82 is not *A. galactophylla* but should be identified as *A. echinata*, since the rhizines are simple and rather long and the thallus is not sorediate below. In *A. galactophylla*, including the holotype specimen, the rhizines are thyrsoïdly or fruticosely branched and the thallus is more or less sorediate below at the tips. *A. galactophylla* resembles *A. subascendens* in external appearance, but *A. subascendens* has sparsely branched rhizines and a yellow pigment below.

Specimens examined: **North America.** U.S.A. North Carolina. M. A. Curtis 67 (UPS). Florida. 5 mi. N. of Pittman, Lake Co., Hale 17502 (US). **Central America.** Panama. Chiriqui. Crater's edge, Chiriqui volcano, 3300–3450 m., Scholander pr. p. (US). **West Indies.** Cuba. Wright Lich. Cub. 82 pr. min. p. (M). **South America.** Peru. San Martin. Tingo Maria, 625–1100 m., Allard 22222 (US). Ayacucho. Aina, between Huanta and Rio Apurimac, 750–1000 m., Killip and Smith 23149 (US). Muna. 7000 ft., Bryan 503 (FH). Chile. Valparaiso. Valparaiso, Santesson 2875 (UPS).

71. *ANAPTYCHIA ALLARDII* Kurokawa, sp. nov.

(Fig. 54)

Thallus foliaceus, cinerascens, 3–4 cm. latus, substrato laxe adnatus; laciniae dichotome vel subirregulariter divisae, apices versus subascendentes dilatataeque, 1.5–2.5 mm. latae, epruinosae, subtus decorticatae, albidae, ad apices saepe sorediosae recurvataeque; rhizinae albae, 0.5–2 mm. longae, simplices sed demum mox thyrsoïdeo-ramosae. Laciniae 120–180 μ crassae; cortex superior aequaliter incrassatus, 35–70 μ crassus, parte exteriore obscure cinerea, 15–20 μ crassa; stratum gonidiale continuum, 20–30 μ crassum, gonidiis 7–14 μ diametro; stratum medullare sat tenue, 20–30 μ crassum.

Apothecia non visa.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

Holotype: In jungle on ridge, east of Tingo Maria, San Martin, Peru, 2500 ft., Oct. 30, 1949—Feb. 19, 1950, Allard 21408c (US).

This species closely resembles *A. galactophylla* in external appearance, but differs in chemical components. It occurs in tropical America.

Specimens examined: **Central America.** Panama. Chiriqui. Crater's edge, Chiriqui volcano, 3300-345 m., Scholander pr. p. (US); Cerra de Punta, Scholander, pr. p. (US). **West Indies.** Cuba. Wright Lich. Cub. 82 pr. min. p. (UPS). **South America.** Bolivia. No precise local., M. Bang 1934 pr. min. p. (UPS).

72. *ANAPTYCHIA BARBIFERA* (Nyl.) Trev. Flora 44: 52. 1861

Physcia barbifera Nyl. Syn. Lich. 1: 416. 1860. Holotype: On branches of *Weinmannia*, near Tatanara, Peru, Aug. 1854, Lechler 2562 (PC, isotypes in FH, G, H (Nyl. Herb. 32443), K, M).

Thallus foliose, greyish white to white, about 5 cm. across, loosely attached to the substratum; laciniae mainly dichotomously branched, sublinear-elongate, 1-4 (rarely 6) mm. wide, subsending only near the apices, distinctly convex, sometimes slightly pruinose near the apices, forming numerous laminal verrucae, often with blackish tips; beneath decorticate, white rather rough, canaliculate; rhizines densely branched, forming a narrow mat along the margins of laciniae, concolorous with the thallus or darkening towards the apices. Laciniae about 200 μ thick; upper cortex irregularly thickened, 30-80 μ thick, with a greyish surface layer about 20 μ thick; gonidial layer subcontinuous, about 30 μ thick, gonidia 7-14 μ in diameter; medulla about 100 μ thick.

Apothecia subterminal, 1-4 mm. in diameter, margins smooth but often becoming lacinulate; disc brown, pruinose; receptacle often with hairs in younger stages; hymenium colorless and hyaline, 180-200 μ high, I⁺ blue; cortex of receptacle more or less irregularly thickened, I⁻; asci cylindrical or subclavate, 33-36 \times 130-170 μ ; spores brown, uncontracted or slightly constricted at the center, 18-20 \times 43-49 μ , locules pyriform, with 2-3 sporoblastidia at each end at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

This species is characterized by densely branched rhizines which form a narrow mat along the margins. The type has rather narrow laciniae (1-2 mm.) but other specimens have laciniae up to 6 mm. wide. In contrast with *A. podocarpa*, the uppersurface is not smooth but produces numerous laminal verrucae.

