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# **LICHENS OF THE HIMALAYAS**

Part I

Lichens of Darjeeling and the Sikkim Himalayas

With 12 Plates

By

**GOVARDHAN LAL CHOPRA, M.Sc.,**

Department of Botany, Panjab University

With a Foreword

by

**HARAPRASAD CHAUDHURI,**

Reader in Botany, Panjab University

Published by

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1934



## Foreword.

The publication of a hand-book of Indian Lichens needs no apology, as no such volume has so far been published. Stray references to Indian Lichens have, however, been made from time to time by European Lichenologists. These are primarily based on the collections made by Hooker and Thompson, and references may be found in Engler and Prantl's *Pflanzenfamilien*, 1926, Nylander's *Synopsis Methodica Lichenum*, 1858-60, and in other books. The specimens described in this volume were mostly collected during the two excursions to Eastern Himalayas and Tibet led by Professor Shiv Ram Kashyap, D.Sc., I.E.S., in which Mr. Chopra accompanied him up to Gangtok. These along with a few other collections in the departmental herbarium have been described by Mr. Chopra under my supervision. In this volume 80 species belonging to 38 genera and 20 families of the Ascolichens have been described. Basidiolichens have not been found, they being generally restricted to the tropics.

Many of these specimens were sent to Miss A. L. Smith and Professor A. Zahlbruckner for identification. Miss Smith published a list of the lichens sent to her in the *Transactions of the British Mycological Society*, December, 1931. She described a new species *Anzia physoidea*, A. L. Sm., and three new varieties, viz. *Pyxine retirugella*, Nyl. var. *subtestacea*, A. L. Sm., *Pyxine retirugella*, Nyl. var. *macrotheca*, A. L. Sm., and *Bacidia* (Weitenwebera) *humana*, A. Zahlbr. var. *rugosa*, A. L. Sm. Professor A. Zahlbruckner found a new genus *Chaudhuria*, A. Zahlbr. among the specimens sent to him. Descriptions of the new genus and the type species *Chaudhuria indica*, A. Zahlbr. have been published by him in *Annales Mycologici*, XXX, 5/6, 1932. To both Miss Smith and Professor Zahlbruckner, I express my indebtedness for kindly examining such a large number of specimens.

In conclusion, I hope that the publication of this illustrated little volume will create an interest in, and stimulate the study of, the almost unexplored and inexhaustible store of lichens in India and that Indian Botanists will take up the study of this altogether neglected but very interesting group of plants.

LAHORE,  
1st May, 1934.

H. CHAUDHURI.

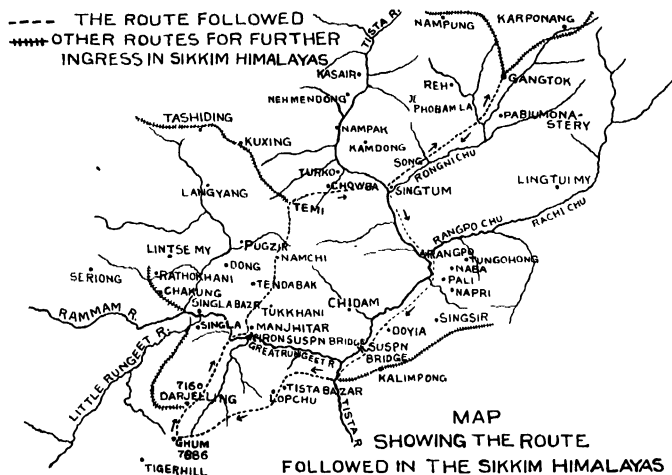
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# Introduction.

Lichens described in this book have been mainly collected from (1) Darjeeling and its suburbs in the outer Sikkim Himalayas and (2) a part of the Sikkim territory up to Gangtok, the capital of the State, including the valleys of the Great Ranjit, the Timmi, the Rangpu, and the Tiesta rivers. The route followed is shown in the accompanying text-figure. During train journey from Siliguri to Darjeeling specimens were collected wherever convenient. A few specimens collected from Calcutta (New Lake) and the Salt Marshes by the writer are also described. Besides, some interesting species, not seen by the writer in the Sikkim Himalayas but collected by Dr. Chaudhuri and Mr. A. C. Joshi from Kashmir and Dr. E. Blatter from Waziristan, are also included.



Lichens were seen in all these parts by the writer in living condition and collections made with proper notes as to their habit, habitat, colour, etc. Direct light, moderate or cold temperature, constant moisture, and pure atmosphere favour lichen growth. Scanty precipitation and hot and dry

summer, as in the Punjab plains, are entirely unfavourable for their growth, though one may occasionally find some crustaceous forms like *Endocarpon pusillum* Hedw., encrusting walls in moist shady places. Conditions almost similar prevail in the valleys where the temperature is fairly high and the rainfall as low as 20" annually. Only a few crustaceous species of *Lecanora* and *Physcia* were collected from the rocks and trunks of *Shorea robusta* in the valleys of the Great Ranjit and the Tiesta. A simultaneous increase in their number and species occurs, proportional to the height as we ascend higher, till between 4,000–8,000' above sea-level they thrive best. Darjeeling and its suburbs, with an altitude varying from 6,000 ft. (Victoria Fall) to 7,852 ft. (Tiger Hill) and situated in the sub-tropical zone between 27° north and 87° 15' east with an annual rainfall of 122 inches are an ideal place for their collection and systematic study. There is no rock, tree or paling which has escaped their invasion. Even the short wooden poles along the road side offer them a good home and are seen bedecked with various forms of crustaceous, fruticose or foliose lichens, displaying their resplendent hues. At Gangtok with an altitude of 5,500 ft. and an annual rainfall of 133 inches the climatic conditions are almost similar to those of Darjeeling, and the lichen flora is quite rich. On the way to Gangtok, however, the lichens are not very abundant, attaining a tolerable profusion between Namchi and Timmi in wooded forests.

In all these places we find arboreal (on trees), saxicolous (on rocks), and terricolous (on ground) lichen communities. Some of these show great variation in their external form, colour, presence or absence of soredia, apothecia, etc., at different altitudes and habitat. It is, therefore, very difficult to be definite, by examining scanty material in the herbarium as to whether a certain specimen is a new species or only a variety of some known one. The range of variability, for instance, shown by *Cladonia furcata* var. *pinnata* affords a very good example. In extreme moist conditions and in

dripping water on the Ghum Road it is sterile and is found to occur in corymbose clusters. The podetia vary up to 4 inches in length, are white in colour and beset with innumerable small squamules. At Tiger Hill, in more exposed situations the same species rarely attains a height of 1½ inches, is fertile, greyish green in colour and bears only a few squamules on the podetia.

The colour of the thallus is of various shades, differing in moist and dry conditions. On soaking in water the gelatinous cell walls swell up rendering the tissues more transparent and the green or blue colour of the underlying gonidia more evident. In some cases, however, the colouring is of a subdued tone, varying from bluish grey to ash grey. Brilliant yellow and white thalli are also of not uncommon occurrence. Black lichens are rather rare and are represented by a single specimen of *Gyrophora cylindrica* in the writer's collections.

*Type of thalli.*—Ascolichens exclusively constitute the lichen-flora of Darjeeling and the Sikkim Himalayas. Almost all the types of thalli, i.e. crustaceous, fruticose, stratoserate, foliose, and squamulose are met with here, with their corresponding dorsiventral or radial structures, which are given in greater details in their proper places in the description of the species.

*Reproductive organs.*—These ascolichens produce their spores in fruits—*apothecia* or *perithecia*—as in ascomycetes. In many, spores inside *pycnidia* are also produced. *Apothecia* are rounded cup-shaped structures with open discs and show a great variation in their beautiful colour from reddish, reddish-brown, yellow to black in different genera. The simplest types of apothecia consist of fungal elements alone and are met with in Lecidaceæ, Gyrophoraceæ, Cladoniaceæ, etc. The disc may be soft and bright in colour or it may be hard and black and formed of asci containing spores and some sterile filaments known as paraphyses. The asci and paraphyses together constitute the hymenium, and the projecting ends of paraphyses make up the epithecium. The region below

the hymenium is termed hypothecium. Iodine and KOH solution impart various colourations to the hymenium from blue, violet green, deep blue to purple, etc. These reactions are very important and sometimes made use of as criterion in the determination of the species. In Lecanoraceæ, Parmeliaceæ, and Physciaceæ, etc., the apothecium is highly developed inasmuch as the gonidial cells of the thallus also take part in the formation of the apothecial margin. In Graphidineæ the apothecia are linear (lirellate), narrow slit representing the disc. In Coniocarpineæ the most primitive types of the apothecia of the Mazædium type are met with. These are more or less closed structures, sessile or borne on short stalks. The asci dissolve early, and the spores lie in a powdery mass in the apothecial cavity. *Perithecia* are generally globose or ovoid structures either embedded entirely in the thallus and surrounded by hyphæ or open by a small ostiole at the apex. Such fructifications are found in the primitive families, e.g. Dermatocarpaceæ and Pyrenulaceæ, etc. *Pycnidia* are invariably seen in almost all the families of the lichens. They occur either as small black dots on the surface of the laciniae or lobes of the thallus as in Physciaceæ, Dermatocarpaceæ, etc., or restricted to the margins of the lobes as small conical protuberances as in *Anzia physoidea* and *Parmelia cristifera*. Generally they are black in colour. In Cladoniaceæ they are associated with apothecia and very often replace them from the margins of the scyphiferous podetia as in *Caldonia furcata* var. *pinnata*. They contain minute cylindrical or fusiform spermatia borne on a simple or branched sterigmata.

*The algal constituents* belong either to the blue-green Myxophyceæ or the green Chlorophyceæ. The former includes *Nostoc*, *Stigonema*, *Rivularia*, *Glæocapsa*, etc., and the latter *Protococcus*, *Cladophora* or *Trentipohlia*, etc. The gonidia or the algal units may be distributed uniformly in the thallus (homoiomorous) as in the Collemaceæ and other gelatinous lichens or they may be restricted to a region just below the upper cortex (heteromorous) as in Parmeliaceæ and othe.

families. As a result of symbiotic life with the fungus, the algal cells may become modified in appearance by loss of colour or change in form or habit.

*Vegetative reproduction in lichens.* In addition to the dissemination of fungal spores by wind and their chance encounter with the requisite algæ, lichens spread by breaking off, of small portions of the thallus, by gemma-like soredia and isidia.

*Soredia.* They are small, powdery granules, consisting of one or several algal cells, surrounded by lichen hyphæ. They occur as greyish white or greyish green crust on the trunks of trees or the soil representing the initial stage of the thallus formation. They are very common on the podetia of *Cladonia* species occurring as greyish-white granules and unfrequently develop into small squamules in extremely moist conditions. In *Parmelia* and *Physcia* species also they are not rare and sometimes occur as small white pustules known as *soralia*.

*Isidia.* They are small conical warts of variable colour and consist of algal cells and hyphal elements like those of soredia, but differ from the latter inasmuch as they are not naked but covered by a cortex.

*Cephalodia.* They are small, dark-coloured swellings, tubercles or warts on the surface of many lichens and are composed of ordinary lichen hyphæ and gonidia. Gonidia, however, differ from those of the lichen thallus on which they occur and are usually blue-green, i.e. *Nostoc* or *Stigonema*. They are quite common in *Stereocaulon ramulosum* and *St. alpinum*.

*Classification.* The arrangement of the families and genera followed in this book is the same as adopted by A. Zahlbruckner in Engler Prantl: Die Naturlichen Pflanzenfamilien (1926), beginning with the Pyrenocarpeæ in which the fruit is more primitive followed by the Gymnocarpeæ with the three subseries in their order of development, viz. (1) Coniocarpineæ with mazædium type of fruit, (2) Graphidineæ with

lirellate fruits, and (3) Cyclocarpineæ with cup-shaped open fruit. In Cyclocarpineæ the more primitive families like Lecidaceæ and Cladoniaceæ, etc., with lecidine fruits precede those with lecanorine fruits, i.e. Parmelliaceæ, Usneaceæ, and Physciaceæ, etc.

The new genus Chaudhuria has been placed in a separate group 'Anomalous', as its characters do not fit in *so far* with any other known family. The descriptions of the new genus and species and discussion on the same, as given by Prof. Zahlbruckner, have been given. The sketches of the new species are also given after him.

For identification of genera, the key given in Miss Smith's Lichens, 1921, will be found very useful.

## SYNOPSIS.

(The species not collected from Darjeeling and the Sikkim Himalayas are marked with an asterisk \*.)

Class—LICHENES.

Subclass—ASCOLICHENES.

Series I—PYRENOCARPEÆ.

Family I—*DERMATOCARPACEÆ*.

Genus I—**Dermatocarpon.**

Species 1. *D. miniatum* var. *complicatum*.

2. *D. moulinsii*.\*

3. *D. rufescens*.\*

Genus II—**Endocarpon.**

4. *E. pusillum*.\*

Family II—PYRENULACEÆ.

Genus III—**Anthracothecium.**

5. *A. variolosum*.

Series II—GYMNOCARPEÆ.

Subseries I—CONIOCARPINEÆ.

Family III—*CYPHELIACEÆ*.

Genus IV—**Tylophoron.**

6. *T. moderatum*.

Subseries II—GRAPHIDINEÆ.

Family IV—*GRAPHIDACEÆ*.

Genus V—**Graphis.**

7. *G. scripta*.

Genus VI—**Graphina.**

8. *G. acharii*.

**Genus VII—Phæographina.**9. *Ph. exserta*.**Family V—CHIODECTONACEÆ.****Genus VIII—Chiodecton.**10. *C. phillipinum*.**Subseries III—CYCLOCARPINEÆ.****Family VI—PYRENOPSISIDACEÆ.****Genus IX—Thyrea.**11. *T. pulvinata*.\***Family VII—COLLEMACEÆ.****Genus X—Collema.**12. *Collema sp.*\***Genus XI—Leptogium.**13. *L. menziesii*.\*14. *L. menziesii* f. *fuliginosum*.15. *L. cæsium*.16. *L. palmatum*.17. *L. moluccanum*.18. *L. trichophorum*.\***Family VIII—PANNARIACEÆ.****Genus XII—Coccocarpia.**19. *C. pellita*.**Family IX—STICTACEÆ.****Genus XIII—Lobaria.**20. *L. pulmonaria*.**Family X—PELTIGERACEÆ.****Genus XIV—Peltigera.**21. *P. canina*.22. *P. venosa*.\*

Genus XV—**Nephroma.**23. *Nephroma* sp.\*Genus XVI—**Solorina.**24. *S. crocea*.\*Family XI—**LECIDEACEÆ.**Genus XVII—**Lecidea (Psora).**25. *L. decipiens*.\*Genus XVIII—**Bacidia.**26. *B. hunana* var. *rugosa*.27. *B. luteola*.Genus XIX—**Rhizocarpon.**28. *R. geographicum*.\*Genus XX—**Lopadium.**29. *Lopadium* sp.Family XII—**CLADONIACEÆ.**Genus XXI—**Bæomyces.**30. *B. roseus*.Genus XXII—**Cladonia.**31. *C. pyxibata*.\*32. *C. furcata* var. *pinnata*.33. *C. squamosa* var. *muricella*.34. *C. pityrea*.Genus XXIII—**Stereocaulon.**35. *St. ramulosum*.36. *St. arbuscula*.37. *St. alpina*.Family XIII—**GYROPHORACEÆ.**Genus XXIV—**Gyrophora.**38. *G. cylindrica*.Family XIV—**PERTUSARIACEÆ.**Genus XXV—**Pertusaria.**39. *P. multipuncta*.

Family XV—*LECANORACEÆ*.Genus XXVI—*Lecanora*.

- 40. *L. (Placodium) chrysoleuca*.\*
- 41. *L. subfusca*.
- 42. *L. subfusca* var. *chlarona*.\*
- 43. *L. rugosa*.
- 44. *L. carnulenta*.
- 45. *L. coilocarpa*.
- 46. *Lecanora* sp.

Genus XXVII—*Hæmatomma*.

- 47. *H. puniceum*.

Family XVI—*PARMELIACEÆ*.Genus XXVIII—*Parmelia*.

- 48. *P. kamtschadalis*.
- 49. *P. cetrarioides*.
- 50. *P. latissima* var. *sorediata*.
- 51. *P. latissima* f. *isidiosa*.
- 52. *P. latissima* f. *marmariza*.
- 53. *P. tinctorum*.
- 54. *P. homogens*.
- 55. *P. conspersa*.
- 56. *P. cristifera*.
- 57. *P. nilgherriensis*.
- 58. *P. sp.*

Genus XXIX—*Anzia*.

- 59. *A. physoidea*.

Family XVII—*USNEACEÆ*.Genus XXX—*Evernia*.

- 60. *E. furfuracea*.

Genus XXXI—*Ramalina*.

- 61. *R. farinacea*.

Genus XXXII—**Usnea.**62. *U. florida.*63. *U. comosa.*64. *Usnea* sp.Genus XXXIII—**Siphula.**65. *S. ceratites.*Family XVIII—**BUELLIACEÆ.**Genus XXXIV—**Rinodina.**66. *R. sophodes.*Family XIX—**PHYSIACEÆ.**Genus XXXV—**Pyxine.**67. *P. cocoes* var. *sorediata.*68. *P. coccifera.*69. *P. retirugella* var. *subtestacea.*70. *P. retirugella* var. *macrothecia.*Genus XXXVI—**Physcia.**71. *Ph. setosa.*72. *Ph. hispida.*Genus XXXVII—**Anaptychia.**73. *A. leucomelæna.*74. *A. podocarpa.*75. *A. speciosa.*76. *A. hypoleuca.*77. *A. hypoleuca* var. *sorediifera.*78. *A. dendritica.*79. *A. corallophora.*XX. Group—**ANOMALUS.**Genus XXXVIII—**Chaudhuria.**80. *C. indica.*

### Series I—PYRENOCARPEÆ.

Thallus foliose, squamulose or variously crustaceous, sometimes obsolete. Perithecia immersed in the thallus or more or less superficial, scattered or united in a stroma, the outer wall soft and waxy or carbonaceous, contents soft and mucilaginous, enclosing occasionally hymenial gonidia; paraphyses simple or branched, sometimes disappearing or altogether wanting.

### Family I—DERMATOCARPACEÆ.

Thallus spreading, foliaceous or squamulose or subcrustaceous, corticated on one or both the surfaces or non-corticated, under-surface naked or with rhizinæ. Perithecia simple more or less immersed in the thallus, opening by a pore at the apex. Spermatogones with short straight spermatia.

#### I. Dermatocarpon Th. Fr.

*Dermatocarpon* Th. Fr. Gener. Heterolist, 1861. (Smith. II, 267.)

Thallus leafy or squamulose, corticated on both the surfaces or only on the upper surface, sometimes with rhizinæ. Algal cells *Pleurococcus*. Perithecia simple, immersed in the thallus, globose or ovate with a projecting ostiole; paraphyses usually mucilaginous and cohering or sparingly developed and branched. Asci 8–16-spored; spores simple, colourless. Spermatogones divided into hollow chambers, opening by slits.

#### *Key to the species.*

|                                                                       |                                                   |
|-----------------------------------------------------------------------|---------------------------------------------------|
| Thallus foliose, ashy grey, attached centrally . .                    | <i>D. Moulinsii</i> .                             |
| Thallus squamulose, reddish-brown, sterile . .                        | <i>D. rufescens</i> .                             |
| Thallus lobed, lobes cæspitose, imbricate and<br>complicate, sterile. | <i>D. miniatum</i> .<br><i>var. complicatum</i> . |

**1. *Dermatocarpon miniatum* var. *complicatum* Th.**

Fr. 1860. A. Zahlbr. Cata. Lich. Univ. (Smith.  
II, 267.)

Thallus ascending, ashy grey or whitish when dry and bluish green in water, coriaceous with large numerous densely cæspitose lobes, imbricate and complicate, slightly crenate, minutely granular pruinose; under-surface whitish and uncorticated, upper surface of one row of plectenchymatous cells with vertical rows of gonidia underlying and interspersed in the medulla; the ultimate medullary hyphæ protrude downwards in the soil and serve as fixing organs. Preithecium absent.

*Hab.* On dry rocks in mountainous regions.

*Loc.* Waziristan, altitude 2,650 ft. Col. Rev. E. Blatter,  
March, 1927.

**2. *Dermatocarpon moulinsii* (Mont) A. Zahlbr. Cata.  
Lich. Univ. (Smith. Tran. Brit. Myc. Soc., Dec., 1931.)**

Thallus foliose, densely dissected, rather thick and coriaceous, margin crenate and incurved; upper surface tawny brown, beneath black covered with furfuraceous rhizinous felt or sometimes naked; corticated on both sides, cortex plectenchymatous with *Pleurococcus* gonidia lying beneath the upper cortex in vertical rows. Perithecia numerous, minute, scattered all over the surface, blackish, immersed in the thallus or opening by a small brownish ostiole. Perithecia in vertical section show a globose or an ovate outline; periphery lined with hyphæ and the cavity filled with mucilaginous unbranched paraphyses; asci clavate with 8 spores; spores colourless, small, ellipsoid or oblong, measuring 11–14  $\mu$  in length and 5–7  $\mu$  in thickness.

*Hab.* On exposed and dry rocks.

*Loc.* Kausernag, Kashmir, altitude 12,000 ft., Col.  
A. C. Joshi; Verinag, Kashmir, altitude 7,000 ft.,  
Col. H. Chaudhuri, June, 1922; Katra, Vaishnu-  
devi, altitude 2,000 ft., Col. G. L. Chopra, Aug.

1931. Simla, Taradevi and Mashobra Road, altitude 6,000–7,000 ft., Col. G. L. Chopra, September, 1931.

3. **Dermatocarpon rufescens** (Arch.) A. Zahlbr. Eng. Prant. Die Natur. Pflanzen. Band 8, p. 71. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus coriaceous, squamulose, brownish red, the squamules brown, contiguous, crenate, appressed and adnate. Transverse section of the thallus shows the usual structure. Apothecia and spermogones absent.

*Hab.* Terrestrial.

*Loc* Waziristan, altitude 400–5,000 ft., Col. Rev. E. Blatter, March, 1927.