Specimens examined: **Central America.** Mexico. Orizaba, Smith 38 pr. min. p. (US). Chiapas. Lagos de Monte Bello, 1220 m., Hale 20405 (US). Costa Rica. Cartago. Alto de la Estrella, Standley 39094 (US). **South America.** Colombia. No precise local., Blaghorne (K). Peru. Muna, 7000 ft. Bryan 496, 504 (FH). Junin. Chanchamayo Valley, 1200 m., Schunke 1259, 1275-76, 1280 (FH). Ayacucho. Between Huanta and Rio Apurimac, 750-1000 m., Killip and Smith 23149 pr. p., 22582 (US). Brazil. Minas Gerais. Caldas, Henschen 1868 (UPS). Rio de Janeiro, A. Glaziou 1813, 1816, 1817 (M).

73. *ANAPTYCHIA SUBCOMOSA* (Nyl.) Trev. Flora 44: 52. 1861

Physcia leucomelaena var. *subcomosa* Nyl. Syn. Lich. 1: 415. 1860. *Physcia barbifera* var. *subcomosa* (Nyl.) Müll. Arg. Rev. Mycol. 1: 168. 1879. *Anaptychia leucomelaena* var. *subcomosa* (Nyl.) Müll. Arg. Hedw. 30: 239. 1891. Holotype: Veracruz, Mexico, Müller (H, Nyl. Herb. 32452).

Thallus foliose, greyish white, rosulate, centrally attached, 2–5 cm. in diameter; laciniae dichotomously branched, suberect or ascending, convex, epruinose, 1.5–2.5 mm. broad, occasionally with laminal cilia; beneath decorticate, white, concave or almost plane, with marginal rhizines (cilia); rhizines concolorous with the thallus, simple or sparsely branched, 1.5–5 mm. long. Laciniae 110–170 μ thick; upper cortex irregularly thickened, often projecting to the undersurface, I⁻; gonidial layer discontinuous, often interrupted by the upper cortex, gonidia 6–13 μ in diameter; medulla quite thin, in part evanescent.

Apothecia subterminal or terminal, pedicellate, 0.3–4 mm. in diameter; margins crenate or short lacinulate, lacinules and receptacle ciliate, cilia the same as the rhizines; disc dark, densely pruinose but becoming more or less naked; hymenium hyaline and colorless, 100–140 μ high, I⁺ blue; cortex of receptacle I⁻; asci cylindrical or subclavate, 29–33 \times 90–120 μ ; spores brown, more or less constricted at the center, 14–18 \times 29–35 μ , locules globose or lacrimiform, with sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine and zeorine.

On the whole, *A. subcomosa* resembles *A. echinata* externally except for cilia on the receptacle of the apothecia. Although Vainio (Hedw. 37: 38. 1898) reduced *Physcia leucomelaena* var. *subcomosa* to a synonym of *A. palpebrata*, *A. palpebrata* is a quite different species with laminal apothecia.

Specimens examined: **Central America**, Mexico. Veracruz, Orizaba, Mohr pr. p. (US) and Smith 38 pr. p. (US). Huatusco, Liebmann 121a (UPS). **South America**, Colombia. Bogotá, Arbelaez 1087 (US).

74. *ANAPTYCHIA TRICHOPHORA* Kurokawa, sp. nov.

Thallus foliaceus, cinerascens, rosulatus, usque ad 2–3 cm. latus, sorediis isidiisque destitutus; laciniae suberectae aut ascendentes, dichotome divisae, superne distincte convexae, 1–3 mm. latae, subtus albae, decorticatae, margine rhizinis thallo concoloribus, ramosis et subintricatis ornatae. Laciniae 180–230 μ crassae; cortex superior irregulariter incrassatus; saepe usque ad inferiorem attingens, I⁻; stratum gonidiale discontinuum, gonidiis 7–13 μ diametro; stratum medullare quin etiam tenue, partim deficiens.

Apothecia subterminalia, pedicellata, 1.5–2 mm. lata, margine integra sed demum levissime crenata, disco fusco albopruinosoque, receptaculis thallo concoloribus et ciliatis, ciliis brevibus ramosisque, thallo concoloribus vel levissime obfuscatibus, subintricatis; hymenium decolore et hyalinum, 140–180 μ altum, I⁺ coeruleum; cortex receptaculi irregulariter incrassatus, I⁻; asci

oblongo-clavati, 34–36 × 140–160 μ ; sporae fuscae, ellipsoideae, medio non aut levissime constrictae, 19–21 × 39–43 μ , loculis demum sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, P⁻.

Chemical ingredients: Atranorine and zeorine.

Holotype: Serra do Picu, Beida Barra, Rio de Janeiro, Brazil, Dec. 11, 1886, H. Schenck 4436 f. pr. p. (UPS).

A. trichophora is quite similar to *A. subcomosa* in the presence of cilia on the receptacle, but it is distinguished by short, branched, and somewhat intricate cilia. It is known only from Brazil and Bolivia.

Specimen examined: Bolivia. No precise local., Bang 1934 pr. min. p. (UPS).

75. *ANAPTYCHIA TRICHOPHOROIDES* Kurokawa, sp. nov.