*Note.*—In the absence of the fructifications the determination is rather doubtful, though in all external characters, the specimen shows great resemblance to the above species.

## II. **Endocarpon** Hedw.

*Endocarpon* Hedw. Descript. et Adumbr. Muscor. Frondos, II, 1788, p. 56. (Smith. II, 274.)

Thallus squamulose or almost crustaceous, corticated on both surfaces or only on the under-surface, sometimes rhizinose beneath. Algal cells *Pleurococcus*. Perithecia simple, immersed in the thallus, globose or ovate with a more or less prominent ostiole and hymenial gonidia; paraphyses mucilaginous, disappearing; asci 1–6- usually 2-spored; spores ellipsoid-elongate, muriform, at first colourless, becoming dark-brown.

4. **Endocarpon pusillum** Hedw. Eng. Prant. Die Natur. Pflanzen. Band 8, p. 73. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus squamulose, greyish, the squamules scattered or crowded, small, closely adnate to the substratum, the margin

slightly raised and crenate; upper surface corticated with Pleurococcus gonidial cells beneath, medulla of compact cellular hyphæ, lower cortex present. Perithecia minute, black, with a prominent black ostiole; hymenial gonidia small; spores 2 in the ascus, oblong, colourless to brown in colour, slightly constricted in the middle, muriform and multicellular, 30–39  $\mu$  long and 18  $\mu$  thick.

*Hab.* On walls.

*Loc.* Gujranwala, Punjab, altitude 600 ft., Col. G. L. Chopra, June, 1927.

---

### Family II—PYRENULACEÆ.

Thallus crustaceous, superficial or developed within the substratum. Algal cells *Trentipohlia*. Perithecia globose or semiglobose, more or less immersed, opening by a pore at the apex (ostiole). Spermogones small, globose or ovoid, with simple or slightly branched apical spermatia.

### III. Anthracothecium Hamp. auped Musse.

*Anthracothecium* Hamp. auped Musse., in Atti. J.R. 1st veneta, Ser. 3, 1860, p. 330. (Smith. II, 342.)

Thallus crustaceous, superficial or hypophlœodal. Perithecia simple, scattered or coherent, more or less immersed, globose or somewhat angular with entire perithecial wall; paraphyses unbranched, free; spores 1–8 in the ascus, elongate or ellipsoid, colourless or brown, muriform, the cells containing lentiform, round or angular guttulæ. Spermogones small, spermatia thread-like, bent.

#### 5. *Anthracothecium variolosum* Mull. Arg. Eng.

Prant. Die Natur. Pflanzen. Band 8, p. 81.

(Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus crustaceous, epiphylœodal, olivaceous yellow, cracked areolate, waxy and somewhat shiny. Gonidial cells

*Trentipohlia*. Perithecia numerous, situated in verrucæ, scattered solitary or coherent, globose more or less immersed, black, shining, opening by a small apical ostiole. Vertical section of the perithecium shows a thick perithecial wall enclosing the hymenium; hymenium turning golden with iodine; asci clavate with 2-4 large spores; spores large, measuring 62-128  $\mu$  in length and 21-32  $\mu$  in thickness, varying very much in form and size, ellipsoid or slightly curved, colourless usually becoming brown, septate, with 1-5 distinct septa and several indistinct ones, muriform, the walls between the cells swollen and indistinct, the individual cell visible only as a separate globose guttule. Paraphyses numerous filling the whole perithecial cavity, slender and free.

*Hab.* On the bark of trees.

*Loc.* Darjeeling and its suburbs, altitude 6,000-7,000 ft.,  
Col. G. L. Chopra, July, 1930.

---

### Series II—GYMNOCARPEÆ.

This series is characterized by fruits with more or less open disc.

#### Subseries—CONIOCARPINEÆ.

Thallus crustaceous or wanting or fruticose. Algal cells *Protococcus*, *Pleurococcus*, *Stichococcus* or *Trentipohlia*. Fruit a stalked or sessile apothecium with a capitulum open or partially closed; asci usually cylindrical, dissolving early so that the spores as they mature lie loose in the apothecium in a powdery mass forming a mazædium.

### Family III—CYPHELIACEÆ.

Thallus crustaceous, horizontally expanded, effigurate, uncorticated with *Pleurococcus*, *Protococcus* or *Trentipohlia* gonidial cells. Fruit sessile with marginate or immarginate receptacle.

IV. *Tylophoron* Nyl.

*Tylophoron* Nyl. in Bot. Zeitung, XX, 1862, p. 279.

Eng. Pr. Pf. 8: 100.

Thallus membranaceous, crustaceous or evanescent with Trentipohliial gonidial cells. Fruit at first ball-like situated in the thalline warts, then globose, scarcely cylindrical to cup-shaped, with open disk; receptacle with thalline margin; hypothecium bright or black; asci cylindrical 8-spored in one row; spores 2, seldom 3-celled, rarely spherical, elliptical to spindleform with small scarcely four-cornered flabellum and thick epispore. Conceptacle of the spermogone sunken in the thallus, with distinct partition, sterigmata cylindrical, slightly branched; pycnidio-spores linear and straight.

6. *Tylophoron moderatum* Nyl. Eng. Prant. Die Natur. Pflanzen. Band 8, p. 100. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus crustaceous, membranaceous. Gonidial cells *Trentipohlia*. Bluish grey, verruculose, surface pruinose. Apothecia numerous, situated in the thalline warts, crowded or solitary, subsessile; disc black with globose mass of spores projecting upwards; margin whitish; asci disappear earlier, consequently liberating the spores *en masse* and filling the whole apothecial cavity; spores small, brownish black, 1-septate, ellipsoid to spindleform, measuring 9–13  $\mu$  in length and 5–7  $\mu$  in thickness.

The spores are liberated in such an abundance as to make the thallus blackish and finger black on touching the plant.

*Hab.* On bark of trees.

*Loc.* Sikkim on the banks of the River Timi, altitude 800–1,000 ft., Col. G. L. Chopra, July, 1930.

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Subseries II—GRAPHIDINEÆ.

Thallus shrubby or crustaceous, sometimes hypophlœodal, often indistinct and obsolete. Algal cells Chlorophyceæ

(*Trentipohlia*). Apothecia roundish or irregular (Ardellæ) or linear (lirellæ), immarginate or with a proper margin only.

#### Family IV—GRAPHIDACEÆ.

Thallus crustaceous. Algal cells *Trentipohlia* or rarely *Palmella*. Apothecia usually linear, rarely oblong or oval, simple or branched, sessile or erumpent, marginate; paraphyses simple or branched; asci elongate, clavate; spores simple or variously septate or muriform, colourless or coloured.

#### V. *Graphis* Mull. Arg.

*Graphis* Mull. Arg. in Memoir Soc. Phys. et Hist. Natur. Geneve XXIX, No. 8, 1887, p. 28. (Smith. II, 246.)

Thallus crustaceous, thin, superficial or developed under the bark. Algal cells *Trentipohlia*. Apothecia elongate, rarely roundish, immersed then erumpent, simple or branched; disc narrow and slit-like, rarely somewhat plane; proper margin tumid, prominent, furrowed or even; hypothecium colourless or dark coloured; asci clavate or elongate, usually 8-spored; spores colourless elongate, pluriseptate, the cells transversely lentiform.

#### 7. *Graphis scripta* Ach. (1810). Lich. Univ., p. 265 (1810). (Sm. II, 248.)

Thallus thin, membranaceous or subtartareous, greyish white, even or wrinkled, effuse or limited by a black line. Apothecia elongate, slender, immersed, then erumpent, the thallus forming an outer white margin or becoming superficial or prominent, straight or curved, simple or branched; margins narrow, elevated, often wavy and crisp; apothecial wall thick and black, colourless at the base; paraphyses slender, slightly swollen and brown at the tips; spores colourless, sometimes becoming brownish, elongate-cylindrical 7–10-septate, 20–45  $\mu$  long and 7–10  $\mu$  thick.

*Hab.* On bark of trees.

*Loc.* Darjeeling and its suburbs, altitude 6,000–7,000 ft. ;  
Sikkim, altitude 400–5,000 ft., Col. G. L. Chopra,  
July, 1929 and 1930.

## VI. *Graphina* Mull. Arg.

*Graphina* Mull. Arg. in Flora LXIII (1880), p. 22.  
(Smith. II, 255.)

Thallus crustaceous, thin, epiphylloidal or hypophylloidal. Apothecia (lirellæ) elongate, immersed in the thallus, or superficial, simple or branched, disc narrow and slit-like, proper margin tumid, prominent, furrowed or simple ; hypothecium colourless or black ; asci clavate or elongate, usually 8-spored ; spores rather large, colourless or muriform.

8. *Graphina acharii* (Fee) Mull. Arg. Eng. Prant.  
Die Natur. Pflanzen. Band 8, p. 115. (Smith. Tr. Br.  
My. Soc., Dec., 1931.)

Thallus crustaceous, thin, greenish white, tartaraceous, minutely warted and wrinkled. Algal cells Trentipohlia. Caustic potash and calcium chloride have no colour reaction. Apothecia numerous, crowded, variable in size and direction, curved, simple or branched ; disc slit-like, more or less dark coloured, slightly tapering towards the ends, proper margin well developed, black, and elevated, sometimes dimidiate ; hypothecium colourless ; epithecium black ; spores colourless, muriform, 2-3 in the ascus, measuring 85–128  $\mu$  in length and 15–40  $\mu$  in thickness.

*Hab.* On bark.

*Loc.* Darjeeling and its suburbs, altitude 6,000–7,000 ft. ;  
Martung, Gangtok Road, Sikkim, altitude 4,000–  
5,000 ft., Col. G. L. Chopra, July, 1929 and 1930.

## VII. *Phæographina* Mull. Arg.

*Phæographina* Mull. Arg. in Flora LXV (1882), p. 336.  
Eng. Pr. Pf. 8 : 116.

in all other respects except the colour of the spores which is brown in this case rather than white as found in *Graphina*.

9. *Phæographina exserta* Mull. Arg. A. Zahlbr. Cata.  
Lich. Univ. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus crustaceous, superficial, greyish white, thin, slightly warted. Algal cells *Trentipohlia*. Apothecia numerous, distributed on the surface of the thallus or restricted to warts, rather small, curved with obtuse apices, proper margin white and crumpled; disc black, pruinose, hollowed out in the margins of the lirellæ; epithecium black; hypothecium brownish white; asci brownish black, curved with 8 spores; spores brownish, pleuriseptate, each cell guttulate, containing 2-3 lentiform guttulæ,  $74\ \mu$  long and  $22\ \mu$  thick, paraphyses unbranched, septate and tipped brownish.

*Hab.* On bark.

*Loc.* Darjeeling, altitude 6,500 ft., Col. G. L. Chopra,  
July, 1930.

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Family V—*CHIODECTONACEÆ*.

Thallus crustaceous. Algal cells usually *Trentipohlia*. Apothecia aggregate in specialized prominent stroma-like portions of the thallus (verrucæ), deeply immersed, immarginate, small and punctiform or elongate; asci elongate, clavate; spore elongate, pluriseptate.

VIII. *Chiodecton* Mull. Arg.

*Chiodecton* Mull. Arg. in Memoir Soc. Phys. et Hist.  
Natur. XXIX, p. 404 (1887). (Smith. II, 261.)

Thallus crustaceous, thin or often rather thick. Algal cells *Trentipohlia*. Apothecia black, immersed in the thalline verrucæ, aggregate or confluent; hypothecium thick, blackish brown; paraphyses slender, branched; asci clavate; spores elongate, fusciform, 2-pleuriseptate, colourless. Spermatogones with cylindrical straight or bent spermatia.

10. **Chiodecton phillippinum** Wain. A. Zahlbr. Cata.  
Lich. Univ. (Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Thallus crustaceous, epiphylloidal, rather thick, greenish grey, pulverulent, verruculose, furrowed, characterized by elongate, elevated and more or less channeled warts, outline cretaceous. Algal cells *Trentipohlia*. Apothecia and spermogones absent.

*Hab.* On bark of palms, and *Coccus nucifera*.

*Loc.* Calcutta, New Lake, Royal Botanical Gardens, Col.  
G. L. Chopra, July, 1930.

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### Subseries III—CYCLOCARPINEÆ.

Thallus crustaceous, squamulose, foliose or fruticose. Algal cells bright green (*Chlorophyceæ*) or blue-green (*Myxophyceæ*). Fruit a roundish, open or partially closed apothecium, marginate or immarginate, the margin composed of hyphæ alone or including gonidia as well; asci and spore various.

The Cyclocarpineæ include a large and varied series of lichens that differ widely in character of thallus and fruits. Most of the families contain bright green algal cells, arranged in a definite zone (heteromerous). Only in a few families the gonidial cells are blue-green (*Myxophyceæ*) and are distributed uniformly in the thallus (homoimerous). Most of the families containing blue-green algal cells are gelatinous.

### Family VI—PYRENOPSISIDACEÆ.

Thallus gelatinous when moist, crustaceous or partly squamulose or minutely fruticose, non-corticated. Algal cells *Myxophyceæ* (*Glæocapsa* or *Chroococcus*). Apothecia small, open or sub-immersed and partly closed. Spores 8 in the ascus, colourless, simple or rarely septate. Spermogones with minute ovate or elongate acrogenous spermatia. The algal cells are generally enclosed in a mucilage sheath.

**IX. Thyrea Mass.**

*Thyrea* Mass. in Flora XXXIX (1856), p. 210.

Eng. Pr. Pf. 8: 158.

Thallus foliose, monophyllous, rarely entire, shield-shaped or indented and broad to small-lobed, with a notch at the tip, under-surface fixed. Algal cells *Xanthocapsa*. Apothecia sunk or somewhat prominent, glossy, often with a narrow disc, with thick thalline margin; asci 8–24-spored; spores ellipsoid, 1-celled, with thin septa.

11. ***Thyrea pulvinata*** (Schacr.) Mass. in Flora XXXIX (1856), p. 210. Eng. Pr. Pf. 8: 158.

Thallus foliose, monophyllous but profusely lobed and dissected, black when dry but becomes bluish black in water. Transverse section of the thallus shows absence of cortex on both sides. Algal cells *Xanthocapsa* enclosed in yellow sheath. Apothecia absent.

*Hab.* On rocks.

*Loc.* Waziristan, altitude 4,000–5,000 ft., Col. Rev. E. Blatter, March, 1927.

**Family VII—COLLEMACEÆ.**

Thallus gelatinous when moist, crustaceous or foliaceous, mostly homoiomerous, corticated or non-corticated, sometimes with rhizinae on the under-surface. Algal cells *Nostoc*. Apothecia partly closed or open, immersed or sessile with or without a thalline margin; spores usually 8 in ascus, varying in form, simple septate or muriform. Spermatogones common.

**X. Collema Wigg. Prim.**

*Collema* Wigg. Prim. Fl. Hols., p. 89 (1780); emend. A. Zahlbr. in Engler and Prantl Pflanzen. i, p. 171 (1906).

(Smith. I, 48.)

Thallus variously lobed or squamulose or almost crustaceous. Swollen and gelatinous when moist, mostly

without rhizinæ, more or less appressed to the substratum, non-corticated. Algal cells distributed in the thallus (homoio-merous). Apothecia with a thalline margin which is sometimes of plectenchyma; hypothecium colourless, paraphyses simple, mostly septate and conglutinate; spores 8 in ascus, fusiform or ellipsoid, variously septate and becoming muriform. Spermogones with colourless walls and with septate sterigmata and pleurogenous minute spermatia.

12. **Collema** sp. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus foliaceous or lobed, appressed to the substratum, gelatinous, marginal lobes imbricate, narrow only 1·5–2 mm. broad with slightly crenate and tumid margin; in centre lobes very much crowded and complicated appearing only as bullate lobulii, scattered all over the surface. The surface lobulii are minute, erect, coralloid, obtuse and nodulose at the apices, congested in small cushion like masses, glossy and get detached easily from the main lobe. Black when dry and bluish green in water. Algal cells *Nostoc*, distributed throughout the thallus. Under-surface with unbranched and unseptate rhizoids. Spermogones present, restricted to the apices of the lobes. Apothecia absent.

The plant is very much identical with *Collema ceraniscum* Nyl. in appearance and morphological characters except the presence of fructifications which are altogether absent here.

*Hab.* On rocks.

*Loc.* Waziristan, altitude 2,650 ft., Col. Rev. E. Blatter, March, 1927.

**XI. Leptogium** S. F. Gray.

*Leptogium* S. F. Gray. Natur. Arr. i, p. 395 (1821).  
(Smith. I, 65.)

Thallus gelatinous when moist and black when dry, lobate, lobes minute and almost granular or large and spreading, corticated (plectenchymatous), homoio-merous. Algal cells *Nostoc* chains which may be distributed unformally through-

out the thallus or zoned. Apothecia cup-shaped with plectenchymatous thalline margin; hypothecium present and colourless; paraphyses simple, conglomerate; spores 8 in the ascus, blunt or pointed at the ends, 3-5 septate, muriform and colourless.

*Key to the species.*

- Thallus foliose, lead-black in colour, *L. menziesii*.  
 apothecia fairly large.
- Thallus spreading, laciniate, surface fuliginous, apothecia absent. *L. menziesii* f. *fuliginosum*.
- Thallus foliose, lobate, membranous, scabrid, beneath naked, apothecia rare. *L. cæsium*.
- Thallus foliose, laciniate, lacineæ shiny and with revolute margins. *L. palmatum*.
- Thallus broad and crisp at the circumference, crowded in the centre, beneath naked, sterile. *L. mollucanum*.
- Thallus foliose, lobes sinuate and crenate, apothecia rare, reddish brown, restricted near the margin. *L. trichophorum*.

13. **Leptogium menziesii** Mont. A. Zahlbr. Cata. Lich. Univ. (Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Thallus corticolous, foliaceous and spreading extensively, rather large, thickish and gelatinous when moist, more or less palmately divided; lobes smooth without any granules, bluish green, beneath densely tomentose a little away from the margin; lead black in dry condition but greenish blue in water, corticated (plectenchymatous) on both sides, cortex single layered. Gonodial cells Nostoc, Nostoc chains distributed throughout showing no trace of zonation. Medullary hyphæ loosely arranged, under-surface provided with groups of septate rhizineæ. Apothecia numerous, cup-shaped, reddish brown, moderate in size, 3-5 mm. in diameter; margin thin and entire; thalline margin plectenchymatous; hypothecium colourless with Nostoc chains interspersed in the hyphæ

below ; epithecium brownish black due to the conglomerate tips of the paraphyses. Spores 8 in the ascus, ellipsoid, muriform, 3-5 septate, measuring  $31\ \mu$  in length and  $13\ \mu$  in thickness, paraphyses slender, sparingly septate ; hymenium colouring deep blue with iodine solution.

*Hab.* On bark of trees near water, on moist rocks as well.

*Loc.* Verinag, Kashmir, altitude 7,000 ft., Col. H. Chaudhuri ; Tiger Hill, Darjeeling, altitude 7,852 ft., Mahanadi, altitude 4,120 ft., Col. G. L. Chopra.

14. **Leptogium menziesii f. fuliginosum** Mull. Arg.

A. Zahlbr. Cata. Lich. Univ. (Smith. Tr. Br.  
My. Soc., Dec., 1931.)

Thallus foliose, spreading, laciniate lobate, lobes subimbricate, sinuate and crisp at the margins, sub-erect, upper surface of bluish lead colour besprinkled with fuliginous crust ; under-surface bluish green with rhizine ; corticated (plectenchymatous) on both surfaces. Gonidial cells *Nostoc* chains interspersed uniformly in the narrow and compact medulla. Cephalodia present on the upper surface containing *Nostoc* chains. The thalline cortex is continuous with that of the cephalodia.

*Hab.* On moist stones as well as bark.

*Loc.* Mahanadi, D.H. Ry., altitude 4,120 ft., Col. G. L. Chopra, July, 1930.

15. **Leptogium cæsium** Vain. A. Zahlbr. Cata.

Lich. Univ. Eng. Pr. Pf. 8 : 172.

Thallus foliose, lobate, lobes moderate in breadth, membranaceous, margin crisp and undulated ; yellowish green in water, smooth near the circumference but scabrid and isidiose in the centre ; under-surface smooth without any rhizineæ. Gonidial chains of *Nostoc* interspersed uniformly throughout the medulla (homoiomorous). Apothecia generally rare, when present very few, minute in size 1-2 mm. in diameter, concave, becoming plane, reddish brown with a paler and thick entire

margin (plectenchymatous); epithecium brownish; hypothecium pale yellow; spores 8 in the ascus, fusiform, 3-5 septate, muriform, measuring 25-33  $\mu$  in length and 14-19  $\mu$  in thickness; paraphyses simple, unbranched, with swollen apices, slightly tipped brownish.

*Hab.* On bark.

*Loc.* Darjeeling, altitude 6,500 ft., Col. G. L. Chopra, July, 1930.

16. **Leptogium palmatum** Mont. A. Zahlbr. Cata.  
Lich. Univ. (Smith. I, 77.)

Thallus foliose, laciniate, lacineæ thin, long and narrow with revolute margins, crowded, greenish or glaucous green in water, bluish black when dry. Apothecia minute, subsessile, on the lobe, pale red, with entire prominent margin; spores ellipsoid or broadly fusiform and irregularly muriform, 30-42  $\mu$  long and 16-19  $\mu$  thick.

*Hab.* Among Mosses on moist stones.

*Loc.* Mahanadi, D.H. Ry., altitude 4,120 ft., Col. G. L. Chopra, July, 1930.

17. **Leptogium moluccanum** Vain. A. Zahlbr. Cata.  
Lich. Univ. Eng. Pr. Pf. 8: 172.

Thallus foliose, thin, membranaceous, outer lobes moderate in breadth with entire sinuate and crisp margins. In the centre, lobes smaller, very much crowded and overlapping each other, margins suberect and deeply wavy, glaucous brown in water and lead black when dry, under-surface with no rhizineæ. Apothecia not present.

*Hab.* On moist stones.

*Loc.* Mahanadi, D.H. Ry., altitude 4,120 ft., Col. G. L. Chopra, July, 1930.