(Fig. 55)

Thallus foliaceus, albido-cinereus vel sordide albidus, subrosulatus, 2–3 cm. latus; laciniae suberectae vel subsascentes, subirregulariter divisae, superne convexae, epruinosa sed hic illic ciliatae, subtus decorticatae, albae, canaliculatae, levissime asperatae et centrum versus reticulatim nervosae, margine rhizinosae; rhizinae thallo concolores, irregulariter ramosae, 1–2 mm. longae. Laciniae 160–220 μ crassae; cortex superior irregulariter incrassatus, saepe fere usque ad inferiorem attingens, 30–200 μ crassus, I⁻; parte exteriore obscure cinerea, ca. 20 μ crassa; stratum gonidiale discontinuum, gonidiis 8–15 μ diametro; stratum medullare quin etiam tenue, ca. 20 μ crassum.

Apothecia subterminalia aut terminalia, pedicellata, 1.5–6 mm. diametro, margine membranacea et sinuata, discis nigro-fuscis albopruinosisque; receptaculum thallo concolore, dense ciliatum, ciliis brevibus, usque ad 0.3 mm. longis, subpellucidis vel thallo concoloribus; hymenium hyalinum et decolore, ca. 160 μ altum, I⁺ coeruleus; cortex receptaculi subaequaliter incrassatus, I⁻; asci oblongo-clavati, 33–36 × 120–140 μ ; sporae fuscae, medio levissime constrictae, 17–22 × 39–49 μ , loculis sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

Holotype: Mexico. No precise local., s.c., s. d. (ex herb. Nyl.) (M).

This species is very close to *A. trichophora* externally but it has different chemical components. It is known only from the type collection from Mexico.

76. *ANAPTYCHIA SPINULOSA* Kurokawa, sp. nov.

(Fig. 56)

Thallus foliaceus, cinereus aut sordide cinereus, rosulatus, 1.5–2.3 cm. latus, centro solum substrato affixus; laciniae ascendentes vel suberectae, saepe dichotome divisae, subimbricatae, superne convexae, epruinosa, 0.3–

2 mm. latae, subtus decorticatae, albidac sed partim leviter sordide fusciscentes, arachnoideae, canaliculatae; rhizinae simplices vel rarissime ramosae, thallo concoloribus et apices versus saepe fusciscentes, 1-2 mm. longae. Laciniae 170-230 μ crassae; cortex superior subirregulariter incrassatus, 25-100 μ crassus, I⁻, parte exteriori obscure cinerea, ca. 25 μ crassa; stratum gonidiale subcontinuum, partim fere usque ad superiorem attingens, gonidiis 6-13 μ diametro; medulla ca. 60 μ crassa.

Apothecia subterminalia vel terminalia, pedicellata, 1-4 mm. diametro, marginibus plus minusve membranaceis, primum subintegris sed demum subsinuatis vel subcrenatis, discis nigro-fuscis leviter pruinosisque, marginibus receptaculisque apotheciorum spinulosis; hymenium decolore et hyalinum, ca. 170 μ altum; cortex receptaculi subaequaliter incrassatus, ca. 100 μ , I⁺ violascens; asci oblongo-clavati, 30-33 \times 130-160 μ ; sporae fuscae, ellipsoideae, 16-20 \times 33-40 μ , 2-loculares, loculis demum sporoblastidiis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁺ deep yellow.

Chemical ingredients: Atranorine, zeorine, and an undetermined substance identical with that in *A. dissecta*.

Holotype: Raisha, Formosa, Jan. 5, 1926, Asahina F 105 pr. p. (As).

This new species is related to both *A. trichophora* and *A. trichophoroides*, but differs from both in having spinules on the receptacle of apothecia and by producing an undetermined P⁺ substance. The species is endemic to Formosa. I am indebted to Dr. Asahina for pointing the species out to me and suggesting the specific epithet.

Specimens examined: Asia. Formosa. Raisha, Asahina F 292 (As). Keitau, T. Masuda (As) and M. Sato (TI, as Taiwan 9a) and Asahina F 109 (W).

77. *ANAPTYCHIA INDICA* Magn.

in Awasthi, Journ. Ind. Bot. Soc. 39: 439. 1960

Holotype: Tiger Hill, Darjeeling, India, 8500 ft., on twigs of shrub, Oct. 6, 1957, Awasthi 3893 (Aw).

Thallus foliose, greyish white, rosulate, about 3 cm. broad, attached only at the center; laciniae irregularly branched, ascending or suberect, subimbricate, 1-3 mm. wide, epruinose; beneath decorticate, whitish, reticulately veined; rhizines marginal, subsquarrosely branched, darkened, 2-4 mm. long. Laciniae about 200 μ thick; upper cortex irregularly thickened, 35-110 μ thick, I⁻; gonidial layer subcontinuous, about 30 μ thick, gonidia 7-12 μ in diameter; medulla rather thin.

Apothecia subterminal or terminal, pedicellate, 1-3 mm. in diameter, margin subentire; disc blackish brown, white pruinose, margins and receptacle of apothecia ciliate, cilia dark, squarrosely branched; hymenium colorless and hyaline, 180-200 μ high, I⁺ violet-blue; cortex of the receptacle irregularly thickened, I⁺ violet; asci oblong-clavate. 33-36 \times

160–180 μ ; spores brown, 23–26 \times 39–44 μ , locules with sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻ or PD⁺ faint yellow.

Chemical ingredients: Atranorine and zeorine.

I have examined only the hilotype specimen of this species. It is obviously different from closely related *A. spinulosa* because of the squarrosely branched cilia on the receptacle and because of the chemical components. *A. indica* is apparently endemic to India.

78. *ANAPTYCHIA COMOSA* (Eschw.) Mass.

Mem. Lichenogr. 39. 1853

Parmelia comosa Eschw. in Mart. Icon. Pl. Crypt. 2: 26. 1828. *Physcia comosa* (Eschw.) Nyl. Syn. Lich. 1: 416. 1860. Type: On branches of trees, near Porta de Móz, Para, Brazil (not seen but based on illustration in Tab. XII, fig. 1).

Thallus foliose, forming rosettes 3–6 cm. across, or irregularly spreading, up to 8 cm. or more across, greyish or sordid white, attached to the substratum only at the center; laciniae ascending or suberect, subimbricate, dilated, 1–4 or rarely up to 10 mm. wide, with rotund apices when sterile, with numerous laminal and marginal cilia, cilia concolorous with the thallus or pellucid, 2–4 mm. long, simple or rarely sparsely branched; beneath decorticate, white or variegated ochraceous, often sorediose at the dilated apical part when sterile. Laciniae 130–180 μ thick; upper cortex irregularly thickened, 20–180 μ thick, I⁻, with a greyish surface layer 15–20 μ thick; gonidial layer about 30 μ thick, often interrupted by the upper cortex and discontinuous, gonidia 7–14 μ in diameter; medulla rather thin, 30–50 μ thick.

Apothecia subterminal or terminal, subpedicellate, 1–5 mm. (rarely 10 mm.) in diameter; margins membranaceous and crenate or lacinulate; disc dark brown, densely pruinose; hymenium hyaline and colorless, 110–150 μ high, I⁺ blue; asci cylindrical or subclavate, 27–30 \times 110–140 μ ; spores brown, 13–16 \times 30–35 μ , locules obovate or ellipsoid, with 2–3 sporoblastidia at maturity.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow, C⁻, KC⁻, PD⁻.

Chemical ingredients: Atranorine, zeorine, and frequently an undetermined ochraceous substance.

This species is widely distributed in the tropical regions of Asia and America. Most specimens from South America contain a considerable quantity of the ochraceous pigment on the undersurface; this pigment is not known in specimens from other regions and is probably best considered as an accessory substance without taxonomic significance.

Representative specimens examined: **Asia.** China. Yunnan. Near Kongai, between Loping and Djiangdi, 1700 m., Handel-Mazzetti 10243 (W). India. Darjeeling. Lloyd Bot. Garden, 6600 ft., Awasthi 3850 (Aw). **Central America,** Mexico. Veracruz. Mirador, Purpus 199 (US), Purpus s. n. (As, M). Michoacán. Cerro Azul, Morelia, Arsène 4002 (US). Chiapas. El Zapotal, Tuxtla Gutierrez, 920 m., Hale 19995 (Krk, US). Guatemala. No precise local., G. Eisen (UPS). **South America.** Colombia. Bogota, 2500 m., Lindig 2558 (M). Venezuela. Caracas, Hampe (UPS). Peru. No precise local., (de am Pavon 162) (UPS). Brazil. Minas Gerais. Sitio, Vain. Lich. Bras. Exs. 613 (FH, M), 971, 1121 (TUR, Vain. Herb. 7935, 7932): Caldas, H. Mosén (UPS). Rio de Janeiro. Cabo Frio, Schenck 4436 (UPS); Serra do Piaí, Beida Barra, Schenck 4436f pr. p. (UPS); Mt. Itatiaya, 2000–2550 m., Schiffner (M); near Rio de Janeiro, Glaziou 1811, 1812, 1814 pr. p. (M). Matto Grosso. Santa Anna da Chapada, Malme 2408-B pr. p. (S). Rio Grande. Blumenau (UPS). Bolivia. Santa Clara, R. E. Fries 80 (S). Tataranda, Fries 133 (S). Paraguay. Bords du Mbai, Balansa 4138 (M). Gran Chaco. Pilcomaya, Malme 25 (UPS). Colonia Risso, near Rio Apa, Malme (S). Argentina. Jujuy, Canada, between Pampa Blanca and San Pedro, Fries 22 (S); Caatinga, between El Quemado and Chalican, Smith 4680a (US). Buenos Aires, G. J. Lyon (FH). No precise local., Lorentz and Hieronymus (M, UPS).