*Note.*—The absence of fructifications makes the determination somewhat doubtful. In all other respects, however, the description tallies with that given in Nylander: *Synopsis Methodica Lichenum*.

18. **Leptogium trichophorum** Mull. Arg. A. Zahlbr. Cata. Lich. Univ. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus foliose, lobate, lobes broad, sub-imbricate, sinuate and crenate at the margins, lead blue in colour, bluish green near the margin, beneath black, tomentose. Apothecia numerous, up to 2 mm. across, subpedicillate, disc reddish brown, concave, margin thick, provided with lacerate narrow proliferations; epithecium brown, hypothecium pale, asci 8-spored; spores muriform, ellipsoid, fusiform, tapering at each end, 32–46  $\mu$  long and 11–16  $\mu$  thick, paraphyses conglutinate, tipped brownish, becoming blue with iodine.

*Hab.* On moist rocks.

*Loc.* Tiger Hill, Darjeeling, altitude 7,850 ft., Col. G. L. Chopra, July, 1930.

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#### Family VIII—PANNARIACEÆ.

Thallus not gelatinous when moist, heteromerous, granular, squamulose or foliose, with hypothallus and rhizineæ. Algal cells blue-green (Myxophyceæ), rarely bright-green. Apothecia disciform, with or without a thalline margin; paraphyses simple or rarely branched, spores 8 in the ascus, simple or septate, colourless or slightly brownish. Spermatogones with upright, septate sterigmata and pleurogenous spermatia.

#### XII. **Coccocarpia** Pers. Apud. Goudich.

*Coccocarpia* Pers. Apud. Goudich, Voy. Uranie Bot. (1826), 206. Eng. Pr. Pf. 8: 181.

Thallus scaly to leaf-like, one-many lobed, tomentose on the under-surface, corticated on both sides, upper surface of the thallus naked, upper cortex paraplectenchymatous. Algal cells *Scytonema*, lying immediately under the upper cortex, the gonidial chains gradually disappear in a thin layer of the medulla, the medulla is not sharply differentiated from the under-cortex which consists of thin-walled overlapping or anastomosing septate hyphæ. Apothecia black or dark-

brown, plane or convex, thalline margin absent ; hypothecium cellular, asci contain 8 spores, spores simple ellipsoid, colourless, paraphyses septate.

**Coccocarpia pellita** (Arch.) Mull. Arg., Eng. Prant.

Die Nat. Pflanzen., p. 181 (1926).

Thallus foliaceous, orbicular, coriaceous, sub-monophyllous, adnate, the surface marked with radiating lines and concentric shell-like conformations, often covered with bluish green tuberculose and isidiose warts, the outer margin broadly crenate ; dull greyish or leaden colour with a thickish rhizinose, bluish hypothallus. Transverse section shows an upper and lower plectenchymatous cortex, medulla rather narrow and compact, lower cortex provided with septate, panniform rhizinae. Algal cells blue-green. Apothecia rather few, black or dark-brown, plane or convex, sometimes confluent ; thalline margin absent, with only a thin proper margin ; hypothecium pale, cellular, epithecium black ; asci contain 8 spores, spores small, ellipsoid, colourless, measuring  $11\ \mu$ – $14.5\ \mu$  in length and  $3.5$ – $5.5\ \mu$  in thickness ; paraphyses septate, tipped blackish.

*Hab.* On moist stones as well as trees.

*Loc.* Mahanadi, altitude 4,100 ft. ; Sikkim, altitude 4,000 ft., Col. G. L. Chopra, July, 1930.

*Note.*—The above specimen named as *Coccocarpia pellita* shows great resemblance to *Coccocarpia plumbea* var. *myriocarpia* Nyl. Syn. Meth. Lich. II, p. 42, in having a crowdedly tuberculose-isidiose surface, more towards the centre of the thallus than the exterior and showing all gradations from smooth to tuberculose thallus even on the same specimen. The rhizinose hypothallus is very luxuriant, penniform and the apothecia are black to dark-brown in colour. In the light of all these points of resemblance the determination by Miss Smith as *C. pellita* seems to be rather doubtful as it was based on the examination of a piece of the thallus only and not the complete plant.

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Family IX—*STICTACEÆ*.

Thallus foliose, horizontal or somewhat ascending, corticated on both surfaces, beneath more or less tomentose. Cyphellæ (minute cup-like depressions) or pseudocyphellæ (opening in the cortex), constant on the under-surface in *Sticta*. *Cephalodia* present in certain species. Algal cells blue-green or bright-green. Apothecia marginal or scattered, scutellate and shortly stalked or sessile; paraphyses simple, septate. Spores elongate, 2-pluri-septate, colourless or brown. Spermatogones with septate sterigmata and short pleurogenous spermatia.

**XIII. *Lobaria* Schreb.**

*Lobaria* Schreb. L. Gen. Pl. ii, p. 768 (1791). (Smith. I, 112.)

Thallus foliose, broadly spreading, horizontal or partly ascending, cortex on both surfaces, plectenchymatous, tomentose below. Algal cells *Nostoc*, *Cystococcus* or *Protococcus*. *Cephalodia* sometimes present. Apothecia at first almost closed, then discoid, marginate, generally with gonidia in the margin; paraphyses simple, septate; spores 8 in the ascus, elongate, 1-9-septate, colourless or brown.

20. ***Lobaria pulmonaria* Hoffm.** Deutchl. Fl. ii,  
p. 146 (1795). (Smith. I, 115.)

Thallus foliose, attached to the substratum, more or less centrally and spreading freely on all sides, attaining fairly large dimensions, rigid and shining, olive-green when moist and dark-brown when dry, surface pitted reticulate and profusely sorediferous on the ridges, lobes sinuate and truncate at the margin, under-surface unequal, bullate or blistered opposite the pits on the upper surface, whitish, with a reddish brown tomentum between the bullate swellings. Caustic potash and Calcium chloride give no colour reaction. Transverse section of the thallus shows an upper plectenchymatous cortex, gonidial zone of *Protococcus* cells, medulla consisting of somewhat loosely anatomosing hyphæ, lower cortex also plectenchymatous and continuous without the cyphellate

or pseudocypheolate depressions. Apothecia absent. Spermogones common.

*Hab.* On mortar, on stones near water or on bark.

*Loc.* Darjeeling (Tiger Hill), altitude 6,000 ft.—7,852 ft.,  
Col. G. L. Chopra, July, 1929 and 1930.

#### Family X—PELTIGERACEÆ.

Thallus foliaceous, wide-spreading, membranaceous or subcoriaceous. Algal cells *Nostoc* or bright-green, restricted to the region below the upper cortex (heteromerous). Upper cortex plectenchymatous, lower cortex non-corticated, medullary hyphæ protrude into rhizine-like hair. Apothecia mostly marginal, rounded, adnate or elongate, restricted to the upper or lower surface of the thallus, thalline margin absent; hypothecium colourless without any gonidial cells; asci 2–8-spored; spores elongate, fusiform or ellipsoid, 1 or pluriseptate, colourless or dark; paraphyses simple, unbranched, septate. Cephalodia enclosing *Nostoc* present in some of the genera. Spermogones absent or rare.

#### XIV. *Peltigera* Willd.

*Peltigera* Willd. Fl. Boerl., p. 347 (1787). (Smith. I, 90.)

Thallus foliose wide-spreading, submonophyllous or polyphyllous, corticate on the upper surface, lower without cortex, tomentose or nerved and more or less rhizinose. Algal cells *Nostoc* or bright-green. Apothecia marginal, adnate, roundish or elongate, restricted to the upper surface of the frond only; spores elongate, fusiform, 3-pleuriseptate, colourless or brownish. Pycnidia sometimes present with ovoid or acrogenous spores.

##### *Key to the species.*

Apothecia elliptical, thallus with blue-green cells. *P. canina.*

Apothecia roundish, thallus with bright-green cells. *P. venosa.*

21. **Peltigera canina** Willd. Willd. Fl. Bessl., p. 347  
(1787). (Smith. I, 91.)

Thallus foliaceous, fairly large and sub-ascending, thick, lobate ; lobes divided in a digitate manner, margin sinuate and partly crenulate, surface slightly pruinose, bluish green when moist, beneath whitish with prominent pale-brown nerves and small brownish rhizinæ, glaucous grey or fawn coloured when dry. KOH and Calcium chloride have no colour reaction. Upper surface plectenchymatous with one or two rows of cells. Algal cells blue-green just below the cortex ; medulla of compact anastomosing hyphæ ; lower cortex absent, medullary hyphæ protruding into rhizinæ-like hairs. Apothecia numerous, marginal, adnate at the tips of the digitate lobes of the thallus, oblong, small, varying from 2–4 mm. in length, revolute, margin crenate, reddish brown ; hypothecium colourless with no gonidia ; thalline margin absent ; epithecium brownish black ; asci contain 6–8 spores ; spores elongate, fusiform, 3–7 septate, measuring 50–75  $\mu$  in length and about 4  $\mu$  in thickness ; paraphyses simple, septate.

*Hab.* Among Mosses on the sides of the mountains in moist shady places.

*Loc.* Ghum Road, Victoria Fall and Sikkim, altitude 4,000–7,000 ft., Col. G. L. Chopra, July, 1929–1930 ; Simla, 7,000 ft., August, 1931.

*Note.*—The rhizinæ are not white but brownish and smaller than recorded in the British species.

22. **Peltigera venosa** Hoffm. Pl. Lich. i, p. 31 (1790).  
(Smith. I, 99.)

Thallus foliaceous, membranaceous, thin, small lobate, appressed to the substratum but partly ascending at the edges, lobes rounded, smooth and shining bright-green when moist, greyish or greyish brown when dry ; beneath white with pale-brown prominent tomentose veins which are branching. No colour reaction with KOH and Calcium chloride. Upper cortex plectenchymatous with bright-green algal cells

below, medullary hyphæ loosely spreading and protruding down as rhizinæ ; lower cortex absent. Apothecia numerous, marginal, small 2–4 mm. in diameter, roundish with crenate margin, reddish brown in colour. Asci contain 6–8 spores ; spores elongate, fusiform, 3-septate and colourless, varying from 30–40  $\mu$  in length and 8  $\mu$  in thickness ; thalline margin absent ; hypothecium colourless, without any gonidia.

*Hab.* On ground among Mosses in the fissures of rocks.

*Loc.* Dalhousie-Chamba Road, altitude 7,000 ft., Col.  
G. L. Chopra, July, 1928.

### XV. *Nephroma* Ach., pr. p., Nyl.

*Nephroma* Ach. Nyl. Syn. Meth. Lich. 316.

Thallus foliose, horizontal with both surfaces corticated, beneath tomentose in a few cases. Algal cells bright-green. Apothecia marginal, adfixed on the under-surface, finally coming upwards by turning back of the fertile lobe ; paraphyses unbranched, septate ; spores fusiform, oblong, usually brownish 1–3-septate. Spermatogones with septate sterigmata and small straight somewhat dumble-shaped pleurogenous spermatia.

#### 23. *Nephroma* sp. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus suborbicular, lacinate lobate, lobes thin, membranaceous, pale-green above, smooth or slightly granular ; beneath brownish black, tomentose ; corticated on both sides (plectenchymatous), lower cortex black. Algal cells bright-green in patches just beneath the upper cortex, medulla rather compact, consisting of anastomosing hyphæ. KOH and Calcium chloride have no reaction. Apothecia numerous, moderate in size, varying from 3–6 mm. in diameter, reddish brown, more or less reniform, restricted to the under-surface of the lobes, coming upwards by turning back of the fertile lobes ; margin crenate without a thalline margin ; hypothecium brownish with gonidial cells below ; spores 6–8 in ascus ; spores fusiform, 3-septate, measuring 16–20  $\mu$  long and 7–8  $\mu$

in thickness. Paraphyses simple, unbranched and septate, gelatinous hymenium turning deep-blue with iodine solution.

*Hab.* On bark near springs.

*Loc.* Verinag, Kashmir, altitude 7,000 ft., Col. H. Chaudhuri, June, 1922.

*Note.*—The specimen resembles most *N. expallidum* Nyl. but whereas the spores in the latter measure  $20\ \mu \times 6\ \mu$  the writer has recorded a variation in the length of the spores from 16–24  $\mu$  in length and 7–8  $\mu$  in thickness in the above specimen. The hymenium is up to 100  $\mu$  high.

## XVI. *Solorina* Ach.

*Solorina* Ach. Lich. Univ., p. 27 (1810). (Smith. I, 103.)

Thallus foliose, fragile, the upper surface corticate, the under-surface partly nervose and rhizinose. Algal cells bright-green, *Dactylococcus*, rarely blue-green *Nostoc*. Apothecia superficial or urceolate and sunk in the upper surface of the thallus, irregularly scattered, reddish or dark-brown without a thalline margin; paraphyses thickish, septate; spores 2–8 in the ascus, fusiform, oblong or ellipsoid, 1-septate, brownish or reddish brown. Spermogones unknown.

24. *Solorina crocea* Ach. Lich. Univ., p. 149 (1810).  
(Smith. I, 103.)

Thallus orbicular, membranaceous, appressed, smooth or rough on the surface, lobate, lobes crisp, brownish green when moist and reddish brown when dry; beneath deep orange with subreticulate brownish nerves and rhizinae; corticate above, under-surface uncorticated. Algal cells bright-green, medulla compact and rather orange in colour. KOH and Ca Cl<sub>2</sub> have no reaction. Apothecia numerous, scattered all over the surface, dark, reddish brown, plane or somewhat tumid, measuring sometimes 1 cm. in diameter; epithecium and hypothecium brownish; paraphyses stout, septate; thalline margin absent, spores generally 4 but sometimes 6 in the ascus,

oblong or somewhat fusiform, pointed at the ends, 1-septate, measuring 32–54  $\mu$  in length and 14–18  $\mu$  in thickness.

*Hab.* On the ground among siliceous and calcareous rocks.

*Loc.* Dalhousie-Chamba Road, altitude 7,000 ft., Col. G. L. Chopra, July, 1928.

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### Family XI—LECIDEACEÆ.

Thallus minutely squamulose or crustaceous, at times evanescent. Algal cells Chlorophyceæ. Apothecia discoid or patellate with proper margin only; spores usually 8 in the ascus, sometimes fewer or more, simple or variously septate, colourless or coloured. Spermatogones immersed, spermatia elongate, elliptical or cylindrical.

### XVII. *Lecidea* Ach.

*Lecidea* Ach. Meth., p. 32 (1803). (Smith. II, 10.)

Thallus squamulose, granulose, areolate-rimulose, evanescent or obsolete, hypothallus various, persistent or indistinct. Algal cells *Protococcus* or rarely *Trentipohlia*. Apothecia either discolourous (not black) and biatorine, or black and lecideine, the proper margin often obliterated; spores usually 8 in the ascus, ellipsoid or oblong, simple, colourless, hymenium gelatine, variously tinged with iodine. Spermatogones with spermatia acicular, straight or shortly cylindrical.

25. *Lecidea decipiens* Ach. Meth., p. 80 (1803).  
(Smith. II, 15.)

Thallus indeterminate, squamulose, appressed, reddish, white beneath; the squamules more or less discrete, subflexose or subcrenate and often whitish at the margins. KOH and  $\text{CaCl}_2$  have no inferential colour reaction. Apothecia marginal, adnate, plane or convex, blackish, the margin thin, entire, at length evanescent; hypothecium pale-brown; paraphyses discrete, brown towards the apices; spores ellipsoid, ovoid,

12-16  $\mu$  long and 5-6  $\mu$  thick, hymenium gelatine bluish with iodine.

*Hab.* On calcareous and cretaceous soil in mountainous districts.

*Loc.* Waziristan, altitude 4,250 ft., Col. Rev. E. Blatter, March, 1927.

### XVIII. *Bacidia* De. Not.

*Bacidia* De. Not. in Giorn. Bot. Ital. ii, p. 189 (1846).

(Smith. II, 149.)

Thallus effuse, minutely squamulose or variously crustaceous. Algal cells *Protococcus*. Apothecia brightly coloured or dark, sometimes carbonaceous, immarginate or with proper margin only; asci usually 8-spored; spores elongate, acicular, colourless, pluriseptate, usually straight or sometimes spirally curved.

#### *Key to the species.*

Thallus rugulose, spores 3-4-septate .. *B. hunana* var. *rugosa*.

Thallus leprose, granulose, spores *B. luteola*.  
acicular, pluriseptate.

#### 26. *Bacidia* (Weitenwebera) *hunana* A. Zahlbr. Sym.

Sinicæ, III (1930), 113, var. *rugosa* A. L. Sm.

var. Novo. Tr. Brit. Myc., Dec., 1931.

Thallus crustaceous, thin, greenish yellow, tartaraceous and rugulose. Apothecia numerous, minute, or sometimes up to 2 mm. across, brown-black when young but become dense black and carbonaceous in colour later on, concave with inflexed, entire or slightly crenate margin at first, disc brownish black and slightly pruinose, later on becoming plane or erumpent with slightly convex and irregular surface; solitary or crowded, sometimes confluent; epithecium brownish; hypothecium dark-brown; thalline margin absent; asci 8-spored; spores ellipsoid, measuring 22-32  $\mu$  in length and 5-7.5  $\mu$  in thickness; paraphyses subdiscrete, simple,

unbranched and unseptate with a slightly swollen tip, hymenium taking deep blue-green tinge with iodine solution.

*Hab.* On soil.

*Loc.* Darjeeling, altitude 6,500 ft., Col. G. L. Chopra, July, 1929.

*Note.*—Miss Smith has described spores attaining a length of 40  $\mu$  sometimes but the writer has not come across more than the above given maximum length in the spores of this specimen.

27. ***Bacidia luteola*** Mudd. Man, p. 183 (1861).  
(Smith. II, 151.)

Thallus effuse, thin, leprose-granulose, greyish green. KOH gives a yellow colouration whereas  $\text{CaCl}_2$  is passive. At times nearly obsolete. Algal cells *Protococcus*. Apothecia numerous, moderate, .5–1 mm. in diameter, sessile, naked, at first concave, becoming plane and obtusely margined, at length convex or subglobose with margin excluded, reddish, flesh-coloured when moist but black when dry; hypothecium pale-yellowish; paraphyses slender, loosely coherent; epithecium indistinct, brownish; asci clavate, with 6–8 spores; spores acicular, pleuriseptate (3–16), straight or slightly curved, 82–91  $\mu$  long and 3–4  $\mu$  thick, hymenium gelatine bluish then dark wine-red or violet with iodine.

*Hab.* On bark of old trees.

*Loc.* Glen Eden, Darjeeling, altitude 6,500 ft., Col. G. L. Chopra, July, 1930.

*Note.*—The spores in the above species have been recorded to vary from 3–45  $\mu$  in thickness but the writer has not come across any spore thicker than 4  $\mu$ .

**XIX. *Rhizocarpon* Ramond.**

*Rhizocarpon* Ramond in D.C. Fl. ii, p. 365 (1885).  
(Smith. II, 187.)

Thallus crustaceous, usually with distinct dark coloured hypothallus or hypothallus sometimes wanting. Algal cells

*Protococcus*. Apothecia usually dark coloured and carbonaceous, immarginate or with proper margin only; asci 8- or few spored; spores ellipsoid or oblong, mostly rather large, septate and muriform, colourless or brown, usually with hyaline, mucilagenous epispore (halonate).

28. **Rhizocarpon geographicum** D.C. Fl. Fr. ii, p. 365 (1805). (Smith. II, 190.)

Thallus crustaceous, bright greenish yellow, determinate, thickish, areolate, areola smooth, contiguous; hypothallus black. KOH and  $\text{CaCl}_2$  have no reaction. Apothecia small or moderate in size, embedded, plane or sometimes convex, black; hypothecium blackish, paraphyses conglomerate; spores broadly fusiform, 3-5 septate, frequently with longitudinal and transverse septa, muriform, measuring  $36\ \mu$  long and  $13\ \mu$  thick, hymenium colours gelatine-blue with iodine.

*Hab.* On granite rocks.

*Loc.* Kausarnag, Kashmir, altitude 12,000 ft., Col. A. C. Joshi, June, 1929.

**XX. Lopadium** Koerb.

*Lopadium* Koerb. Syst. Lich. Germ., p. 210 (1885). (Smith. II, 199.)

Thallus crustaceous. Algal cells *Protococcus*. Apothecia light or dark coloured, without a thalline margin, proper margin only present; ascus usually 1-spored, sometimes 4-8-spored; spores colourless, large and muriform (non-halonate).

29. **Lopadium** sp.

Thallus crustaceous, thinnish, greenish. Algal cells *Protococcus*. Apothecia numerous, minute, scattered all over, the surface, brownish black, concave, with inflex and slightly crenate margin; thalline margin absent, with only thin proper margin; epithecium black; hypothecium brownish black; asci contain single large spore, spore globose, brown and muriform, measuring  $75.55\text{--}156.5\ \mu$  long and  $21.5\text{--}21.5\ \mu$  in thick-

ness ; paraphyses slender, subdiscrete, gelatinous, hymenium colouring violet blue with iodine solution, ascus remaining brownish.

*Hab.* On moist rocks, encrusting dead Liverworts and Mosses.

*Loc.* Mahanadi, D.H. Ry., altitude 4,120 ft., Col. G. L. Chopra, July, 1930.

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### Family XII—CLADONIACEÆ.

Thallus usually of two-fold character, primary thallus crustaceous or squamulose, often evanescent, corticate or non-corticate, attached to the substratum by the hypothallus, by rhizineæ or occasionally by a branching rhizoid ; secondary thallus or podetium upright, varying from a short apothecial stalk to a simple or branched usually tubular structure, corticate or non-corticate, tapering to a point or opening out into a trumpet-shaped scyphus. Algal cells *Protococcus*. Apothecia sessile on the tips of the podetia or on the margin of the scyphus, rarely on the primary thallus ; immarginate, paraphyses generally unbranched ; spores simple or variously septate, colourless. Spermogones closely associated with or replacing the apothecia, with branching sterigmata and acrogenous spermatia.

### XXI. *Bæomyces* Pers.

*Bæomyces* Pers. in Ust. Ann. Bot, vii, p. 19 (1794), Nyl.