79. *ANAPTYCHIA CUBENSIS* Kurokawa, sp. nov.

Thallus rosulatus aut subrosulatus, centro solum substrato affixus, albocinereascens, 2–4 cm. latus; laciniac dichotome vel partim palmatim divisae, apices versus saepe dilatatae et apice rotundatae, superne et margine ciliis albidis simplicibus vel raro ramosis vestitae, sorediis isidiisue, destituta, 1–2.5 mm. latae, subtus decorticatae, arachnoideae, albidae. Lacinae ca. 150 μ crassae; cortex superior irregulariter incrassatus, I-, parte exteriori obscure cinerea ca. 15 μ crassa; stratum gonidiale discontinuum, gonidiis 7–13 μ diametro; stratum medullare quin etiam tenue, ca. 30 μ crassum.

Apothecia subterminalia vel terminalia, subpedicellata, 1–5 mm. diametro, margine membranacea, membranis 1–2 mm. latis, crenato-lobatis, discis vulgo concavis, nigro-fuscis, dense albopruinosis, receptaculis dense ciliatis; hymenium hyalinum, 140–180 μ altum, I+ coeruleescens; cortex receptaculi subaequaliter incrassatus, I-; asci oblongo-clavati, 26–33 \times 120–150 μ ; sporae fuscae, ellipsoideae, 16–20 \times 33–42 μ , 1-septatae, 2-loculares, loculis sporoblastidiis parvis praeditis.

Reaction: Thallus K⁺ yellow; med. K⁺ yellow turning red, C⁻, KC⁻, PD⁺ yellow.

Chemical ingredients: Atranorine, zeorine, norstictic and salazinic acids.

Holotype: Cuba, Wright Lich. Cub. 83 (UPS, isotypes in BM, K, M) (sub *Physcia speciosa* var. *galactophylla* f. *comosa*).

It is difficult to separate *A. cubensis* from *A. comosa* on external appearance only. *A. cubensis* is unique in producing norstictic and salazinic acids along with atranorine and zeorine. It is distributed from Mexico and Cuba to tropical South America.

Specimens examined: **Central America.** Mexico. Orizaba, Müller pr. p. (UPS) and C. Mohr pr. min. p. (US). Guatemala. Samac, Alta Veracruz, 4500 ft., Johnson 786 (US). **South America.** Peru. San Martin. At Findo Sinchona, 4 mi. W. of Divisonia, 1290 m., Allard 21 808 pr. p. (US). Brazil. Minas Gerais. Cidade de Caldas, Arfenes, Campo, Henschen, Herb. Regnell. 94 a pr. p. (UPS).

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EXPLANATION OF PLATES

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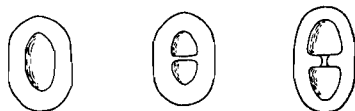
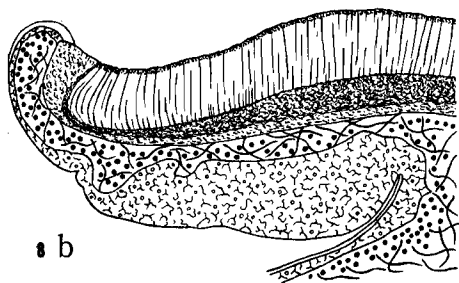
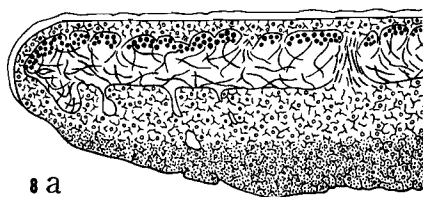
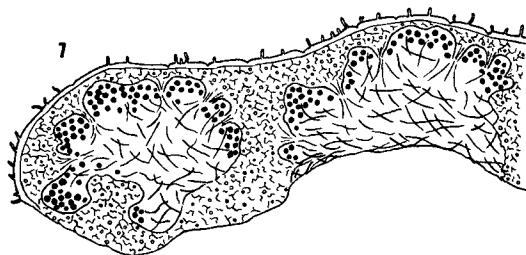
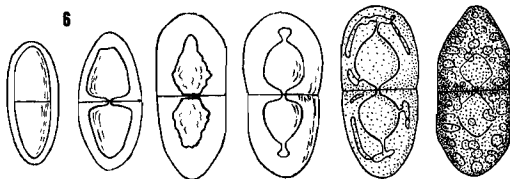
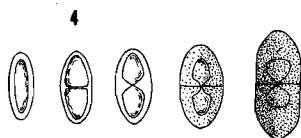
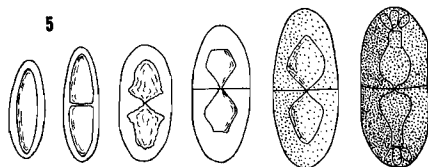
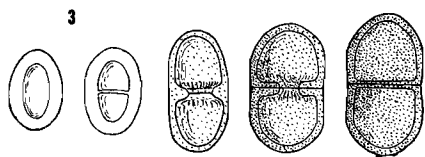
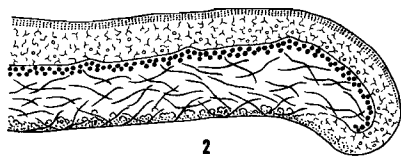
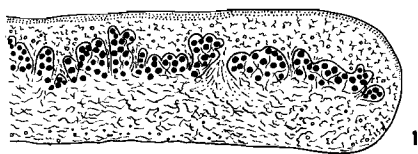
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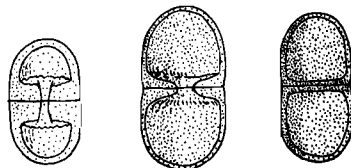
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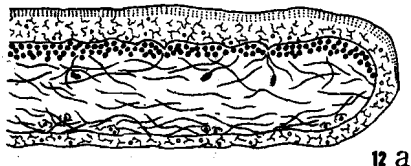
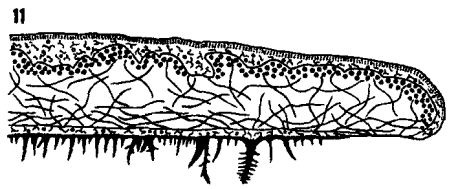