Syn. Lich. i, p. 175 (1860). (Smith. I, 403.)

Horizontal or primary thallus crustaceous, granular, pulverulent or squamulose. Podetia endogenous in origin, rising from the inner tissue of the thalline granules, very short with or without gonidia. Apothecia terminal, immarginate, light-coloured ; hypothecium pale ; spores usually 8 in the ascus, ellipsoid or fusiform, simple or septate, colourless. Spermogones immersed in small tubercles, with septate sterigmata and acrogenous spermatia.

30. **Bæomyces roseus.** Pers. in Ust. Ann. Bot., vii, p. 19 (1794). (Smith. I, 404.)

Thallus granular, crustaceous and determinate, brownish white in colour. KOH gives yellow reaction. Secondary thallus rather short, rose coloured, without any algal cells. Apothecia terminal or podetium, single, more or less globose, rose or pale flesh coloured; no thalline margin; hypothecium pale, spores usually 8 in the ascus, fusiform, simple, unseptate, narrow, 15–26  $\mu$  in length and 3–4  $\mu$  in thickness, hymenium gelatinous, scarcely coloured but the tips show a blue reaction with iodine.

*Hab.* On exposed rocks dressed with lime.

*Loc.* Tiger Hill, Darjeeling, altitude 7,852 ft., Col. G. L. Chopra, July, 1929–30.

## XXII. *Cladonia* Hoffm.

*Cladonia* Hoffm. Deutsch. Fl. ii, p. 114 (1795).  
(Smith. I, 413.)

Primary thallus crustaceous, squamulose or subfoliaceous, sometimes evanescent; secondary thallus or podetium upright, simple or branched, tapering to a point or widening to form a shallow cup or scyphus; more or less corticate, pulverulent or beset with squamules, tubular and sometimes perforate at the axils or in scyphi. Apothecia terminal, at first somewhat plane or even marginate, becoming convex; spores 8 in the ascus, oblong, simple, colourless. Spermogones usually terminal on the podetia, with cylindrical, straight or curved arogenous spermatia.

### *Key to the species.*

Podetia not pervious, scyphiferous, with or without cortex.

Primary thallus squamulose, scyphus *C. pyxidata*.  
large, funnel-shaped.

Primary thallus squamulose, scyphus narrow, cup-shaped with  
proliferous margin. *C. pityrea*.

Podetia pervious, scyphiferous, mostly decorticated.

Basal squamules evanescent, podetia *C. Squamosa* var.  
warted and areolate. *muricella.*

Podetia corticated, ascyphus, pervious.

Basal squamules almost evanescent, *C. fercata* var.  
podetia beset with squamules, erect *pinnata.*  
in corymbose clusters.

31. **Cladonia pyxidata** Hoffm. Deutsch. Fl., p. 121 (1795).  
(Smith. I, 425.)

Primary thallus squamulose, squamules small, thickish, variously incised or crenate, glaucous green or greyish, whitish beneath, transverse section of the squamule shows upper cortex of plectenchymatous cells of 2 or 3 rows in thickness. Gonidial zone of *Protococcus* cells, medullary region shows patch work of loosely arranged hyphæ. Podetia mostly rather short, decorticate and finely pulverulent, whitish or greyish green, coarsely granular, the granules frequently growing out into small squamules, stalk slender, cylindrical and scyphiferous; the scyphi widening into trumpet shape, wine glass to funnel-shaped cavity, crenulate at the margin and showing no trace of proliferation; the margin of the scyphi copiously sorediose. Transverse section of the podetium shows no trace of any would-be cavity at the base but higher up the hyphæ become loose with the appearance of a small cavity in the centre. The margin of the podetium is characterized by a fine covering of soredia which rarely develop into squamules. Vertical section of the scyphus shows a depression above with the margin bedecked with abundance of soredia, the sides are composed of longitudinal rows of hyphæ with narrow lumen, the inner and exterior walls are chambered, the intervening layers being formed by hyphæ. Apothecia and spermogones absent.

*Hab.* Terrestrial among Mosses in dry places.

*Loc.* Kausarnag, Kashmir, altitude 12,000 ft., Col.  
A. C. Joshi, June, 1929.

32. **Cladonia pityrea** Fr. Nov. Sched. Crit., p. 21  
(1828). (Smith. I, 434.)

Primary thallus squamulose, often evanescent, the squamulæ small, rather, thin, greyish green, whitish beneath. Podetia with thin walls, rather short, corticate, or entirely decorticate and granular sorediate or with few squamules, greyish white, scyphiferous, scyphi narrow fimbriate and proliferous at the margin. KOH and  $\text{CaCl}_2$  show no reaction. Apothecia rather small, subpedicillate on the edges of the scyphi or terminal on the branches, dark brown; paraphyses scarcely thickened at the tip, epithecium brownish; thalline margin absent, spores indistinct, the apothecia being young.

*Hab.* On the ground among Mosses.

*Loc.* Sikkim, altitude 3,000–4,000 ft., Col. G. L. Chopra, July, 1930; Darjeeling (Tiger Hill), 7,852 ft., Col. G. L. Chopra, Simla, 7,000 ft., September, 1931.

33. **Cladonia squamosa** var. **muricella** Vain. A. Zahlbr.  
Cata. Lich. Univ. (Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Primary thallus almost evanescent. Podetia 1–5 cm. in height, subcylindrical, tapering upwards, erect, greyish brown, granulose and decorticate, usually warted and areolate, more or less covered with small squamules, apices furcate, the tips of the branches brownish black. Apothecia and spermogones absent.

*Hab.* On the ground among Mosses.

*Loc.* Darjeeling, Tiger Hill, altitude 7,852 ft., Col. G. L. Chopra, July, 1930.

34. **Cladonia furcata** var. **pinnata** Vain. Mon. Clad.  
Univ. 1, p. 332 (1887). (Smith. I, 447.)

Primary thallus obsolete. Podetia or secondary thallus crowded, corymbose, cylindrical, fragile, surface uneven irregularly sorediose and squamulose, squamules pinnatisect, gradating from larger to smaller towards the tip, longitudinal

fissures common, glaucous white when dry and brownish white in water, branched, usually characterized by perforations at the axils; branches erect, sometimes subradiate, attenuate, subulate and spreading, furcate at the apices. KOH and  $\text{CaCl}_2$  have no colour reaction. Transverse section of the podetium shows a solid structure below, consisting of two well marked regions. The interior or medullary portion is composed of thick walled and compact hyphæ whereas the exterior comprises loosely arranged hyphæ with numerous interspaces. Towards the tip a cavity appears in the centre and a layer of gonidial cells (*Protococcus*) is conspicuous lying in patches on the exterior. Cortex decomposed, consisting of thick walled conglutinate hyphæ, continuous or discontinuous over the whole surface. Transverse section of the squamule shows the upper surface of the plectenchymatous cortex, a layer of gonidial cells below, medulla of elongate and compact hyphæ and the lower cortex absent. Apothecia minute, brownish and subglobose; spore 10–13  $\mu$  long and 3–4  $\mu$  thick.

*Hab.* On moist turf walls of the mountains in dripping water or in sunny places.

*Loc.* Ghum Road, and Tiger Hill, Darjeeling, altitude 6,500–7,852 ft., Col. G. L. Chopra, July, 1929 and 1930.

*Note* :—In extreme moist conditions the podetia are profusely squamulose and show no trace of apothecia. Apothecia, however, are present in specimens collected from Tiger Hill in more sunny places. The podetia here are not so densely squamulose as in specimens collected from Ghum Road.

### XXIII. *Stereocaulon* Scherb.

*Stereocaulon* Scherb. Gen. pl. ed. 8, ii, p. 768 (1791).  
(Smith. I, 407.)

Primary thallus granular or minutely squamulose, usually soon evanescent. Podetia erect or decumbent, developed from the upward growth of the primary thallus (not endogenous), much branched, solid in the centre, the exterior

beset with minute warts or variously formed squamules which are more or less corticate. Cephalodia present, usually on the podetia and containing *Nostoc* or *Stigonema*. Apothecia terminal or lateral, usually dark brown, immarginate (rarely with a thalline margin), hypothecium colourless, paraphyses slender, discrete; asci cylindrical, 6–8 spored; spores elongate, 4-pleuriseptate, colourless. Spermatogones with filiform or cylindrical, straight or bent acrogenous spermatia.

*Key to the species.*

- Podetia erect, fibrillose, cephalodia contain *St. Ramulosum*.  
*Stigonema*, apothecia flesh coloured,  
 brownish black-numerous.
- Podetia erect, covered with crowded and *St. alpinum*.  
 turgid squamules, cephalodia contain  
*Nostoc*, apothecia absent.
- Podetia, short, shrubby, densely soresiose *St. arbuscula*.  
 apothecia and cephalodia absent.

35. **Stereocaulon ramulosum** Ach. Eng. Prant. Die Natur. Pflanzen. Band 8, p. 208.

Primary thallus evanescent. Podetia cæspitose, erect, 3–5 cm. high, branched irregularly, the ultimate branches forked, granulate or warted, fibrillose, the fibrillæ papillate, simple or ramose; greenish in water, taking a brownish green hue in the herbarium. Cephalodia present on the podetia, somewhat spherical, opaque, verrucose, and granulate on the surface, pale or bluish, containing *Stigonema*. In transverse section the podetium shows a capaceous medulla, gonidial layer is very thin and the algal cells (*Protococcus*) occur in patches, the cortical region is rather thin, composed of intricate dense layer of gelatinous walled hyphæ, lying in all direction but not coalescent. In longitudinal section the medulla shows loose hyphæ, running in the direction of the long axis, gonidial zone scarcely visible. The gonidia in groups occur in protuberances of the fronds. Apothecia numerous, 3–5 mm. in

diameter, situated terminally on the dichotomous branches or on the lateral ones, globose, disc brown, convex becoming brownish black when dry; thalline margin wanting with proper margin only; hypothecium colourless with no gonidial cells; asci clavate, 8 spored; spores elongate, filiform, 18-30 septate, measuring 142-190  $\mu$  long and 3-4  $\mu$  in thickness; paraphyses slender, filiform, discrete, with tips slightly swollen. Spermatogones very common, appearing as minute black spots on the podetia or the fibrillæ.

*Hab.* On exposed rocks.

*Loc.* Mahanadi, D.H. Ry., altitude 4,120 ft.; Darjeeling, altitude 6,500 ft.; and Sikkim, altitude 4,000-6,000 ft., Col. G. L. Chopra, July, 1929 and 1930.

*Note.*—The spores in the above specimen are abnormally long. In no recorded species of the genus, they attain such large dimensions. Only in *Stereocaulon strictum* Th.Fr. they reach 165  $\mu$  in length. The above determination by Miss Smith seems rather doubtful, because Nylander in his Synop. Meth. Lich. has recorded the measurements of spores from 35-60  $\mu$  and with 3-7 septa only.

36. *Stereocaulon arbuscula* Nyl. Syn. Meth. Lich. i, p. 253. (Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Primary thallus evanescent. Podetia whitish, slender, shrubby, congested, filiform, axis thin arachnoid, pale, cinerous grey, irregularly branched, densely proliferous at the apices, sorediose, soredia white, copious at the tips of the branches, occurring in groups, scanty in the main stalk greyish white. KOH gives deep yellow colouration. Transverse section of the podetium shows usual structure, gonidia absent. Apothecia and cephalodia absent.

*Hab.* On bark.

*Loc.* Darjeeling, altitude 6,500 ft., Col. G. L. Chopra, July, 1929.

37. **Stereocaulon alpinum** Laur. ex. Fr. Lich. Eur., p. 204 (1831). (Smith. I, 413.)

Primary thallus absent. Podetia 3–5 cm. in height, branched, and fibrillose at the apices or just below it, covered with conglomerate, tumid, bluish green squamules almost obscuring the branching, lower down scanty; surface touching the soil almost naked with no granules or branches. Cephalodia pale to bluish green containing *Nostoc*. Structure of the podetium as usual. Apothecia absent.

*Hab.* Terrestrial in moist places.

*Loc.* Tiger Hill, Darjeeling, altitude 7,852 ft., Col. G. L. Chopra, July, 1930.

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Family XIII—*GYROPHORACEÆ*.

Thallus foliose, may be monophyllous or polyphyllous; attached by a central holdfast to the substratum or by the general under-surface (rhizinæ), both sides provided with cortex (plectenchymatous). Gonidial cells *Protococcus*. Apothecia sessile or sub-sessile with proper margin only (lecidine), the disc variable, may be plane or furrowed, showing the family character (gyrose), black; spores 1–8 in the ascus, colourless or dark brown, simple or muriform. Spermatogones common.

XXIV. *Gyrophora* Ach.

*Gyrophora* Ach. Meth. Lich., p. 100 (1803). (Smith. I, 338.)

Thallus foliose mono or polyphyllous, both sides corticated (plectenchymatous) attached by a central or sub-central holdfast, beneath naked or rhizinose. Apothecial disc plane or furrowed more or less concentrically with alternate fertile and sterile tissue; hypothecium dark-coloured, paraphyses sub-discrete; asci ellipsoid-cylindrical or broadly ellipsoid, 8 spored, spores one-celled, rarely septate, rather small, ellipsoid, or colourless becoming brownish.

38. *Gyrophora cylindrica* Ach. Mith. Lich., p. 107 (1803). (Smith. I, 395.)

Thallus foliaceous, measuring 5-7 cm. across, polyphyllous, attached by rhizoids to the substratum, more or less leathery in texture, sinuate-lobate, lobes with lacerate and crenulate margin which are beset with blackish fibrillæ upper surface shiny, smooth or slightly pruinose, beneath mottled with black, densely covered with short black rhizinæ which are slightly branched at the tip. Brownish grey when dry and greenish in water. KOH and  $\text{CaCl}_2$  have no reaction. Transverse section of the thallus shows an upper and lower plectenchymatous cortex with *Protococcus* gonidial cells below ; medulla consists of loosely arranged hyphæ. Spermatogones found embedded in the thallus. Apothecia numerous, small, 1-2 mm. across, sessile, plane orbicular in outline, thin and convex, then gyrose, thinly marginate ; hypothecium as well as epithecium black ; hymenium consists of alternating regions of fertile and sterile tissue ; asci 8 spored, spores small, 10-15  $\mu$  long and 5-8  $\mu$  thick, ellipsoid ; paraphyses slender, subdiscrete.

*Hab.* On exposed rocks in sunny places.

*Loc.* Tiger Hill, Darjeeling, altitude 7,852 ft., Col. G. L. Chopra, July, 1929-30.

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#### Family XIV—PERTUSARIACEÆ.

Thallus crustaceous with a definite or indefinite outline, attached by hyphæ to the substratum ; upper surface corticate or without cortex. Algal cells *Protococcus*. Apothecia one or several, immersed in thalline warts, enclosed by a thick and well developed thalline margin ; paraphyses mostly branched and intricate, asci 1-8 spored ; spores colourless or brownish, very large, oblong, ellipsoid, simple or 1-septate, spermatogones common.

**XXV. Pertusaria DC.**

*Pertusaria* Dc. Fl. Fr. ii, p. 319 (1805). (Smith. I, 356.)

Thallus continuous or cracked areolate, thick and<sup>4</sup> unequally warted and wrinkled or thinner and smoothy, generally superficial, rarely sub-corticolous (hypophloeodal). Apothecia one or several, immersed in the fertile protuberances, more rarely immersed in thalline areolæ, the disc appearing as minute ostiole or broadening out into a lecanorine form; hypothecium colourless, paraphyses long very slender, spores 1-8 in the ascus, colourless or rarely blackish, simple, mostly very large with a thick epispore, generally the asci alone are coloured deep blue with iodine.

**39. *Pertusaria multipuncta* Nyl. in Flora Ixiii, p. 393 (1880). (Smith. I, 361.)**

Thallus crustaceous, epiphloeodal, determinate, thin cracked areolate, veruculose and wrinkled, dotted with round, flat, white, sorediate verrucæ, whitish. KOH gives yellow colouration whereas  $\text{CaCl}_2$  gives none. Upper cortex composed of hyphæ running parallel with the surface. Algal cells *Protopoccus*. Apothecia numerous, small, 1-3 immersed in the thalline verrucæ; disc rather wide and not ostiolar, white, pulverulant; thalline margin thin and furrowed, hymenium turning blue with iodine, the asci, however, take up a deep blue colour; epithecium whitish, hypothecium colourless; asci contain but one large spore, measuring 90-147  $\mu$  in length and 9-16  $\mu$  in thickness, usually unseptate but in a few cases septation present, separating a round mass of protoplasm from the tip, epispore thick; paraphyses simple, unseptate, branched at the tip.

*Hab.* On the bark of trees.

*Loc.* Mount Pleasant, Darjeeling, altitude 6,500 ft.,  
Col. G. L. Chopra, July, 1930.

*Note.*—Miss Smith has recorded the breadth of the spore varying from 28-68  $\mu$  and length from 106-140  $\mu$  but the author hasn't come across any spore more than 16  $\mu$  in thickness

The minimum length of the spore in the above specimen was  $90\ \mu$  and not  $106\ \mu$  as recorded in the British specimens.

### Family XV—*LECANORACEÆ*.

*Thallus* may be crustaceous or squamulose, variable in colour, structure almost stratose with or without a cortex on the upper surface, beneath uncorticated attached by hyphæ to the substratum. Algal cells Chlorophyceæ. Apothecia scattered on the surface or at first immersed in the thallus, discoid, thalline margin present, spores 8 in the ascus, rarely many, simple or variously septate.

### XXVI. *Lecanora* Ach.

*Lecanora* Ach. Lich. Univ., p. 77 (1810). (Smith. I, 259.)

*Thallus* squamulose, variously crustaceous, rarely somewhat minutely fruticose, mostly of stratose structure, cortex of the upper surface of decomposed hyphæ or wanting. Algal cells *Protococcus*. Apothecia generally superficial, sometime immersed at first; usually 8 spores in the ascus, spores colourless, simple mostly ellipsoid, spermogones common.

#### *Key to the species.*

*Thallus* appressed, radiate-effigurate, pale, *L.* (Placodium)  
yellowish straw coloured. *chrysoleuca*.

Apothecia reddish brown—

Apothecia moderate in size (2 mm.). *L. subfusca*.

*Thalline* margin not very pro-  
minent, slightly crenate.

Apothecia smaller, lighter, with pro- *L. subfusca* var.  
minent and crenate thalline margin. *chlarona*.

*Thallus* thick, apothecia with thick *L. rugosa*.  
prominent margin, receptacle fur-  
rowed.

Apothecia confluent .. .. *L. carnulenta*.

Apothecia black, thallus areolate, *L. coilocarpa*.  
granulate.

40. **Lenacora (Placodium) chrysoleuca** Ach. Lich. Univ., p. 411 (1810). (Smith. I, 261.)

Thallus rather thick effigurate, surface wrinkled, crenate-lobate at the circumference or of imbricate-squamules, lobes crenate, undulate, incised and rounded at the apex; pale yellowish or straw coloured, sometimes pruinose, beneath pale towards the centre and bluish black towards the edges. KOH gives a slight yellow reaction. Transverse section of the lobe shows small celled plectenchymatous cortex on both sides; gonidial zone consists of *Protococcus* cells distributed in groups below the upper cortex; medullary hyphæ rather compact and densely amassed. Apothecia numerous, situated on the margin of the lobe as well as scattered on the thallus, subsessile, slightly peltate, concave, attaining a diameter of 5-4 mm.; thalline margin thin, slightly plectenchymatous, inflex and crenate; hypothecium light coloured with gonidial groups below; spores 6-8 in the ascus, colourless, simple, small, ellipsoid, varying from 10-12  $\mu$  in length and 5-6  $\mu$  in thickness.

*Hab.* On rocks in sub-alpine regions.

*Loc.* Kausarnag, Kashmir, altitude 12,000 ft., Col. A. C. Joshi, June, 1929.

41. **Lecanora subfusca** Ach. Lich. Univ., p. 393 (1810). (Smith. I, 267.)

Thallus thin, developed above or under the bark, effuse or determinate, slightly wrinkled, unequal or occasionally granular, whitish or ash-grey. KOH gives yellow reaction. Apothecia moderate in size, varying up to 2 mm. across, scattered or crowded, rather prominent and attached by a narrow base, rounded, the disc plane or generally convex, brownish red; thalline margin rather thin, not prominent, entire or sometimes slightly crenulate; paraphyses slender, subdiscrete, more or less distinctly septate, straight or slightly flexose, variously formed at the tip, sometimes slightly clavate or swollen and turgid with a bright brown colour or embedded

in brown gelatinous epithecium ; spores 8 in the ascus, oblong ellipsoid, measuring 12–16  $\mu$  long and 8–9  $\mu$  thick ; hymenium gelatine blue, the asci dark blue coloured with iodine.

*Hab.* On bark of old trees.

*Loc.* Darjeeling and its suburbs, altitude, 6,500 ft.,  
Col. G. L. Chopra, July, 1930.

42. **Lecanora subfusca** var. **chlarona** Ach. Syn.

Lich., p. 159 (1814). (Smith. I. : 68.)

Thallus thin, smoothish or somewhat wrinkled, unequal or thinly granulate, whitish or greyish white. Apothecia rather small, plane or slightly convex, the disc generally flesh coloured, or pale brown, the thalline margin thickish and more prominent than in the species, entire at first, but soon becoming crenulate, and the receptacle more or less furrowed, spores rather smaller, measuring 10–13  $\mu$  long and 5–8  $\mu$  thick.

*Hab.* On bark.

*Loc.* Darjeeling, Mt. Pleasant, altitude 6,500 ft., Col.  
G. L. Chopra, July, 1930.

43. **Lecanora rugosa** Nyl. in Flora Iv, p. 250 (1872).

(Smith. I, 271.)

Thallus generally determinate, thickish up to the margin, wrinkled, granulate or warted, unequal, whitish or greyish. Algal cells Protococcus. KOH gives yellow reaction. Apothecia scattered or crowded, moderate in size, somewhat prominent, closed then open, the disc brown or reddish brown, the thalline margin thick, crenulate, the receptacle furrowed and wrinkled ; paraphyses slender, septate, scarcely thickened upwards, ending in a brown epithecium ; spores ellipsoid, generally 8 in the ascus, measuring 11–15  $\mu$  long and 9  $\mu$  thick ; hymenium gelatine blue with iodine, the asci dirty wine red in strong solution.