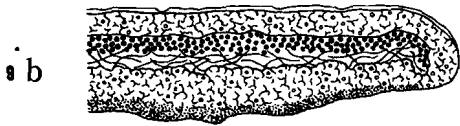
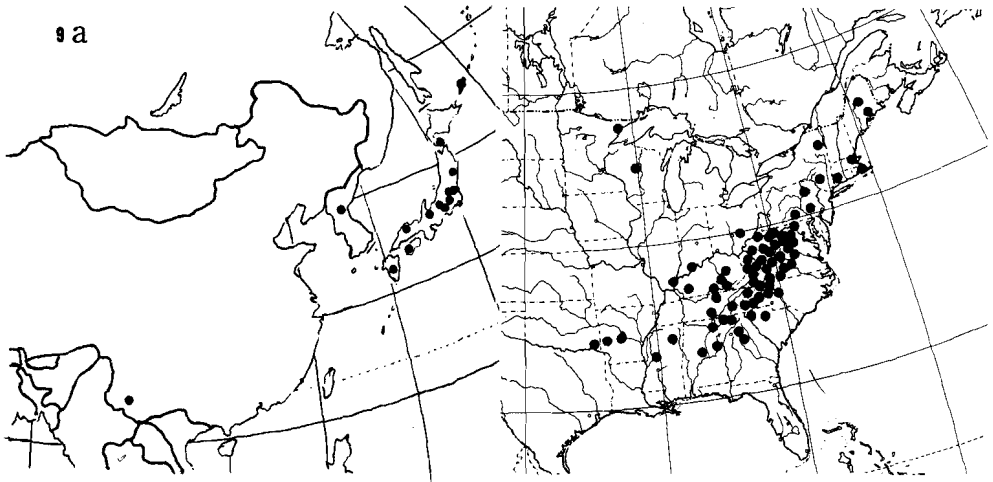
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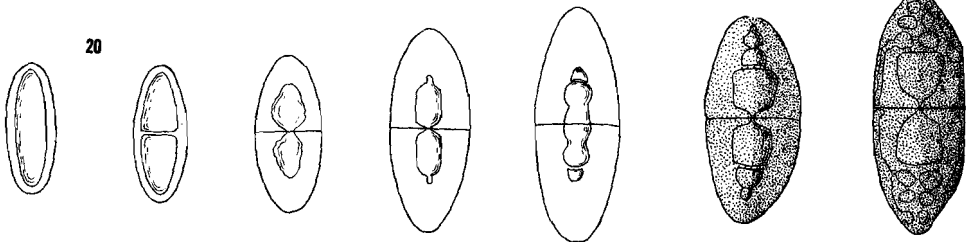
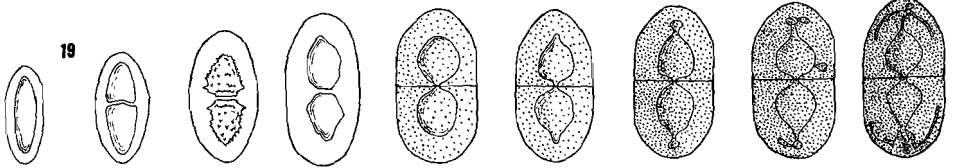
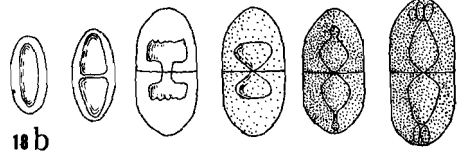
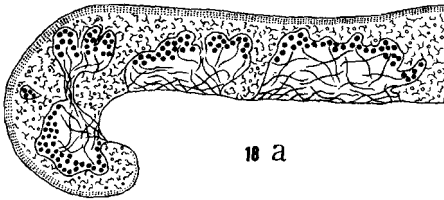
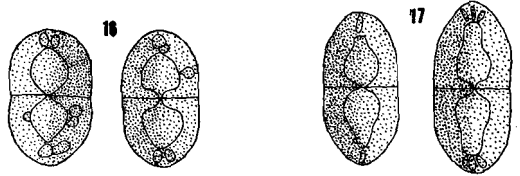
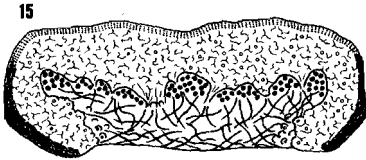
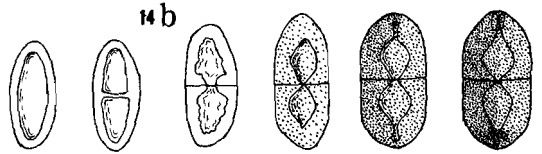
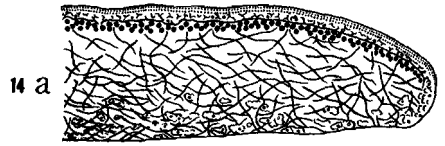
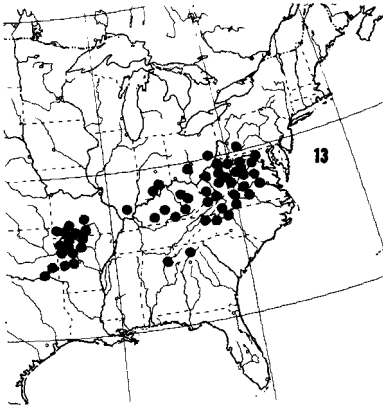
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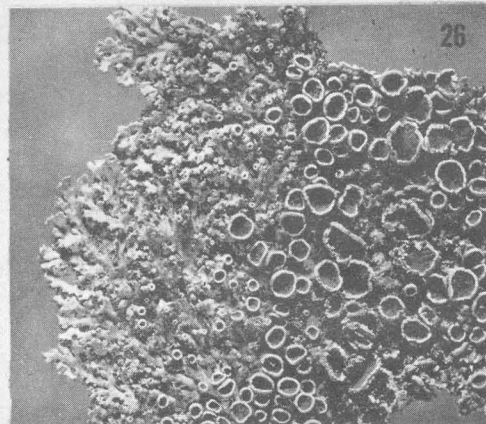
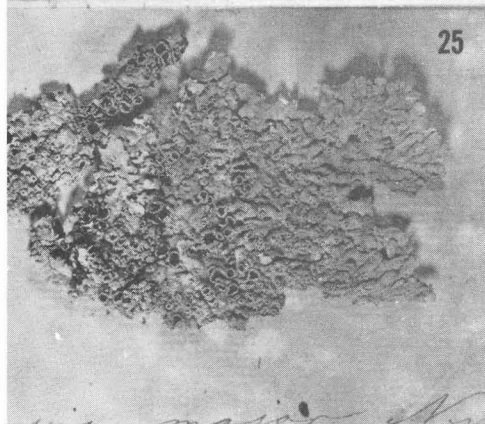
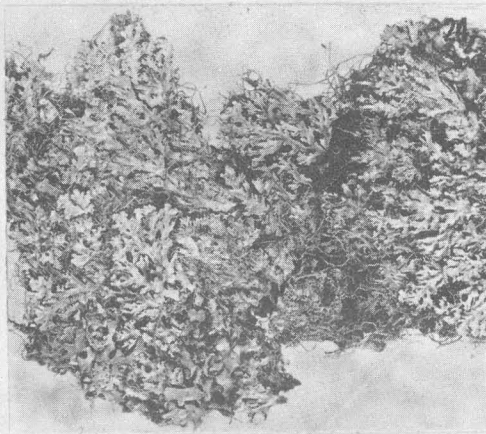
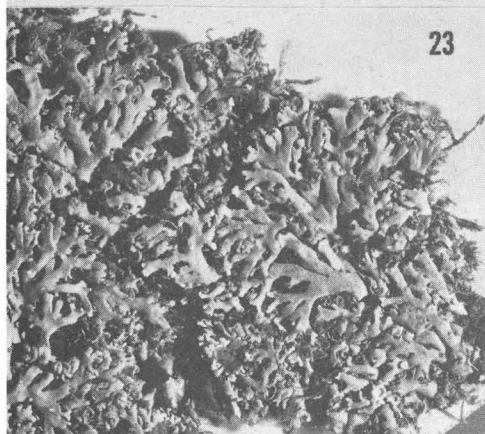
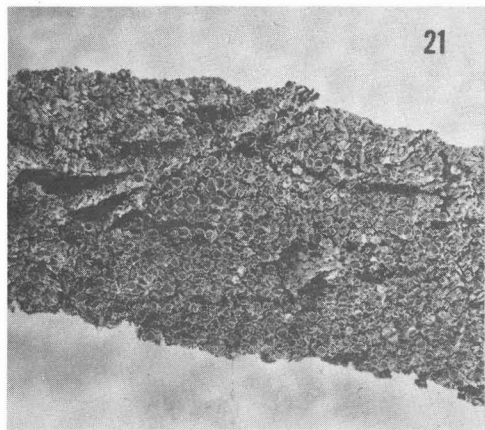