*Hab.* On bark.

*Loc.* Darjeeling, altitude 6,500 ft., Col. G. L. Chopra,  
July, 1930.

44. **Lecanora carnulenta** Nyl. A. Zahlbr. Cata. Lich. Univ. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus crustaceous, thin, whitish grey, surface areolate verruculose, each areola spotted with 4-5 young apothecia, raised from the surface as small warts. Gonidial cells *Protococcus*. KOH gives yellow reaction. Apothecia numerous, represented by small, hollow, yellowish sunken spots on the verrucæ, generally 4-5 on one areola, later on taking brownish black hue and fusing with each other, sometimes the apothecia on two or three areolæ fuse together and form a petalate or stellate reddish brown apothecium with crenulate obtuse margin; epithecium brownish, hypothecium colourless without any gonidia, proper margin present, with an indistinct thalline margin; asci clavate with 8 spores, spores small, globose, or ellipsoid, measuring 12-13  $\mu$  in length and 3-4  $\mu$  in thickness; paraphyses simple sub-discrete, unbranched, tipped brownish; hymenium turns yellowish with iodine.

*Hab.* On calcareous rocks.

*Loc.* Ghum Road, Darjeeling, altitude 7,000 ft., Col. G. L. Chopra, July, 1930.

45. **Lecanora coilocarpa** Nyl. ex Norrlin in Medd. Sallsk. Faun and Fl. Fenn. i, p. 23 (1876).

Thallus sub-determinate, unequal, warted or granular-areolate, whitish or grey. KOH gives yellow colouration. Apothecia small, 2-3 mm. in diameter, the disc concave then plane, brownish black with thalline margin entire often becoming flexose or crenulate; paraphyses slender, septate, scarcely widened upwards; epithecium black or sometimes brownish; spores ellipsoid, measuring 11-14  $\mu$  in length and 4-5  $\mu$  in thickness; hymenium gelatine blue with iodine.

*Hab.* On bark.

*Loc.* Darjeeling, altitude 6,500 ft., Col. G. L. Chopra, July, 1930.

46. *Lecanora* sp. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus crustaceous, thickish verruculose, sulphur-yellow in colour. Algal cells *Protococcus*. KOH gives slight yellow reaction. Apothecia numerous, small up to 1 mm. across, disc plane or slightly erumpent, reddish brown-black when dry, margin thick and sulphur yellow in colour, slightly inflexed and crenate; asci clavate, containing 8 spores; spores ellipsoid, colourless, unseptate,  $12\ \mu$  long and  $7\ \mu$  thick, paraphyses unseptate and tipped brown, hymenium turning violet-blue with iodine.

*Hab.* Crustaceous on trunks of trees.

*Loc.* Darjeeling, altitude 6,500 ft., Col. G. L. Chopra, July, 1929.

**Hæmatomma, Massal.**

*Hæmatomma*, Massal, Ric. Lich. Crost., p. 32 (1852).  
(Smith. I, 353.)

Thallus crustaceous, corticate on the upper surface or without cortex. Algal cells *Protococcus*. Apothecia sessile or somewhat immersed; paraphyses discrete, slender; spores 8 in the ascus, narrowly elongate, straight, bent or sometimes partly coiled, 3-many septate, colourless. Spermatogones with simple or branched sterigmata and acrogenous spermatia.

47. *Hæmatomma puniceum* (Ach.) Vain. Eng. Prant.

Die Natur. Pflanzen. Band. 8, p. 227.

Thallus crustaceous, thin, fragile, tartaraceous, pale sulphur coloured; hypothallus white. KOH gives yellow colouration. Apothecia scattered at first, gradually immersing and becoming sessile, small, or rarely up to 1-2 mm. across, disc plane, reddish brown giving violet purple tinge with KOH; thalline margin insignificant, more or less crenulate; hypothecium colourless with gonidial cells below; paraphyses coherent, slender, sparsely septate; spores 8 in the ascus, elongate, fusiform, 3-12 septate, measuring  $30-90\ \mu$  long and  $4-6\ \mu$  thick. Hymenium gelatine blue with iodine.

*Hab.* On bark of trees. (Araucaria.)

*Loc.* Darjeeling, Mt. Pleasant, and Tiger Hill, altitude 6,500–7,852 ft., Col. G. L. Chopra, July, 1929 and 1930.

### Family XVI—*PARMELIACEÆ*.

Thallus foliose, horizontal, sometimes partly ascending or fruticose, corticate on one or both the surfaces ; beneath with rhizinæ or naked. Algal cells *Pleurococcus*. Apothecia sessile or slightly stalked with a thalline margin ; asci 2–8-spored or rarely many spored ; spores colourless, simple. Spermatogones with pleurogenous or more rarely acrogenous spermatia.

### XXVII. *Parmelia* Ach.

*Parmelia* Ach. Meth. Lich., p. 153, emend De Not. in  
Mem. R. Acad. Sci. Torino, ser. 2, x, p. 378 (1849).  
(Smith. I, 118.)

Thallus foliose, horizontal, rarely ascending, lobate or laciniate or linear, variously coloured, generally somewhat shining ; cortex more or less distinctly plectenchymatous, soredia and isidia frequent, beneath rhizinose or almost naked, usually darker in colour, the rhizinæ of fasciculate frequently mucilaginous at the tips. Apothecia scattered, sessile or shortly stalked, often becoming rather large, round, with a thalline margin ; hypothecium colourless with gonidial cells underneath ; paraphyses usually branched and septate, involved in mucilage ; asci 2–8-spored, spores ellipsoid or subglobose, simple, colourless. Spermatogones scattered, becoming prominent, blackish with septate sterigmata, the minute pleurogenous spermatia cylindrical or fusiform or thickened at each end.

#### *Key to the species.*

Thallus fruticose.

Fronds narrow, decumbent, strap- *P. kamtschadalis*.  
shaped, apothecia lateral, sub-  
pedicellate.

## Thallus foliose.

Laciniae narrow, multifid, yellow, *P. conspersa*.  
 apothecia rare.

## Surface brown.

Fairly large in dimensions, lobate *P. latissima* f.  
 covered with isidia. *isidiosa*.

Thallus laciniate, laciniae long, *P. latissima* var.  
 multifid, apothecia brownish black, *marmariza*.  
 and large in size.

Laciniate, laciniae deep reddish brown, *Parmelia* sp.  
 appressed, apothecia brown.

## Surface greyish green, sorediose.

Fairly large in size, orbicular, lobate, *P. latissima* var.  
 lobes broad with turgid soralia at *sorediata*.  
 the margin or tips, apothecia absent.

Orbicular or irregular, sorediose at the *P. cetrarioides*.  
 circumference, surface besprinkled  
 with small whitish glistening dots,  
 apothecia absent.

Wide-spreading, lobate, lobes sinuate *P. nilgherrensis*.  
 in the centre subascending, sorediose  
 at the circumference.

Thallus fairly large in size, lacineae *P. homogens*.  
 long, imbricate and contiguous,  
 disappearing in the centre, surface  
 besprinkled with pustulate isidia,  
 apothecia absent.

Surface dirty grey, wide-spreading, *P. tinctorum*.  
 lobate, lobes broad, covered with  
 brownish black isidia, apothecia  
 rare.

Thallus suborbicular, slightly sub- *P. cristifera*.  
 ascending at the circumference,  
 apothecia large, occasionally punctured in the centre, spermogones  
 black, coral-like at the margin.

48. ***Parmelia kamtschadalis*** Esch. A. Zahlbr. Cata.  
Lich. Univ. (Nyl. Syn. Meth. Lich. 387.)

Thallus partly horizontal or ascending or fruticose or somewhat narrow, decumbent, strap-shaped fronds, dichotomously branched, daughter branches further divided with pointed or truncate apices; attached to the substratum by means of a basal sheath or marginal cilia which may or may not extend right up to the circumference, margin incurved; greenish grey when moist, becoming ashy-grey in herbarium; under-surface brownish black, pale-brown near the tip, KOH gives deep-brown colouration. Corticated on both sides (plectenchymatous), under-cortex rather black, gonidial cells Pleurococcus, just beneath the upper cortex, medulla consisting of anastomosing hyphæ, forming the major portion of the section. Apothecia numerous, moderate in size or sometimes fairly large, measuring 1 mm. to 1 cm. in diameter, marginal or submarginal, sessile or subpedicellate, round, concave with inflexed slightly crenate and dissected margin; disc brown; asci clavate, with 8 spores; spores ovoid or ellipsoid, straight or slightly curved, measuring 14–26  $\mu$  in length and 5–7  $\mu$  in thickness; hypothecium slightly yellow with gonidial cells below. Spermatogones black, scattered innumerable on the fronds.

*Hab.* On bark as well as rocks along with Mosses.

*Loc.* Darjeeling, altitude 6,000–7,000 ft.; Sikkim, Gangtok, etc., altitude 4,000–5,500 ft.; Col. G. L. Chopra, July, 1929 and 1930. Simla, 7,000 ft., August, 1931; Vaishno Devi (Kashmir), 7,000 ft., July, 1931.

49. ***Parmelia cetrarioides*** Del. ex Nyl. in Flora lii,  
p. 290 (1869). (Smith. I, 129.)

Thallus foliose, large, orbicular, or irregular, lobate, lobes broad, sinuate, crenate and slightly reflexed, ascending and densely sorediate at the circumference, shiny, smooth, surface yellowish grey, besprinkled with small, whitish,

glistening dots ; beneath dark-brown, pale-brown near the edges ; both sides corticate (plectenchymatous), lower cortex black ; gonidia *Pleurococcus*, medulla narrow. Apothecia and spermogones rare.

*Hab.* On bark entangled with Mosses and Liverworts.

*Loc.* Darjeeling, Tiger Hill, altitude 7,852 ft., Col.  
G. L. Chopra, July, 1930.

50. ***Parmelia latissima* var. *sorediata*** Hue. A. Zahlbr.  
Cata. Lich. Univ. (Smith. Tr. Br. Myc.  
Soc., Dec., 1931.)

Thallus horizontal, almost orbicular in outline, lobate, lobes moderately broad, imbricate, deeply divided and crenulate, slightly black, ciliate, often with turgid soralia on the tips or the margins, rarely on the surface or the circumference, soredia brownish, taking up the colour of the thallus ; surface smooth, slightly reticulate, rimulose, brownish grey, beneath black, rhizinose, rhizinae over the entire surface or pillose towards the edges which are deep brown in colour. KOH gives a yellow colouration at first changing into deep brownish red later on. Apothecia and spermogones absent.

*Hab.* On stones in moist situation as well as bark.

*Loc.* Kurseong Spring, Darjeeling, altitude 7,000 ft.,  
Col. G. L. Chopra, July, 1929 and 1930 ;  
Simla, 7,000 ft., September, 1931.

*Note.*—Miss Smith in her monograph of the British Lichens has described *Parmelia cetrata* with similar characters but mostly from Maritime Districts. The above specimen may be the same species or some variety of the same.

51. ***Parmelia latissima* f. *isidiosa*** Mull. Arg. A. Zahlbr.  
Cata. Lich. Univ. (Smith. Tr. Br.  
My. Soc., Dec., 1931.)

Thallus foliose, horizontal, suborbicular, lobes longish, and deeply dissected, crenate and sinuate at the circumference, black ciliate, surface besprinkled with coral-like blackish isidia,

groyish brown above, slightly wrinkled, beneath black, covered entirely with rhizinæ or papillæ present near the dark-brown edges. KOH gives at first yellow and then deep red colouration.  $\text{CaCl}_2$  have no reaction. Apothecia and spermogones absent.

*Hab.* On moist stones along with Mosses.

*Loc.* Kurseong Spring, Darjeeling, altitude 7,000 ft.,  
Col. G. L. Chopra, July, 1929 and 1930.

52. ***Parmelia latissima* var. *marmariza* Nyl. A.**

Zahlbr. Cata. Lich. Univ. (Smith. Tr. Br.

My. Soc., Dec., 1931.)

Thallus horizontal, foliose, appressed, linear, laciniate, multifid, lacinia imbricate towards the periphery and disappearing towards the centre, occasionally black ciliate at the margins, upper surface reddish brown in the centre and brownish grey at the periphery, densely covered with brownish papillate isidiose outgrowth, beneath brownish black, covered with rhizinæ, extending almost on the entire surface or papillose near the edges, structure usual. KOH produces at first yellow and then red colouration,  $\text{CaCl}_2$  has no colouration. Apothecia numerous, fairly large, attaining a diameter of 2–11 mm., brownish red, with crenate, dissected and inflexed margin; hypothecium colourless with *Pleurococcus* gonidial cells in groups below; spores 6–8 in an ascus, ellipsoid, globose, measuring 14–20  $\mu$  long and 9–15  $\mu$  thick.

*Hab.* On exposed rocks near water.

*Loc.* Kurseong Spring, Darjeeling, altitude 7,000 ft.,  
Col. G. L. Chopra, July, 1929 and 1930.

53. ***Parmelia tinctorum* Despr. Eng. Prant. Die Natur.**

Pflanzen. Band 8, p. 235.

Thallus foliose, wide-spreading, orbicular in outline, attaining dimensions of 6"  $\times$  4", lobate, lobes broad, sinuate, with entire margin, surface dirty grey, with slight bluish tinge, densely covered with coral-like brownish isidia almost

all over the surface except near the circumference ; under-surface brownish black without any rhizoids, structure as usual. KOH gives slight yellow reaction, whereas  $\text{CaCl}_2$  produces deep red colouration. Apothecia rare, almost sessile, disc brownish, margin entire ; hypothecium brownish with gonidial cells below, rather old and distorted, asci and spores absent.

*Hab.* On bark.

*Loc.* Sikkim, altitude 5,000 ft., Col. G. L. Chopra,  
July, 1930.

54. ***Parmelia homogens*** Nyl. var. ***vestita*** Azalbr.

Cata. Lich. Univ. (Smith. Tr. Br. Myc. Soc.,  
Dec., 1931.)

Thallus foliose, measuring  $6'' \times 3''$ , laciniate, lobate, laciniae long, not very broad, more or less imbricate and contiguous, disappearing in the centre, margin dissected, crenate and rounded, upper surface greenish grey, beneath brownish black covered with small rhizinæ, extending almost right up to the margin, the margin of the laciniae and the surface of the thallus densely bedecked with isidia which may be solitary or crowded into globose, pustule-like protuberances, more restricted to the central part than towards the exterior, internal structure as usual, medulla gives faint yellow colouration with KOH. KOH gives slight yellow colouration, thallus becoming yellowish green. Apothecia and spermogones absent.

*Hab.* On rocks.

*Loc.* Sikkim, altitude 5,000 ft., Col. G. L. Chopra,  
July, 1930.

55. ***Parmelia conspersa*** Ach. Meth. Lich., p. 205 (1803).

Nyl. Syn. M. Lich. 391.

Thallus horizontal, appressed, small, orbicular, laciniate lobate, laciniae linear, deeply multifid with convex and spreading apices, surface of the laciniae characterized by transverse

and longitudinal cracks. Upper surface greenish grey in the centre but brownish near the margin, under-surface black-white with scattered rhizinæ. KOH gives yellow colouration,  $\text{CaCl}_2$  gives none. Apothecia not present. Spermatogones numerous and scattered all over the surface appearing as minute black dots.

*Hab.* On granite rocks.

*Loc.* Kausarnag, Kashmir, altitude 12,000 ft., Col. A. C. Joshi, June, 1929.

56. ***Parmelia cristifera*** Tayl. A. Zahlbr. Cata. Lich. Univ. (Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Thallus foliaceous, wide-spreading, suborbicular, laciniate lobate, laciniae moderately broad, multifid and overlapping, attached with adjacent laciniae by marginal cilia; margin crenate and incised, black ciliate; apex truncate, slightly ascending at the circumference. Spermatogones numerous, prominent, black, restricted to the circumference of the laciniae, appearing as small conical protuberances with minute whitish apices, mass of small fusiform spermatia varying from 2-4.5  $\mu$  in length and 1  $\mu$  in thickness, flow out in a regular stream from the ostiolar tip when placed in water, whitish grey above and beneath brownish black, rhizinose, rhizinæ extending almost on the entire under-surface but absent near the brownish edges of the laciniae. KOH gives slight yellow reaction. Structure usual. Apothecia numerous, varying from .5 mm. to 2 cm. in diameter, subpedicellate, concave, margin inflexed, crenate and dissected; disc reddish brown, sometimes with a hole in the centre; thalline margin present; hypothecium palish with gonidial cells below; epithecium brownish; asci 6-8-spored; spores globose, ellipsoid, measuring 21-24  $\mu$  in length and 11  $\mu$  in thickness; paraphyses slender, branched and septate involved in mucilage.

*Hab.* On rocks near water as well as the branches of trees.

*Loc.* Kurseong Spring, Darjeeling, altitude 7,000 ft.; Tiger Hill, Darjeeling, altitude 7,852 ft.; Col. G. L. Chopra, July, 1929-1930; Simla, 7,000 ft., August, 1931.

57. ***Parmelia nilgherriensis*** Nyl. A. Zahlbr. Cata. Lich. Univ. (Smith. Tr. Br. My. Soc., Dec., 1931.)

Thallus foliaceous, widely spreading, appressed, measuring 6" × 4", lobate, lobes broad, sinuate at the margin, with no crenation, margin provided with black cilia, sometimes sordiose at the circumference; in the centre lobes very much crowded, divided and subascending; surface brownish grey, pruinose and wrinkled, beneath black, rhizinose, reddish brown near the edges, structure usual. KOH gives slight yellow reaction. Spermatogones numerous, scattered, more towards the periphery than in the interior, black, embedded in the thallus. Apothecia absent.

*Hab.* On rocks.

*Loc.* Kurseong Spring, Darjeeling, altitude 7,000 ft.; Gungtok, Sikkim, altitude 5,000 ft.; Col. G. L. Chopra, July, 1930.

58. ***Parmelia* sp.** (Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Thallus foliaceous, lacinate lobate, laciniae linear, much divided with sinuate and rounded margins, closely appressed to the substratum, lobes contiguous; upper surface reddish brown, slightly wrinkled, shining, pruinose, spotted irregularly with black spermatogones, beneath black, rhizinose on the entire surface. KOH gives deep red colouration. Structure usual, medulla tabacine. Apothecia numerous, scattered all over 1-7 mm. in diameter, sessile; disc plane, brownish black, margin inflexed and crenate; asci 8-spored; spores globose, ellipsoid, 13-22  $\mu$  in length and 9-10  $\mu$  in thickness; epithecium brownish; hypothecium brownish with gonidial cells below; paraphyses branched, septate, involved in mucilage.

*Hab.* On bark of coniferous trees.

*Loc.* Gangtok, Sikkim, Residency Garden, altitude 5,500 ft., Col. G. L. Chopra, July, 1930.

*Note.*—The specimen shows great resemblance with *P. acetabulum* or *P. tabacine*, both, in the general morphological features and the colour of the thallus. The medulla, however, in the above two species is reported to be colourless, whereas it is brown, 'tabacine' in the specimen collected from Gangtok. The spores in *P. acetabulum* are only 12–16  $\mu$  in length and 9–10  $\mu$  in thickness but in the above specimen the spores measure 13–22  $\mu$  in length and 9–10  $\mu$  in thickness, dimensions too large for *P. acetabulum*. There is a red reaction with KOH as in the other two species and the medulla becomes first yellow and then red. It is, however, difficult to refer the specimen definitely to any known species. It may be a new record from Himalayas.

## XXVIII. *Anzia* Stizbg.

*Anzia* Stizbg. in Flora XLIV (1861). Eng. Pr. Pf. 8: 235.

Thallus foliose, lobate, lobes divided, pressed to the substratum, dorsiventral, simple or branched, corticate above, gonidial zone of Protococcus cells, medulla compact, consisting of anastomosing hyphæ, beneath uncorticated, covered with long coral-like black rhizinous felt. Apothecia flat, rounded, with thalline margin; hypothecium bright with gonidial cells below, ascus 8-spored; spores 1-celled, globose.

59. *Anzia physioidea* A. L. Smith (1931). Sp. Novo.  
Trans. Br. Myc. Soc., Dec., 1931.

Thallus foliose, pressed to the substratum, laciniate lobate, laciniae linear, multifid, variously branched, 5 cm. long and 2 mm. broad, margin incurved with crenate apices; upper surface cinerous grey, under-surface brownish black, covered with black coral-like spongy rhizinae extending right up to the tip. KOH gives slight yellow reaction. Spermogones numerous, black, represented by small conical warts,

on the margins of the lacinia. Transverse section of the lobe shows a narrow plectenchymatous cortex on the upper surface with Protococcus gonidial cells below, medulla very compact, consisting of capitate anastomosing hyphæ, occupying more than two-third of the section, ultimate medullary hyphæ continue into black, granulate, rhizinous hyphæ below. Transverse section of the rhizina shows a central core from which ramify multibranched granulate hyphæ with narrow  $5.5 \mu$  broad lumen forming more or less a dense pannose, spherical, spongy patch. Apothecia absent.

*Hab.* On trees entangled with Mosses and Liverworts.

*Loc.* Tiger Hill, Darjeeling, altitude 7,852 ft., Col.  
G. L. Chopra, July, 1930.

*Note.*—This species shows marked resemblance with *P. physiodes* in general form and the colour of the thallus but is distinguished by long black rhizina, covered by a spongy hyphal-network beneath, a characteristic of the genus *Anzia*. Invariably it creeps over straggling dead Mosses and Liverworts, inhabiting the tree trunks and the long rootlets serve as very efficient attaching organs and water reservoirs. In the absence of fructifications the species has been retained under the old genus *Anzia* rather than *Pannoparmelia*, the number of spores in the ascus being the distinction between the two. This new species is recorded for the first time from Sikkim Himalayas and has added to the list of already known lichens of the world.

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#### Family XVII—USNEACEÆ.

Thallus fruticose, elongate, upright or pendulous, filamentous or strap-shaped, branched and attached at the base, usually radiate in structure and chondroid. Algal cells Protococcus. Apothecia roundish, sessile or subpedicellate, marginate; asci 1-8-spored; spores colourless or rarely brown, simple or septate. Spermatogones immersed; sterigmata simple, sparingly septate with acrogenous or pleurogenous spermatia.

**XXIX. Evernia Ach.**

*Evernia* Ach. Lich. Univ., p. 84 (1910). (Smith. I, 161.)

Thallus erect or pendulous, divided or repeatedly branched, rather soft and flaccid, attached by a basal sheath, occasionally by a few rhizinæ; differently coloured above and below. Algal cells Protococcus. Structure subdorsiventral, cortex on both surfaces of gelatinous cells, gonidia mostly confined to layers below the upper surface. Apothecia lateral or almost terminal with thalline margin; paraphyses stout, simple; spores 8 in the ascus, small, ellipsoid, simple. Spermatogones lateral, immersed with pleurogenous straight, acicular spermatia.

60. ***Evernia furfuracea* Mann.** Lich. Bohem., p. 105 (1825). (Smith. I, 162.)

Thallus ascending, pendulous or decumbent, of long narrow fronds, repeatedly dichotomously branched, incurved at the margins, attenuate upwards; greyish or greyish green, becoming dark-grey, beneath black, naked, attached by a rhizinose basal sheath or marginal haptera. KOH gives yellow than red colouration. Apothecia moderate in size up to 1 cm. across, subpedicellate, brownish red, the margin thin, inflexed, spores small, 9–11  $\mu$  in length and 4  $\mu$  in thickness, simple, non-septate and ellipsoid; hypothecium slightly yellow with gonidial cells below. Spermatogones common, immersed in the thallus.

*Hab.* On trunks of trees as well as on exposed rocks.

*Loc.* Darjeeling and its suburbs, very abundant on Ghum Road along the railway line, altitude 6,000–7,000 ft.; Sikkim, 4,000–5,000 ft.; Simla and suburbs, altitude 7,000 ft., Col. G. L. Chopra, July, 1929 and 1930, August, 1931.

*Note.*—The species has been often confused with *P. kamtschadulis*, but though for the main part the fronds show a dorsiventral surface, the tips are, however, frequently radiate, a character of the genus *Evernia*.

**XXX. Ramalina Ach.**

*Ramalina* Ach. Lich. Univ., pp. 122 and 598 (1810).  
(Smith. I, 164.)

Thallus of erect or partly pendulous fronds, branched, compressed and strap-shaped, or narrow and almost cylindrical, attached by a basal sheath or penetrating hyphæ; structure radiate, medulla of loose hyphæ, the gelatinous cortex of shortly branched, thick walled, coalescing hyphæ, growing in a direction vertical to the long axis of the thallus, inner cortex of longitudinal strengthening hyphæ in a ring or as separate strands which are rarely absent; soralia not infrequent, air pores occurring as breaks in the thallus. Algal cells Protococcus. Apothecia terminal or lateral, sometimes on the angles of bent fronds (geniculate) marginate; hypothecium colourless; paraphyses simple concrete; spores 8 in the ascus; ellipsoid, colourless, 1-septate, straight or slightly curved.

**61. Ramalina farinacea Ach. Lich. Univ., p. 606 (1810).**  
(Smith. I, 170.)

Thallus fruticose, frond narrow, compressed and strap-shaped, stiff or somewhat flaccid, and pendulous, branched, attached by a basal sheath; lacunæ present, surface marked with unequal longitudinal wrinkles, pale-greenish, and shining; soralia roundish, ellipsoid, scattered on the margins of the fronds. KOH produces yellow colour, whereas  $\text{CaCl}_2$  has no reaction. Transverse section of the fronds shows a radial structure, medulla consists of loose hyphæ; upper and lower cortex gelatinous, upper cortex consists of shortly branched, thick walled, coalescing hyphæ, whereas inner cortex is formed of longitudinal strengthening hyphæ; algal zone of Protococcus cells, lying in groups below the upper cortex. Apothecia numerous, terminal or sub-terminal or lateral; disc pale-brown, plane; thalline margin present; hypothecium colourless with gonidial cells beneath; spores 8 in the ascus, small,

ellipsoid, 1-septate and slightly curved, 16·5 to 20  $\mu$  in length and 3·5–4·5  $\mu$  in thickness.

*Hab.* On trunks and branches of trees.

*Loc.* Darjeeling, Tiger Hill and its suburbs, altitude 6,000–7,852 ft. ; Simla, altitude 7,000 ft. ; Col. G. L. Chopra, July, 1929 and 1930, August, 1931.

*Note.*—In appearance and other general characters the specimens collected by the author resemble *R. farinacea* greatly, but whereas the apothecia in the latter are reported to be rare in British specimens they are quite numerous here with spores as large as 16–20  $\mu$  in length, another variation from *R. farinacea* in which the spores measure only from 8–16  $\mu$  in length.

### XXXI. *Usnea* Dill.

*Usnea* Dill. Hist. Musc., p. 56 (1741). (Smith. I, 177.)

Thallus filamentous, upright, pendulous, generally cylindrical, variously branched, often scabrid, greyish green or yellowish, attached at the base by a sheath or by a penetrating hold-fast ; structure radiate, with a firm chondroid central axis, or very rarely hollow, the cortical layer thin. Algal cells Protococcus. Apothecia mostly rather large, lateral or terminal, peltate, the disc usually rather light-coloured with a thalline, generally ciliate margin ; hypothecium colourless, with underlying gonidia ; paraphyses concrete, branched and septate ; asci 8-spored ; spores small, ellipsoid and simple. Spermatogones lateral, immersed, or slightly protuberant, light or black coloured, with sparingly branched sterigmata and acrogenous spermatia.

#### *Key to the species.*

Fronds verruculose, apothecia large, with ciliate margin. *U. florida.*

Fronds almost smooth, comose, apothecia absent. *U. comosa.*

Fronds slightly branched, apothecia with non-ciliate margins. *U. sp.*

62. **Usnea florida** Web. in Wigg. Prim. Fl. Hol.,  
p. 91 (1780). (Smith. I, 177.)

Thallus fruticose, cylindrical, erect and attached by a hold-fast; main stalk single or many, rising from the base; surface scabrid with white scattered soredia, stalk repeatedly forked and terete, about 1.5 mm. in diameter. Secondary as well as main branches covered with fibrils, which may be short or elongate. Pale-greyish or greyish green in colour. Transverse section of the frond shows a central firm chondroid axis; medullary zone composed of very loosely arranged hyphæ with several interspaces, gonidial zone of *Protococcus* cells; cortex very thin. Apothecia common, mostly terminal, peltate and rather large, up to 1 cm., geniculate or terminal, the margins bordered with long slender cilia which are occasionally branched and sparingly fibrillose; hypothecium colourless with gonidia underneath; asci 8-spored, spores simple, ellipsoid, colourless, measuring 9–14.5  $\mu$  long and 7–9  $\mu$  thick.

*Hab.* On branches of trees.

*Loc.* Darjeeling, Sikkim, altitude 5,000–7,000 ft.; Simlā and Vaishno Devi (Kashmir), altitude 7,000 ft., Col. G. L. Chopra, July, 1929–1930, August, 1931.

63. **Usnea comosa** Vain. Cata. Univ. A. Zahlbr.  
(Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Thallus suberect, shrubby, comose, becoming elongate, attached by a basal sheath, pendulous, terete; cortex becoming ringed, almost smooth, finely verruculose slightly sorediose, branched, branches beset with copious fibrils which are again branched variously and besprinkled with small verrucæ; pale-brownish in colour. KOH gives slight yellow to brownish colouration. Structure usual. Apothecia absent.

*Hab.* On branches of trees.

*Loc.* Kausarnag, Kashmir, altitude 12,000 ft., Col. A. C. Joshi, June, 1930.

64. *Usnea* sp. (Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Thallus fruticose, suberect or pendulous, attached by a basal sheath, with one or more main branches, branched, branches terete, .5 mm. in diameter, fibrillose, fibrils present mostly below, upwards almost rare, covered with copious, turgid white soredia which unfrequently develop into small squamules or minute fibrils, non-verruculose, soredia present on the fibrils as well. KOH gives yellow to brownish colouration. Structure usual. Apothecia small, rather rare, rarely terminal, most commonly geniculate; disc plane or concave with slightly inflexed crenate, sorediose and non-ciliate margin; asci 8-spored; spores oblong ellipsoid, measuring 9–14.5  $\mu$  in length and 6–9  $\mu$  in thickness. Spermatogones occur as minute black dots on the surface of the branches.

*Hab.* On branches of trees.

*Loc.* Tiger Hill, Darjeeling, altitude 7,852 ft., Col. G. L. Chopra, July, 1930.

*Note.*—The above specimen resembles *U. jamaicensis* Ach. recorded from Western Himalayas, in appearance and non-ciliate apothecia but the spores in the Darjeeling specimen are, however, much larger. In *U. jamaicensis* they measure 8–10  $\mu$  long and 4–5  $\mu$  thick only. The above specimen may be regarded as another variety of the same.

XXXII. *Siphula* Fr.

*Siphula* Fr. Syst. Orb. Veget. 1 (1825), 238.  
Eng. Pr. Pf. 8: 247.

Primary thallus almost evanescent, represented by a greenish crust. Secondary thallus or podetium reduced, decumbent, fixed with sparse rhizinae below, turfy, scarcely coralloid, simple or slightly branched, flat or terete, corticate, cortex paraplectenchymatous; gonidia Protococcus, lying beneath the cortex; pith solid, consisting of compact anastomosing hyphae. Apothecia and spermatogonia absent.

**65. *Siphula ceratites* Fr. in V. Ac. H. 1821, p. 119.**

(Smith. Tr. Br. M. Soc., Dec., 1931.)

Primary thallus crustaceous, greenish. Podetia dirty white, cylindrical and terete, longitudinally regulose or almost smooth, 1 mm. in diameter and 1 cm.—2.5 cm. in height, erect or slightly bent, bifurcating at the tip or branched from the very base, attached to the substratum by means of sparsely branched rhizinæ. Apothecia and spermogonia absent.

*Hab.* Terrestrial, in moist shady places.

*Loc.* Sakna, D.H. Ry., altitude 533 ft., Sikkim, from Timi to Gangtok, altitude 4,000–5,000 ft., Col. G. L. Chopra, July, 1930.

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**Family XVIII—BUELLIACEÆ.**

Thallus crustaceous, or rarely squamulose. Algal cells Protococcus. Apothecia minute, dark coloured, with or without a thalline margin; asci 8-, rarely more, spored; spores 1-septate, polarilocular, colourless or brown.

**XXXIII. *Rinodina* S. F. Gray.**

*Rinodina* S. F. Gray, Nat. Arr. 1, p. 448 (1821).

(Smith. I, 249.)

Thallus crustaceous, rarely squamulose, non-corticate, except in highly developed species. Algal cells Protococcus. Apothecia dark coloured, generally with prominent thalline margin; paraphyses slender, broader, septate, brown and often shortly branched at the tips; spores 8 in the ascus, rarely more, 1-septate, more or less distinctly polarilocular, brown.

**66. *Rinodina sophodes* Th. Fr. Lich. Arch., p. 125 (1860).**

(Smith. I, 250.)

Thallus determinate or subdeterminate; often suborbicular, rather thin, verruculose-areolate, grey or greyish brown, with a black hypothallus. KOH has no reaction.

Apothecia small, usually crowded in roundish patches, brownish black; the thalline margin entire, sometimes crenulate; spores ellipsoid, 12–20  $\mu$  long, 6–8  $\mu$  thick.

*Hab.* On bark of *Excrea aglauca*.

*Loc.* Salt marshes, Calcutta, Col. G. L. Chopra, July, 1930.

### Family XIX—PHYSIACEÆ.

Thallus fruticose, foliose, squamulose or crustaceous; yellow coloured, grey or brown. Algal cells Protococcus. Apothecia discoid, marginate or rarely immarginate; spores colourless or brown, 1-septate, with thick outer walls and septum, the latter generally pierced by a longitudinal canal (polarilocular), rarely simple or 3-septate. Spermatogones chambered, the sterigmata cellular, with short pleurogenous spermatia.

#### XXXIV. Pyxine Fr.

*Pyxine* Fr. Syst. Orb. Veget. Pars., i (1825), 267.

Nyl. Syn. M. Lich. ii. 1.

Thallus white, or cinerous white, laciniate lobate, laciniae arranged in a stellate manner, adpressed, laciniae linear, multifid; under-surface black, rhizinose. Apothecia black, lecideine, spores 8 in the ascus, brownish white, polarilocular, 1-septate. Spermatogones with arthrosterigmata, spermatia small, cylindrical.

#### *Key to the species.*

- |                                                                                |                                                 |
|--------------------------------------------------------------------------------|-------------------------------------------------|
| Thallus cinerous white, sorediose, apothecia black, slightly concave at first. | <i>P. cocoes</i> var. <i>sorediata</i> .        |
| Thallus greenish blue, sorediose, soredia brownish, fructifications absent.    | <i>P. coccifera</i> .                           |
| Thallus subtestaceous, smooth, apothecia convex, moderate.                     | <i>P. retirugella</i> var. <i>subtestacea</i> . |
| Thallus smooth, apothecia large, lobed ..                                      | <i>P. retirugella</i> var. <i>macrothecia</i> . |

67. **Pyxine cocoes** (Sw.) Nyl. var. **sorediata** (Tuck) in  
Synop. Lich., ii, p. 2.

Thallus orbicular, whitish or cinerous white, closely adpressed to the substratum, laciniate, laciniae narrow, 1 mm. or narrower in width, contiguous, distinct or at the circumference with rounded and crenate apices but disappearing in the interior, densely sorediose; soredia white, distributed along the margin of the laciniae in small pustules or irregularly scattered on the thallus more profuse in the interior than towards the periphery; under-surface black, covered with small, black, rhizinous fibrils. Transverse section of the lacinia shows an upper thin, paraplectenchymatous cortex with Protococcus gonidial cells below; medulla consists of thick walled, narrow, compactly arranged hyphæ; lower cortex black, composed of longitudinal hyphæ, running parallel to the long axis of the thallus. KOH gives yellow reaction. Apothecia numerous, scattered all over the surface, minute, 1 mm. across, almost closed at first, becoming plane (lecidine) with thin inflexed, almost entire or partly crenate margin; margin scarcely sorediose; epithecium black; hypothecium also black; asci 8-spored, spores ellipsoid, polarilocular, 1-septate, measuring  $14.5-21.5 \mu$  in length and  $5.5-9 \mu$  in thickness; hymenium colours violet-blue with iodine solution.

*Hab.* On bark of trees.

*Loc.* Sakna, D.H. Ry., altitude 533 ft., Col. G. L. Chopra, July, 1930.

68. **Pyxine coccifera** (Fee) Nyl. Eng. und Prant. Die  
Nat. Lich. Pfl. Band 8, p. 257.

Thallus foliose, small, 1 in.  $\times$  2 cm. or smaller, cineraceous white, orbicular, laciniate, laciniae divided with rounded and crenate apices, 1-2 mm. broad, contiguous and subimbricate, bluish green in water, laciniae distinct at the periphery, but the demarcation disappear in the centre on account of the predominance of copious brownish soredia, distributed uniformly on the thalline margins but rare towards the outer

region ; undersurface black, rhizinose, rhizinæ black. Structure usual. Apothecia absent.

*Hab.* On bark of *Ficus elastica*.

*Loc.* Parbatipur, D.H.Ry., altitude 1,000 ft., Col.  
G. L. Chopra, July, 1930.

*Note.*—The soredia here are brownish and not scarlet-red as described in other books.

69. **Pyxine retirugella** Nyl. var. **subtestacea** A. L.

Sm. var. **novo**. Tr. Brit. Myc. Sci., Dec., 1931.

Thallus foliose, laciniate, smooth or subpruinose, subtestaceous, adpressed to the substratum, laciniae elongate and subradiate at the circumference with divided and crenate margins, but becoming reduced to small subimbricate and much divided lobes in the centre ; beneath black, rhizinose ; rhizinæ minute, black. KOH gives slight yellow reaction at first, changing into reddish brown. Structure usual, composed of thin paraplectenchymatous upper cortex with *Protococcus* cells below, medulla compact and subtestaceous, under-cortex black, composed of hyphæ running parallel along the long axis of the thallus. KOH gives no reaction to medulla. Apothecia numerous, minute, up to 1.5 mm. across, sessile, closely attached to the thallus, scattered, sometimes 2 or 3 crowded together, carbonaceous ; disc black, plane to crumpled becoming convex, pruinose, margin thin and entire (lecidine) ; epithecium black, hypothecium also black ; asci 8-spored, spores ellipsoid, 1-septate, polarilocular, measuring 12.5–18  $\mu$  in length and 3.5–5.5  $\mu$  in breadth ; hymenium colouring violet-blue with iodine and slight purple with KOH. Spermatogones numerous, occurring as black dots and distributed on the thalline lobes.

*Hab.* On exposed rocks.

*Loc.* Darjeeling and its suburbs, altitude 6,500–7,000 ft. ; on way to Great Ranjit, altitude 5,000 ft., Col. G. L. Chopra, July, 1930.

*Note.*—The specimen described above shows all the characters of *P. retirugella* Nyl. but differs in the characteristic non-regulose and subtestaceous character of the thallus. The spores seen by the author, however, are not so large, i.e.  $21-27\ \mu \times 9-11\ \mu$  as described by Miss Smith. The medulla also does not appear to give any red reaction in the subgonidial region with KOH, but the thallus, however, becomes reddish brown and not slightly yellowish as described by Miss Smith.

70. **Pyxine retirugella** Nyl. var. **macrothecia** A. L.

Sm. var. **novo**. Tr. Brit. Myc. Soc., Dec., 1931.

Thallus similar to *P. retirugella* Nyl. var. *subtestacea* A. L. Sm. Medulla, however, becomes distinctly reddish unlike the former one with KOH. Apothecia small to large, up to 4 mm. across, rotund, lobate, lobes as many as 6; margin thin, lecideine rounded, crenate, slightly crumpled; epithecium black; hypothecium brownish black; asci 8-spored, spores 1-septate, polarilocular, measuring  $14.5-20\ \mu$  in length and  $5.5-9\ \mu$  in thickness; hymenium colours violet-blue with iodine and epithecium purple with KOH after about an hour or so.

*Hab.* On bark of trees.

*Loc.* Opposite Glen Eden, Darjeeling, altitude 6,500 ft., Col. G. L. Chopra, July, 1930.

*Note.*—This specimen is similar to No. 69 in all characters except the presence of large apothecia and larger spores. Medulla here gives distinct red reaction in the subgonidial region with KOH unlike the former one.

XXXVI. **Physcia** Schreb.

*Physcia* Schreb. Gen. Pl. ed. 8, ii, p. 768 (1791), emend.

Th. Fr. Lich., Arct., p. 60 (1860). (Smith. I, 230.)

Thallus rarely ascending and fruticose, more generally foliose and horizontal, greyish, whitish or brownish, attached

by haptera or rhizoids, structure various, radiate, subradiate or dorsiventral. Apothecia discoid, sessile or shortly stalked, with a thalline margin; the disc dark; hypothecium colourless, brownish yellow or dark; paraphyses septate, simple or branched near the apices and tipped brownish; spores 8 in the ascus, dark-brown, more or less distinctly polarilocular.

*Key to the species.*

- Thallus orbicular, laciniae sorediose at the tips, apothecia rare. *Ph. setosa.*  
Thallus orbicular, hispidus, apothecia with proliferous margins. *Ph. hispida.*

71. **Physcia setosa** (Ach.) Nyl., Ach. Syn., p. 203.  
Eng. Pr. Pf. 8: 257.

Thallus suborbicular, laciniate, laciniae elongate, multifid, narrow, 1.5–2 mm. in breadth, subimbricate, discrete and glabrous; margin crenate and rounded; cinerous grey, sorediose, soredia greyish white, present at the tips of the daughter-branches of the laciniae, restricted more towards the interior than at the edges; beneath black, covered with dense felt of black rhizoids occurring in groups. KOH gives slight yellow reaction, colouring the thallus yellowish green. Transverse section of the thallus shows upper plectenchymatous cortex with Protococcus gonidial cells below; medulla rather narrow, composed of thick walled loosely arranged hyphæ, lower cortex black, beset with black branching rhizinae. Apothecia rather rare, 1–4 mm. in diameter; disc black, margin crenate, inflex; epithecium brown, hypothecium pale-brown with gonidial cells below; asci 8-spored; spores 1-septate, brown, polarilocular, ellipsoid, 16–30  $\mu$  long and 5.5–11  $\mu$  thick; paraphyses branched and tipped brownish.

*Hab.* On trees as well as rocks.

*Loc.* Darjeeling, Kurseong Spring, altitude 7,000 ft.; Tiger Hill, altitude 7,852 ft.; Sikkim, altitude 3,000–5,000 ft., Col. G. L. Chopra, July, 1930;

Simla and Vaishno Devi, 7,000–8,000 ft., August–September, 1931.

*Note.*—The soresiose tips of the multifid laciniae is a characteristic feature which is more conspicuous in the sterile specimens rather than in the fertile ones, which, however also, do not entirely lack it. The apothecia are rare, only met with in the corticulous specimens.

72. **Physcia hispida** Tuckern. Syn. N. Amer. Lich. i, p. 75 (1882). (Smith. I, 240.)

Thallus suborbicular, spreading laciniate, laciniae long, formed of narrow (·5–1 mm. in breadth) branching horizontal or ascending straggling laciniae with rounded and bifurcating margins; margins beset with cilia which are greyish white in colour; greenish white in water, but brownish grey in herbarium; laciniae overlapping, lying one above the other in regular succession, covered with small, greyish white, bullate swellings which sometimes develop into small tubercles; beneath brownish, slightly grooved, beset with white hispidus, marginal cilia which are infrequently very much branched at the tips. KOH gives yellow reaction. Transverse section of the laciniae shows an upper fibrous cortex with gonidial cells below, lying in groups; medulla rather narrow, medullary hyphæ protruding downwards; lower cortex absent. Apothecia not very common, variable in size, up to 5 mm. across, terminal or at the tips of the daughter-laciniae, pedicellate, lying almost tilted at an angle of 45° to the horizontal axis of the thallus; disc pruinose, blackish white, margin denticulate or sometimes proliferous, the laciniate outgrowth also brownish beneath, branched white ciliate and bear secondary terminal or lateral apothecia; epithecium brown, hypothecium pale-brown with gonidial cells below; asci 8-spored, spores globose or oblong ellipsoid, reddish brown, 1-septate, polarilocular, 27–47  $\mu$  long and 11–21·5  $\mu$  thick.