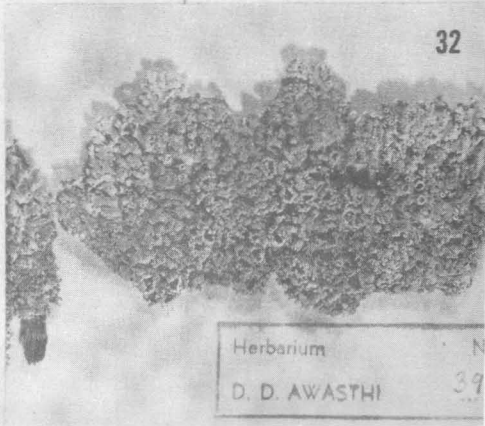
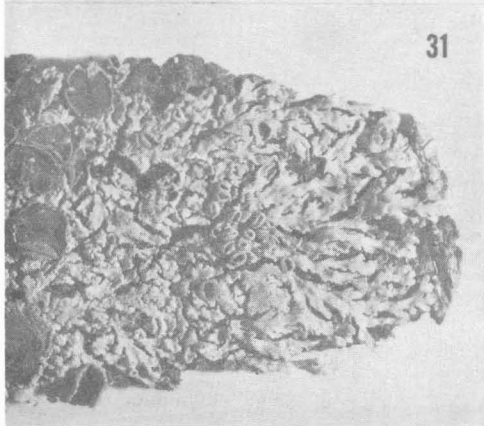
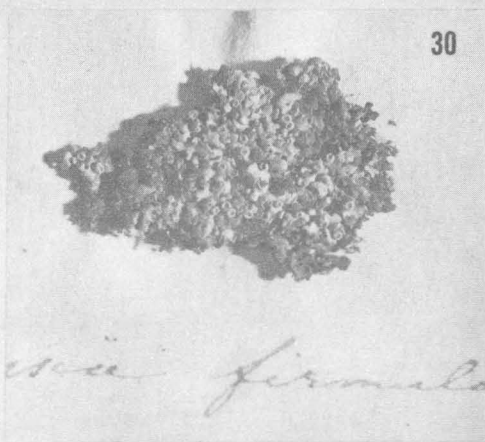
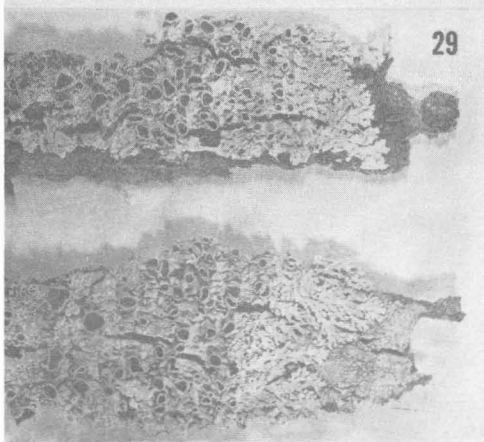
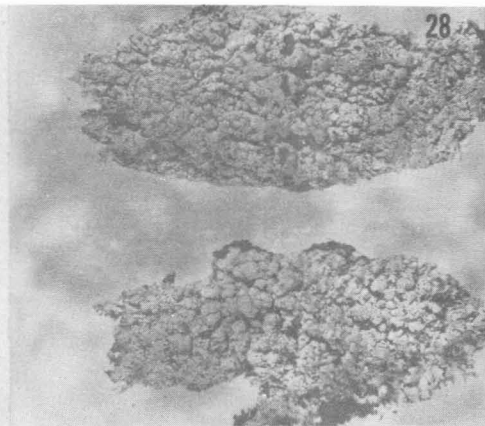
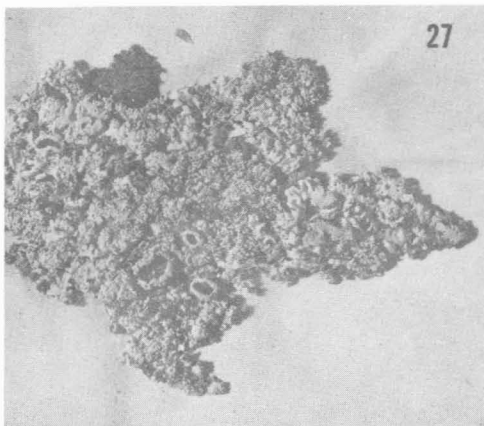
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