*Hab.* On rocks.

*Loc.* Gangtok, Sikkim, altitude 5,500 ft.; Timi to Martam

Road, Sikkim, altitude 4,000 ft., Col. G. L. Chopra, July, 1930.

*Note.*—This specimen is unique in having characteristic bullate swellings on the surface of the laciniae and the presence of secondary apothecia on the main apothecial proliferations, the latter though, however, are not of very common occurrence were met with by the writer only in a single fructification. The brown, naked, slightly grooved under-surface of the laciniae and the upper fibrous cortex are also characters quite unknown in *Ph. hispida* Tuckern. Besides, the spores are too large for *Ph. hispida* ( $15-23\ \mu \times 8-11\ \mu$ ) and measure  $21-47\ \mu$  long and  $11-21.5\ \mu$  thick. In the light of all these observations the Sikkim specimen shows great resemblance to *Ph. ciliaris* DC. f. *actinota* (though the secondary apothecia on the lacinate margins of the main apothecia are not recorded even here) rather than *Ph. hispida* Tuckern.

### XXXVII. *Anaptychia* Korb. Apudmass.

*Anaptychia* Korb. Apudmass. Memor. Lichenoger. (1853).

Eng. Pr. Pf. 8: 258.

Thallus rarely ascending and fruticose, more generally foliose and horizontal, greyish, whitish or brownish attached by haptera or rhizoids. Structure various, radiate, sub-radiate or dorsiventral, corticated, cortex present on both sides or only on the upper surface (fibrous). Apothecia discoid, sessile or shortly stalked with a thalline margin, the disc dark; hypothecium colourless, brownish yellow or dark; paraphyses septate, simple or branched near the apices and tipped with brown; spores 8 in the ascus, dark-brown, more or less distinctly polarilocular.

#### *Key to the species.*

Lower cortex absent, upper fibrous.

Thallus fruticose, laciniae narrow, branch- *A. leucomelæna*.  
ed and forked, beneath hollowed out,

furfuraceous, apothecia lateral, and laciniate.

Thallus orbicular, subascending, laciniae ciliate, apothecia terminal. *A. podocarpa.*

Thallus dendroid, apothecia large, in the centre, with proliferous margins. *A. dendritica.*

Thallus orbicular, densely sorediose at the margin or tips of the laciniae sterile. *A. hypoleuca* var. *sorediifera.*

Both surfaces corticated (fibrous).

Thallus orbicular-stellate, appressed with narrow contiguous laciniae, apothecia central, with large spores. *A. hypoleuca.*

Thallus orbicular-stellate, laciniae narrow, long, provided with marginal soralia, spores small. *A. speciosa.*

Thallus orbicular, laciniae discrete at the edges but indistinct in the centre, profusely isidiose. *A. corallaphora.*

73. **Anaptychia leucomelæna** (Linn.) Wainio. Die Nat Pflanzen. Eng. Prant. Band 8, p. 259 (1926).  
(Smith. I, 232.)

Thallus fruticose, much spreading with narrow branching laciniae tapering or forked at the tips, narrow, generally .5 mm. broad but 1 mm. at the point of branching, white or greyish white, becoming blackish in herbarium, smooth, the margin provided with long, frequently branching black cilia which attach the plant to the substratum by coiling round the grasses, mosses, etc., or by haptera; beneath white, furfuraceous, hollowed out. KOH gives yellow reaction. Transverse section of the lacinia shows an upper fibrous cortex, composed of hyphæ, running parallel to the long axis of the thallus, gonidia Protococcus, medulla narrow and lower cortex absent. Apothecia common, lateral, pedicellate up to 4 mm. across, plane, disc bluish black, pruinose; the margin denticular or proliferous, the marginal proliferations also sometimes

black ciliate ; epithecium brownish, hypothecium pale-yellow ; asci 8-spored ; spores 1-septate, polarilocular ; colourless or brown, oblong, ellipsoid, measuring  $31-54\ \mu$  long and  $18-27\ \mu$  thick ; paraphyses branched, tipped brownish.

*Hab.* On the sides of the mountains among Mosses and grasses.

*Loc.* Darjeeling and its suburbs, very common on Ghum Road, altitude 6,000–7,000 ft., Col. G. L. Chopra, July, 1929 and 1930.

74. **Anaptychia podocarpa** Trev. A. Zahlbruckner. Cata. Lich. Univ. (Smith. Tr. Br. Myc. Soc., Dec., 1931.)

Thallus orbicular of moderately broad, laciniae 3 mm.–5 mm. in breadth, horizontally spreading or slightly ascending at the circumference, branched, multifid with rounded, divided and incurved apices beset with white marginal cilia which become blackish and densely divided a little away from the margin and serve to attach the plant to the substratum and the adjacent laciniae ; greyish green in water but becoming bluish green with brownish tips in the herbarium ; beneath white, furfuraceous and slightly hollowed out. Transverse section of the lacinia shows an upper fibrous cortex with gonidial cells (Protococcus) lying in groups below ; medulla rather narrow, with no cortex on the under-surface. KOH gives yellow reaction. Apothecia numerous, large, varying from 1–8 mm. in diameter pedicellate, restricted to the tips of the dividing laciniae ; disc plane, brownish black, often bluish grey, pruinose, margin prominent, denticulate and becoming somewhat proliferous ; epithecium black ; hypothecium brownish with gonidial cells below ; asci 8-spored ; spores brownish, 1-septate, polarilocular, oblong, ellipsoid, measuring  $43-55\ \mu$  long and  $18-23.5\ \mu$  thick ; spermogones present, occurring as black dots on the surface of the laciniae.

*Hab.* On branches of coniferous trees.

*Loc.* Gangtok, Residency Garden, Sikkim, altitude 5,500 ft. ; Vaishno Devi, Kashmir, altitude 7,000 ft. ;

Simla, Taradevi Forest, altitude 7,000 ft., Col. G. L. Chopra, July, 1930, and August and September, 1931.

75. **Anaptychia speciosa** (Wulf.) Wainio, die Nat. Pflanzen. Eng. Prantl. Band 8, p. 259 (1926). (Smith. Tr. B.M.S., 1931.)

Thallus foliaceous, spreading, orbicular-stellate, appressed, formed of narrow much branched laciniaë, laciniaë plane, subimbricate or contiguous with blunt and retuse apices occasionally whitish or black ciliate, light dull grey, with raised apical or marginal white soralia; beneath whitish or slightly pale near the periphery, adhering by stout, whitish or black rhizinaë or black cilia. KOH gives yellow reaction. Transverse section of the lacinia shows an upper and lower fibrous cortex with Protococcus gonidial cells below the upper cortex and compact medulla. Apothecia numerous, 1-4 mm. in diameter, restricted more in the centre; disc brownish black, margin thick, incurved, crenate and whitish pruinose, hypothecium colourless with gonidial cells below; epithecium brownish black on account of the brownish tips of the paraphyses; spores 6-8 in the ascus, 1-septate, polarilocular, ellipsoid, 24-35  $\mu$  in length and 8-16  $\mu$  in thickness.

*Hab.* On rocks.

*Loc.* Darjeeling and suburbs, altitude 6,500-7,000 ft.; Col. G. L. Chopra, July, 1929 and 1930; Simla, 7,000 ft., September, 1931.

76. **Anaptychia hypoleuca** (Muhlbg.) Wainio, Die Nat. Pflanzen. Eng. Prantl. Band 8, p. 259 (1926). (Smith. Tr. B.M.S., 1931.)

Thallus spreading, attaining a fairly large dimension and appressed to the rocks, orbicular-stellate, laciniaë narrow, contiguous and rather crowded and indistinct in the centre, retuse grey or black ciliate, margin besprinkled with white grey soralia among the margins of the laciniaë, greyish white

above and whitish beneath, covered with copious branched bristle like rhizinae, structure usual. KOH gives yellow reaction, apothecia numerous, 3-7 mm. in diameter, disc plane, brownish black, pruinose with thickly laciniate sorediate margin; spores 8 in the ascus, ellipsoid or fusiform, brownish or colourless, 30-40  $\mu$  long and 15-20  $\mu$  broad.

*Hab.* On rocks.

*Loc.* Darjeeling and its suburbs, altitude 6,000-7,000 ft., Gangtok, Sikkim, altitude 5,500 ft., Col. G. L. Chopra, July, 1929 and 1930; Simla, 7,000 ft., September, 1931.

77. **Anaptychia hypoleuca** var. **sorediifera** Vain.

A. Zahlbruckner, Cata. Lich. Univ. (Smith. Tr.  
B.M.S., 1931.)

Thallus foliose, spreading, orbicular, laciniae narrow, linear, multifid, subimbricate and discrete, 1.5-2 mm. broad, margin crenate and revolute or hooded, covered with white patches of soralia, more in the centre than towards the exterior, cinerous grey, tinged here and there with reddish or distinctly rubescent and yellowish red on the outer rims of the greyish laciniae; beneath brownish near the edges, covered with dense and much branched marginal haptera occurring in groups. KOH gives slight yellow reaction, colouring the thallus yellowish green. Structure as usual, lower cortex fibrous, may or may not be present. Apothecia absent.

*Hab.* On siliceous rocks in exposed places.

*Loc.* Darjeeling, altitude 6,500 ft.; Sikkim, altitude 4,000-5,000 ft., Col. G. L. Chopra, July, 1929 and 1930.

*Note.*—The specimens from Sikkim and Darjeeling are characterized by reddish brown tips of the laciniae. Miss Smith has recorded a similar colouring in some herbarium specimens in the British Museum but not so well marked as here.

78. **Anaptychia dendritica** Pers. A. Zahlbruckner, Cata.  
Lich. Univ.

Thallus foliose, horizontally spreading, laciniate, laciniae long, 5 cm.  $\times$  2 mm.—4 mm. much branched and overlapping, dendroid, apex rounded and divided; greyish green, turning brownish at the tips in the herbarium, under-surface white, beset with greyish or black rhizoids. KOH gives yellow reaction. Structure usual, corticated on both sides (fibrous). Apothecia few, large, measuring up to 8 mm. across, disc brownish black, pruinose, margins proliferous, marginal laciniae provided with black cilia; epithecium brown; hypothecium brownish, asci 8-spored; spores 1-septate, polarilocular, ellipsoid, measuring

*Hab.* On mossy rocks.

*Loc.* Darjeeling, altitude 6,500 ft., Col. G. L. Chopra,  
July, 1929.

79. **Anaptychia corallophora** Vain. A. Zahlbruckner,  
Cata. Lich. Univ. (Smith. Tr. B.M.S., 1931.)

Thallus orbicular, foliaceous, laciniate, laciniae small, narrow, about 2 mm. broad, branched subimbricate, with rounded or crenate margin; distinct at the periphery but losing their identity just a little away from the circumference due to the predominance of blackish white coral-like isidia, distributed along the margin of the laciniae or scattered all over the surface in the centre; greyish green, beneath palish with small greyish white rhizinae, few near the tips but dense in the centre. KOH imparts yellow colouration. Apothecia absent.

*Hab.* On moist rocks, entangled with mosses and liverworts.

*Loc.* Darjeeling, altitude 6,000–7,000 ft., Col. G. L. Chopra, July, 1929.

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XX. Group—*ANOMALUS*.

Genus XXXVIII—*Chaudhuria*, Nov. Gen. A. Zahlbr.

*Annales Mycologici*, Vol. XXX, no. 5/6, 1932.

Thallus foliaceous, laciniate, decumbent, non-stalked, stratose, corticated on both sides, cortex plectenchymatous, medulla ample, enclosing Polycoccum gonidial cells, under-surface non-venose, rhizinæ frequent, cyphellæ and pseudo-cyphellæ absent. Apothecia parmeloid, superficial; paraphyses simple; asci 8-spored; spores dark, polari-bilocular. Pycnoconidia hitherto not seen.

80. *Chaudhuria indica*, Nov. Sp. A. Zahlbr. *Annales*

*Mycologici*, Vol. XXX, no. 5/6, 1932.

Thallus foliaceous and frequently laciniate, subcoriaceous-membranaceous, greyish green, opaque, KOH and  $\text{CaCl}_2\text{O}_2$  have no reaction; marginal laciniae frequently digitately divided, lacinia up to 1 mm. broad, towards apex broadly rounded or emarginate, margin subcrenulate or entire, simple, upper surface naked, central laciniae undivided; pale underneath, somewhat flesh coloured; rhizinose; soredia and isidia absent; corticated on both sides. Upper cortex almost colourless, iodine stains violet-blue, not scattered, subchondroid, plectenchymatous, 54–66  $\mu$  thick; lower cortex similar, more or less narrow; gonidial layer situated below the upper cortex, narrow, sub-continuous, gonidia globose, dirty blue-green, 3–4  $\mu$  broad, surrounded by a thin membrane, belonging to Polycoccum; medulla white, KOH,  $\text{CaCl}_2\text{O}_2$  and iodine have no reactions, broad, occupies greater portion of the thallus, composed of thick anastomosing hyphæ, up to 3  $\mu$  thick, not scattered; rhizinæ sparse, up to 3.5 mm. long, almost colourless, simple, above 90–120  $\mu$  thick, consisting of slender hyphæ, straight, unseptate, forming dense masses glued together. Apothecia parmeloid completely sessile or subpedicellate, numerous, superficial, up to 2 mm. broad; smooth outside; thalline margin present and concoloured with the thallus, at first entire, somewhat broad, obtuse,

finally unevenly verrucose-crenate, crenis incurved; disc dark-brown, opaque, slightly concave, not powdery; receptacle corticated above, cortex similarly formed, subcartilaginous, colourless, towards margin slightly dark, medulla ample, enclosing gonidial strata and lower cortex and hypothecium; excipulum thin, entire, colourless, with iodine no reaction; hymenium dark above, not powdery, rest colourless clear, 180–210  $\mu$  wide, with iodine gives blue colour, paraphyses filiform, close, simple, unseptate, capitate and dark, conglutinate; asci oblong-clavate, apices rounded, 8-spored, spores in asci 2-seriate above and 1-seriate below, dark and finally dark smoke coloured, oval or ellipsoid, apices somewhat broad, rarely slightly rounded, straight, polarilocular, bilocular lumen of the cells rounded or subtriangular, quite small, septum somewhat thick and dark, isthmus thin, not conspicuous, not constricted in the middle, 29–31  $\mu$  long and 14.5–15  $\mu$  broad. Pycnoconidia not seen.

*Hab.* On mossy stones.

*Loc.* Darjeeling, altitude 7,500 ft., Col. G. L. Chopra.

‘The new genus can be easily recognized from the description given above. It is difficult to determine its phylogenetic connections and put it in the lichen system. Among the foliaceous lichens with gonidial cells belonging to *Myxophyceæ*, *Stictaceæ* and *Peltigeraceæ* may be mentioned as being closely related to it. *Peltigeraceæ*, however, differs from it in having apothecia without a margin. In the remaining *Stictaceæ*, we have two genera *Lobaria* and *Sticta*. Both have got characteristic pycnoconidia. In the new genus *Chaudhuria*, pycnoconidia are unknown up till now. So it becomes difficult to put *Chaudhuria* in the family *Stictaceæ*. Also the two genera of *Stictaceæ* differ in the anatomical character of the thallus. In *Lobaria* and *Sticta*, the cortex is paraplectenchymatous, whereas in *Chaudhuria* it is plectenchymatous. This difference appears to me important. I am of opinion that the plectenchymatous and prosoplectenchymatous series denote a higher type of development in the foliaceous and fruticose

lichens. Still, to put the new genus in *Stictaceæ*, these particulars would have offered no difficulties, because similar conditions are found in the family *Physciaceæ*. *Physcia* possesses paraplectenchymatous and *Anaptychia* prosoplectenchymatous cortical structures and yet the two are closely allied.

Apart from structure of the thallus, *Chaudhuria* differs from *Sticta* in the absence of cyphellæ and pseudocyphellæ. It is very similar to *Lobaria*, but the structure of the spores is altogether different. The *Lobarias* possess throughout small spores with one or more thin cross walls; a placodiomorph (polarilocular) spore has not been observed up till now, though very often seen in *Sticta* (*St. physciospora*). Thus *Chaudhuria* exhibits a similarity to *Lobaria* in the construction of the thallus and to *Sticta* in the structure of the spores.

However, *Chaudhuria* could be placed in the *Stictaceæ* so long as the pycnidia are not known, but then the diagnostic characters of the *Stictaceæ* must be extended.

The blue colouring of the cortex with Iodine is very remarkable, which, as far as I know, has not been observed in any other lichens.'

The above-mentioned discussion is quoted from Professor Zahlbruckner's paper, Neue Flechten, in *Annales Mycologici*, Vol. XXX, no. 5/6, 1932. Considering everything, the present author thinks it best to put *Chaudhuria* in a separate group, *Anomalus*, for the present. Hence it is described separately.

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(New species and varieties are marked with an asterisk \*.)

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## GLOSSARY.

Acicular (Lat. acus, a needle), slender or needle-shaped.

Adnate (Lat. adnascor, to grow to), attached the whole length.

Affixed, fixed to or upon.

Agglutinate (Lat. agglutino, to glue on to), glued together.

Aggregate (Lat. aggregatus, assembled), crowded together but not confluent.

Amphithecium (Gr. Amphi, around, theke, a case), the thalline margin of the apothecium.

Apothecium (Gr. apo, up, theke, case), an open or disc-shaped fructification.

Appendiculate (Lat.), with small appendages.

Appressed, adpressed, lying flat.

Ardellæ (Gr. ardo, to sprinkle), the small spot like apothecia of Arthoniaceæ.

Arcola (Lat. area, a space), a small space marked out on the surface of crustaceous Lichens.

Arthrosterigmata (Gr. arthron, a joint, sterigma, a prop), septate sterigmata.

Ascus (Gr. a wine skin), an enlarged cell in which the spores are developed.

Ascyphus (Gr. a, without, skuphose, a cup), without scyphi.

Biatorine, with soft or waxy apothecia, often brightly coloured, without a thalline margin as in Biatora.

Bifid (Lat. bis, twice, fidi, to cut), divided into two.

Bilocular (Lat. bi-, bis, twice, locus, a compartment), having two cells.

Bullate (Lat. bulla, a bubble), blistered.

Cæspitose (Lat. cæspes, a sod), growing in tufts.

Capitate (Lat. caput, head), formed into or having head.

Capitulum, fructification of Calicieï, a globose apical apothecium.

Carbonaceous (Lat. carbo, charcoal), black, like charcoal.

- Cephalodia (Gr. kephale, a head), abnormal development within or upon a Lichen thallus, usually inducing irregular outgrowth which contain a blue-green alga.
- Chondroid (Gr. chondros, cartilage), hard and tough like cartilage, applied to a compact medulla, with the longitudinally running hyphæ forming a solid axis.
- Cilium (Lat. an eyelash), marginal hair on thallus or fruit.
- Citrine (Lat. citrus), greenish or lemon yellow.
- Clavate (Lat. clavus, a club), club-shaped.
- Conceptacle (Lat. conceptaculum, a receptacle), a cavity within which reproductive cells are produced.
- Concolorous, similar in colour.
- Concrescent (Lat. concreso, to grow together), growing together.
- Conglomerate (Lat. con, together, glomus, a ball), clustered.
- Conglutinate (Lat. conglutino, to glue), glued together.
- Contiguous (Lat. contiguus, adjoining), the separate parts of the thallus touching and continuous.
- Convolute (Lat.), rolled up.
- Coralloid (Lat. corallum, coral), having a coral-like appearance.
- Coriaceous (Lat. corium, leather), leathery.
- Corneous (Lat. cornu, a horn), horny.
- Corrugate (Lat.), wrinkled.
- Cortex (Lat. bark or rind), the outer layer of the thallus.
- Corticulous (Lat. cortex, the bark, colo, to inhabit), living on the bark of trees.
- Corymbose (Gr. Korumbos, a cluster of fruit or flower), arranged in clusters.
- Crenate (Lat. crena, a notch), scalloped, toothed with crenatures.
- Crispate (Lat. crispus, curled), curled and twisted.
- Crustaceous (Lat. crusta, rind or shell), hard, thin, brittle, applied to closely adhering thallus without cortical layers.
- Cylindrical (Gr. kulindros, a cylinder), elongate and circular in cross section.
- Cyphella (Gr. kuphella, the hollows of the ears), orbicular fringed spots like dimples, under the thallus of Lichens.

- Dactyloid (Gr. *dactylos*, a finger), spreading like fingers.
- Decumbent (Lat. *reclinans*), reclining with the apex ascending.
- Dendroid (Gr. *dendron*, a tree), having a branched appearance.
- Dentate (Lat. *dens*, a tooth), toothed at the margin.
- Denudiate (Lat.), stripped, naked.
- Determinate (Lat. *bounded*), with a definite margin.
- Dichotomous (Gr. *dichotomeo*, to cut in two), forked.
- Dimidiate (Lat. *dimidiatus*, halved), applied to the perithecial wall when it covers only the upper half of the perithecium.
- Discoid (Gr. *diskos*, a quoit, *eidos*, like), disc-like.
- Discrete (Lat. *discretus*), separate and distinct.
- Dissected (Lat. *dissectus*, cut up), deeply divided.
- Effigurate (Lat. *e*, out, *figura*, a figure), having a distinct form or figure.
- Effuse (Lat. *effusus*, poured out), spread out, expanded.
- Elliptical, Ellipsoid, shaped like an ellipse, oblong with rounded ends.
- Emarginate (Lat. *emargino*, to deprive of its edges), having a notch cut out.
- Epiphylæodal (Gr. *epi*, upon, *phloios*, bark), applied to the thallus when growing on the outside of the bark.
- Epispore (Gr. *epi*, upon, *spora*, seed), the outer spore coat.
- Epithecium (Gr. *epi*, upon, *thekē*, a case), the layer covering the hymenium.
- Faciculate (Lat. *fascis*, a bundle), growing in a close bundle or cluster.
- Fibrillæ (Lat. *febra*, a fine thread), minute fibre-like branches.
- Fimbriate (Lat.), fringed.
- Fistulose (Lat. *fistula*, a pipe), hollow.
- Flaccid (Lat. *flaccidus*), flabby, limp.
- Flexuose (Lat. *flexus*, bent), wavy.
- Foliaceous (Lat. *folium*, a leaf), leaf-like and flat.
- Fruticose (Lat. *frutex*, a shrub), having the thallus attached by a single basal point, cylindrical, filamentous or strap-shaped.

- Fuliginous (Lat. fuligo, soot), brown, verging on black, soot coloured.
- Furcate (Lat.), forked.
- Furfuraceous (Lat. furfur, bran), scurfy.
- Fusiform (Lat. fusus, a spindle, forma, shape), spindle-form.
- Glabrous (Lat. glaber, without hair), with hairless surface.
- Glaucous (Gr. glaukos, bluish grey), sea-green.
- Gonidium (Gr. gonos, offspring), a green algal cell (Chlorophyceæ) constituent of the Lichen thallus.
- Gonimum (Gr. gonimos, productive), a blue-green algal cell in Lichen thallus.
- Granulate, Granular (Lat. granum, a grain), consisting of minute particles.
- Guttæ (Lat. gutta, a drop), oil drops in spore cells.
- Gyrose (Lat. from Gr. guros, round), curved backward and forward in turn.
- Halonate (Gr. halos, the disk of the sun, halo), surrounded by an outer circle.
- Heteromerous (Gr. heteros, other, meros, a part), fungal and algal constituents in definite strata in the thallus. \*
- Hispid (Lat. bristly), beset with rough hairs or bristles.
- Homoiomorous (Gr. homios, like, meros, a part), fungal and algal constituents mixed in the thallus.
- Hymenium (Gr. human, a membrane), the layer composed of asci and paraphyses in an apothecium.
- Hypophlœodal (Gr. hypo, under, phloios, bark), thallus growing under bark.
- Hypothallus (Gr. hypo, under, thallus, a sprout), the undergrowth of the thallus hyphæ visible at the edges of the thallus.
- Hypothecium (Gr. hypo, under, theke, case), the layer below hymenium.
- Imbricate (Lat. imbricatus, covered with tiles), overlapping.
- Incised (Lat. cut into), cut at the margins sharply.
- Indeterminate, without a definite outline, effuse.
- Isidiferous (Lat. fero, to bear), thallus bearing isidia.

- Isidium (Gr. isis, a genus of coral, eidos, like), a coral-like outgrowth on the Lichen thallus, with rounded apex.
- Lacerate (Lat. lacer, mangled), torn or irregularly cleft.
- Lacinia (Lat. lacinia, a fragment of cloth), a slender thalline lobe.
- Laciniate, thallus cut in narrow lobes.
- Lævigata (Lat.), smooth as if polished.
- Lecanorine (Lecanora, a genus of Lichens), apothecia with thalline margin as in genus Lecanora.
- Lecideine (Lecidea, a genus of Lichens), apothecia usually carobaceous or dark coloured, without a thalline margin as in Lecidea.
- Lenticular, lentiform (Lat. lens, a lenti), lens-like.
- Leprarioid (Gr. lepra, leprosy), with scurfy surface.
- Lirella (Lat. lira, a ridge between two furrows), a long narrow apothecium with a ridge down the middle.
- Mazædium, fructification of Calicei, spores free from the asci forming a powdery mass in almost closed heads.
- Monophyllous (Gr. mono, one, phyllon, a leaf), one-leaved.
- Muriform (Lat. murus, a wall), multicellular spores divided like the masonry of a wall.
- Mycelium (Gr. mukes, a mushroom), an aggregate of fungal hyphæ.
- Nodule (Lat. nodus, a knot), a small knot or round body.
- Obsolete (Lat. obsoletus, worn out), wanting a rudimentary.
- Orbicular (Lat. circular), a flat body with circular outline.
- Ostiole (Lat. ostiolum, a little door), opening in the perithecium through which spores escape.
- Palmate (Lat. palma, the palm of hand), lobed in finger-like manner.
- Paraphysis (Gr. para, beside, phusis, growth), a sterile filament in the hymenium growing alongside the asci.
- Patent (Lat. patens, open), spreading.
- Perithecium (Gr. peri, about, theke, a case), a rounded closed fructification with minute opening at the apex.

- Periphysses (Gr. *peri*, about, *phusis*, growth), filaments rising near the mouth of the perithecium.
- Pervious (Lat. *pervius*, passable), scyphi, open or perforate at the base.
- Plicate (Lat. *plico*, to fold), folded in plates.
- Plurilocular, many celled.
- Podetium (Gr. *pous*, *podos*, a foot), a stalk-like thalline elevation supporting the apothecium.
- Polaribilocular, two-celled spore with a thick central wall traversed by a connecting tube, the lumen of the cell at extreme ends.
- Polyphyllous (Gr. *pollus*, many, *phullon*, a leaf), many leaved.
- Proliferous (Lat. *prolos*, offspring, *fero*, to bear), bearing offshoots.
- Proper margin, the rim or margin encircling the apothecium, as distinct from the thalline margin.
- Pruina (Lat. hoar, frost), bloom on the surface of plants.
- Pyriform (Lat. *pyrus*, a pear), pear-shaped.
- Radiate (Lat. *radius*, a ray or spoke of a wheel), spreading outward from a centre.
- Ramos (Lat. *ramus*, a branch), branching.
- Ramuli, secondary branches.
- Receptacle (Lat. *receptaculum*, a reservoir), term used for the base or surrounding tissue of the apothecium.
- Reticulate (Lat. *rete*, a net), resembling a net-work.
- Retuse (Lat. *retusus*, blunted), with a shallow notch in the rounded apex.
- Revolvute (Lat. *re*, back, *volvo*, to roll), rolled back from the margin.
- Rhizina (Gr. *rhiza*, a root), root-like hairs.
- Rima (Lat. a cleft), a chink or cleft—Rimose.
- Rugose, Regulose (Lat. *ruga*, a wrinkle or a fold), wrinkled.
- Saxicollous (Lat. *saxum*, rock, *colo*, to inhabit), growing on rocks or stone.
- Scabrid (Lat.), rough with minute elevations.

- Scyphus (Gr. skyphos, a cup), cup-like opening of the podetia bearing apothecia.
- Sinuate (Lat. sinus, a curve), with a deep wavy margin.
- Soredia, small powdery granules consisting of one or more algal cells surrounded by Lichen hyphæ. When these occur as small white pustules, they are known as soralia.
- Spermogone (Gr. sperma, a seed, gonos, offspring), closed receptacle containing spermatia.
- Spinose, Spinulose (Lat. spina, a thorn), beset with spines.
- Squamule (Lat. squama, a scale), a small thalline lobe.
- Stellate (Lat. starry), star-shaped.
- Sterigma, pl. sterigmata (Gr. sterigma a prop), the stalk bearing spermatia.
- Subulate (Lat. subula, a small weapon), shaped like an awl.
- Sulcate (Lat.), furrowed or grooved.
- Tartaraceous, having a rough surface.
- Terricolous (Lat. tera, the earth, colo, to inhabit), living on soil.
- Testaceous (Lat. testa, a brick or tile), brick-red.
- Tomentose (Lat. tomentum, a stuffing for cushions), densely covered with down-like hairs.
- Thalline margin, an apothecium margin formed of and usually coloured like the thallus.
- Tumid (Lat.), inflated, swollen.
- Turgid (Lat. turgidus, inflated), swollen.
- Undulate (Lat. unda, a wave), with a wavy margin.
- Urceolate (Lat. urceus, a pitcher), pitcher-like.
- Vermicular (Lat. vermiculus, a little worm), worm-shaped.
- Verruca (Lat. a wart), the granular wartlike part of the thallus.

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## EXPLANATION OF PLATES.

### PLATE I.

DERMATOCARPON MOULINSII A. Zahlbr. (Fig. 1-5.)

1. Portion of the plant.
2. Portion of plant magnified.
3. Vertical section of thallus with perithecia.
4. Vertical section of thallus showing chambered spermogone.
5. Ascus, paraphysis and spores.

ENDOCARPON PUSILLUM Hedw. (Fig. 6-11.)

6. Plant on stone.
7. Portion of plant.
8. V.S. of the thallus.
9. V.S. of perithecia.
10. An ascus with spores.
11. Spores.

ANTHACOTHECIUM VARIOLOSUM Mull. Arg. (Fig. 12-17.)

12. Plant on bark.
13. Portion of plant.
14. Vertical section of thallus.
15. Vertical section of perithecium.
16. Ascus and paraphyses.
17. Spores.

TYLOPHORON MODERATUM Nyl. (Fig. 18-21.)

18. Plant on bark.
19. Portion of plant.
20. Vertical section of apothecium.
21. Spores.

## PLATE II.

## GRAPHIS SCRIPTA Ach. (Fig. 1-7.)

1. Plant on bark.
2. Portion of plant.
- 3-4. Vertical sections of apothecia.
5. Vertical section of thallus.
6. Ascus and paraphysis.
7. Spore.

## GRAPHINA ACHARII Mull. Arg. (Fig. 8-12.)

8. Plant on bark.
9. Portion of plant.
10. Vertical section of apothecia.
11. Vertical section of thallus.
12. A spore.

## PHÆOGRAPHINA EXSERTA Mull. Arg. (Fig. 13-17.)

13. Plant on bark.
14. Portion of plant.
15. Vertical section of apothecium.
16. Ascus and paraphysis.
17. A spore.

## CHIODECTON PHILLIPINUM Waino. (Fig. 18-20.)

18. Plant on bark.
19. Portion of plant.
20. Vertical section of thallus.

## PLATE III.

## THYREA PULVINATA Mass. (Fig. 1-4.)

1. Plant on rock.
2. Portion of plant.
- 3-4. Vertical sections of thallus,

COLLEMA SP. (COLLEMA CERANISCUM Nyl. ?).  
(Fig. 5-8.)

5. Plant on soil.
6. Portion of plant.
- 7-8. Vertical sections of thallus.

LEPTOGIUM MENZIESII Mont. (Fig. 9-14.)

9. Plant on bark.
10. Portion of plant.
11. Vertical section of thallus.
12. Vertical section of apothecium.
13. Ascus and paraphysis.
14. Spore.

COCCOCARPIA PELLITA Mull. Arg. (Fig. 15-19.)

15. Portion of plant.
16. Portion of plant enlarged.
17. Vertical section of apothecium.
18. Vertical section of thallus.
19. Ascus, paraphysis and spores.

PLATE IV.

LOBARIA PULMONARIA Hoffm. (Fig. 1-3.)

1. Portion of plant.
2. Portion of plant magnified.
3. Vertical section of thallus.

PELTIGERA VENOSA Hoffm. (Fig. 4-9.)

4. Plant on soil.
5. Portion of plant.
6. Vertical section of thallus.
7. Vertical section of apothecium.
8. Ascus and paraphysis.
9. Spores.

## NEPHROMA SP. (NEPHROMA EXPALLIDUM Nyl. ?).

(Fig. 10-15.)

10. Plant on bark.
11. Portion of plant.
12. Vertical section of thallus.
13. Vertical section of apothecium.
14. Ascus and paraphysis.
15. Spore.

## SOLORINA CROCEA Ach. (Fig. 16-20.)

16. Portion of plant.
17. Vertical section of thallus.
18. Vertical section of apothecium.
19. Ascus and paraphysis.
20. Spores.

## PLATE V.

## BACIDIA HUNANA VAR. RUGOSA A. L. Sm. (Fig. 1-5.)

1. Plant on stone.
2. Portion of plant.
3. Vertical section of apothecium.
4. Ascus and paraphysis.
5. Spores.

## BACIDIA LUTEOLA Mudd. (Fig. 6-11.)

6. Plant on bark.
7. Portion of plant.
8. Vertical section of thallus.
9. Vertical section of apothecium.
10. Ascus and paraphysis.
11. Spores.

## RHIZOCARPON GEOGRAPHIUM D.C. (Fig. 12-16.)

12. Plant on rock.
13. Portion of plant.
14. Vertical section of apothecium.

15. Ascus and paraphysis.

16. Spores.

LOPADIUM Sp. (Fig. 17-21.)

17. Plant on Moss.

18. Portion of plant.

19. Vertical section of thallus.

20. Vertical section of apothecium.

21. Ascus and spores.

PLATE VI.

BÆOMYCES ROSENS Pers. (Fig. 1-6.)

1. Plant on soil.

2. Portion of plant.

3. Vertical section of primary thallus.

4. Transverse section of podetium.

5. Vertical section of apothecium.

6. Ascus, paraphysis, and spores.

CLADONIA PYXIDATA Hoff. (Fig. 7-11.)

7. Plant on soil.

8. Portion of plant.

9. Transverse section of thallus.

10. Transverse section of podetium.

11. Vertical section of scyphus.

CLADONIA FURCATA VAR. PINNATA Wain. (Fig. 12-17.)

12. Plant on soil.

13. Portion of plant.

14. Transverse section of thallus.

15. Transverse section of podetium.

16. Vertical section of apothecium.

17. Ascus, paraphysis, and spores.

STEREOCAULON RAMULOSUM Ach. (Fig. 18-23.)

18. Plant on soil.

19. Vertical section of apothecium.

20. Longitudinal section of podetium.
21. Transverse section of podetium along with cephalodia.
22. Ascus and paraphysis.
23. Spores.

## PLATE VII.

## STEREOCAULON ARBUSCULA Nyl. (Fig. 1-3.)

1. Plant on bark.
2. Portion of plant.
3. Transverse section of podetium.

## GYROPHORA CYLINDRICA Ach. (Fig. 4-8.)

4. Portion of a plant.
5. Portion of the plant enlarged.
6. Transverse section of thallus with spermogone.
7. Vertical section of apothecium.
8. Ascus, paraphysis, and spore.

## PERTUSARIA MULTIPUNCTA Nyl. (Fig. 9-14.)

9. Plant on bark.
10. Portion of plant.
11. Vertical section of thallus.
12. Vertical section of apothecium.
13. An ascus.
14. Gonidia.

## LECANORA SUBFUSCA Ach. (Fig. 15-20.)

15. Plant on bark.
16. Portion of plant.
17. Vertical section of apothecium.
18. Vertical section of apothecium.
19. Ascus and paraphysis.
20. Spores.

## PLATE VIII.

## LECANORA CARNULENTA Nyl. (Fig. 1-5.)

1. Plant on rock.
2. Portion of plant.
3. Vertical section of apothecium.
4. Ascus and paraphysis.
5. Spores.

## HÆMATOMMA PUNICEUM Wain. (Fig. 6-10.)

6. Plant on bark.
7. Portion of plant.
8. Vertical section of apothecium.
9. Vertical section of thallus.
10. Spores.

## PARMELIA CRISTIFERA Tayl. (Fig. 11-15.)

11. Portion of plant.
12. Portion magnified.
13. Vertical section of apothecium.
14. Vertical section of thallus.
15. Ascus, paraphysis, and spores.

PARMELIA LATISSIMA VAR. MARMARIZA Nyl.  
(Fig. 16-20.)

16. Portion of plant.
17. Vertical section of thallus.
18. Vertical section of apothecium.
19. Ascus and paraphysis.
20. Spores.

## PLATE IX.

## ANZIA PHYSOIDEA A. L. S. (Fig. 1-4.)

1. Portion of plant.
2. Portion magnified.
3. Vertical section of thallus.
4. Vertical section of rhizina.

## EVERNIA FURFURACEA Ach. (Fig. 5-9.)

5. Portion of plant.
6. Portion magnified.
7. Vertical section of thallus.
8. Vertical section of apothecium.
9. Ascus and spores.

## RAMALINA FARINACEA Ach. (Fig. 10-15.)

10. Complete plant.
11. Portion of plant.
12. Vertical section of apothecium.
13. Vertical section of thallus.
14. Ascus and paraphysis.
15. Spores.

## USNEA FLORIDA Web. (Fig. 16-20.)

16. Plant with sheath.
17. Transverse section of thallus.
18. Vertical section of thallus.
19. Vertical section of apothecium.
20. Ascus, paraphysis, and spores.

## PLATE X.

## SIPHULA CERATITES Fr. (Fig. 1-4.)

1. Plant on soil.
2. Plants magnified.
3. Transverse section of the secondary thallus.
4. Vertical section of the secondary thallus.

## RINODINA SOPHODES Th. Fr. (Fig. 5-10.)

5. Plant bark.
6. Position of plant.
7. Vertical section of thallus.
8. Vertical section of apothecium.
9. Ascus and paraphysis.
10. Spores.

## PYXINE RETIRUGELLA VAR. SUBTESTACEA A. L.

Sm. (Fig. 11-16.)

11. Portion of plant.
12. Portion magnified.
13. Vertical section of thallus.
14. Vertical section of apothecium.
15. Ascus and paraphysis.
16. Spores.

## PYXINE RETIRUGELLA VAR. MACROTHECIA

A. L. Sm. (Fig. 17-22.)

17. Plant on bark.
18. Portion of the plant.
19. Vertical section of thallus.
20. Vertical section of apothecium.
21. Ascus and paraphysis.
22. Spores.

## PLATE XI.

## PHYSCIA SETOSA Nyl. (Fig. 1-5.)

1. Portion of plant.
2. Portion magnified.
3. Vertical section of apothecium.
4. Vertical section of thallus.
5. Ascus, paraphysis, and spores.

## PHYSCIS HISPIDA Frege. (Fig. 6-10.)

6. Portion of plant.
- 7-8. Vertical sections of thallus.
9. Vertical section of apothecium.
10. Spores.

ANAPTYCHIA LEUCOMELÆNA Waino. (Fig.  
10 A.-15.)

- 10 A. Plant.
11. Portion of plant.
12. Vertical section of thallus.

13. Vertical section of apothecium.
14. Ascus and paraphysis.
15. Spores.

**ANAPTYCHIA PODOCARPA Trev. (Fig. 16-21.)**

16. Plant on a branch.
- 17-18. Vertical sections of thallus.
19. Vertical section of apothecium.
20. Ascus and paraphysis.
21. Spores.

**PLATE XII.**

**ANAPTYCHIA HYPOLEUCA VAR. SOREDIIFERA**  
Waino. (Fig. 1-4.)

1. Plants entangled with Mosses.
2. Portion of plant.
- 3-4. Vertical sections of thallus.

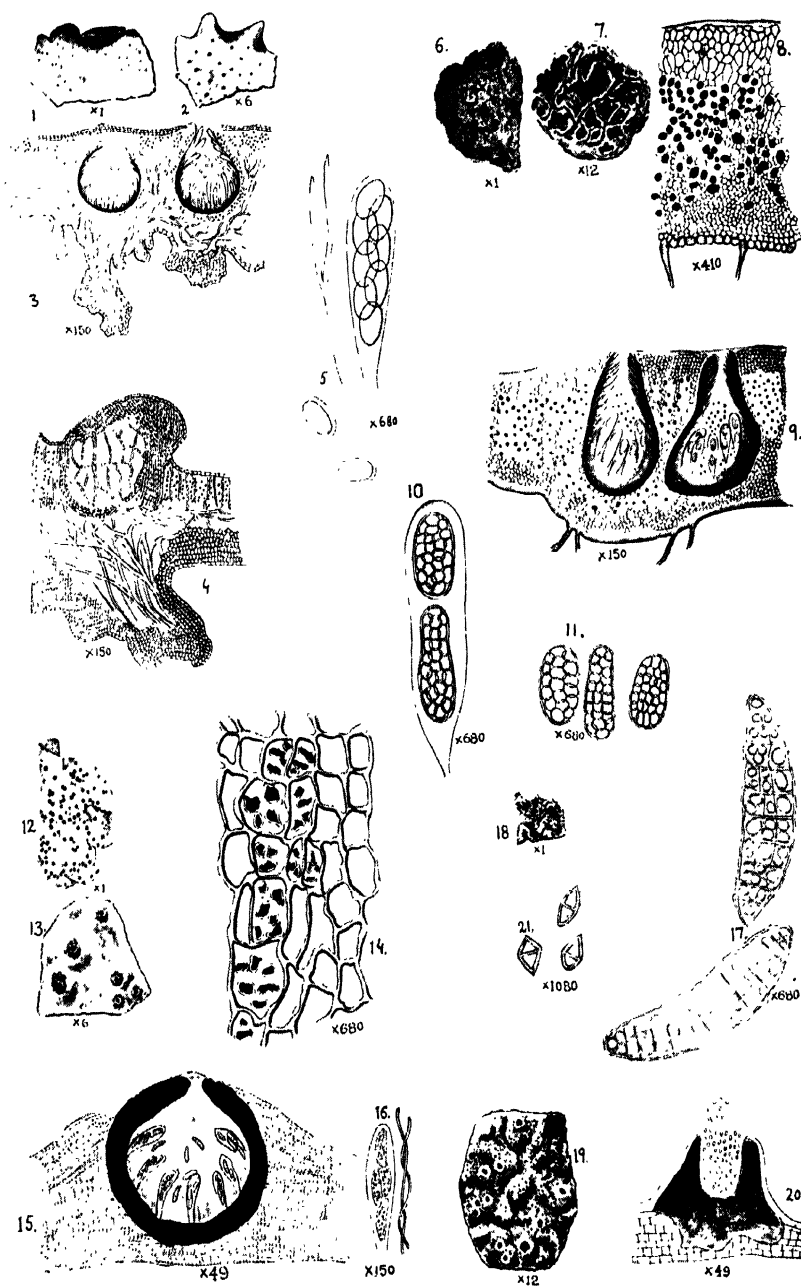
**ANAPTYCHIA DENDRITICA Pers. (Fig. 5-9.)**

5. Portion of plant.
- 6-7. Vertical sections of thallus.
8. Vertical section of apothecium.
9. Spores.

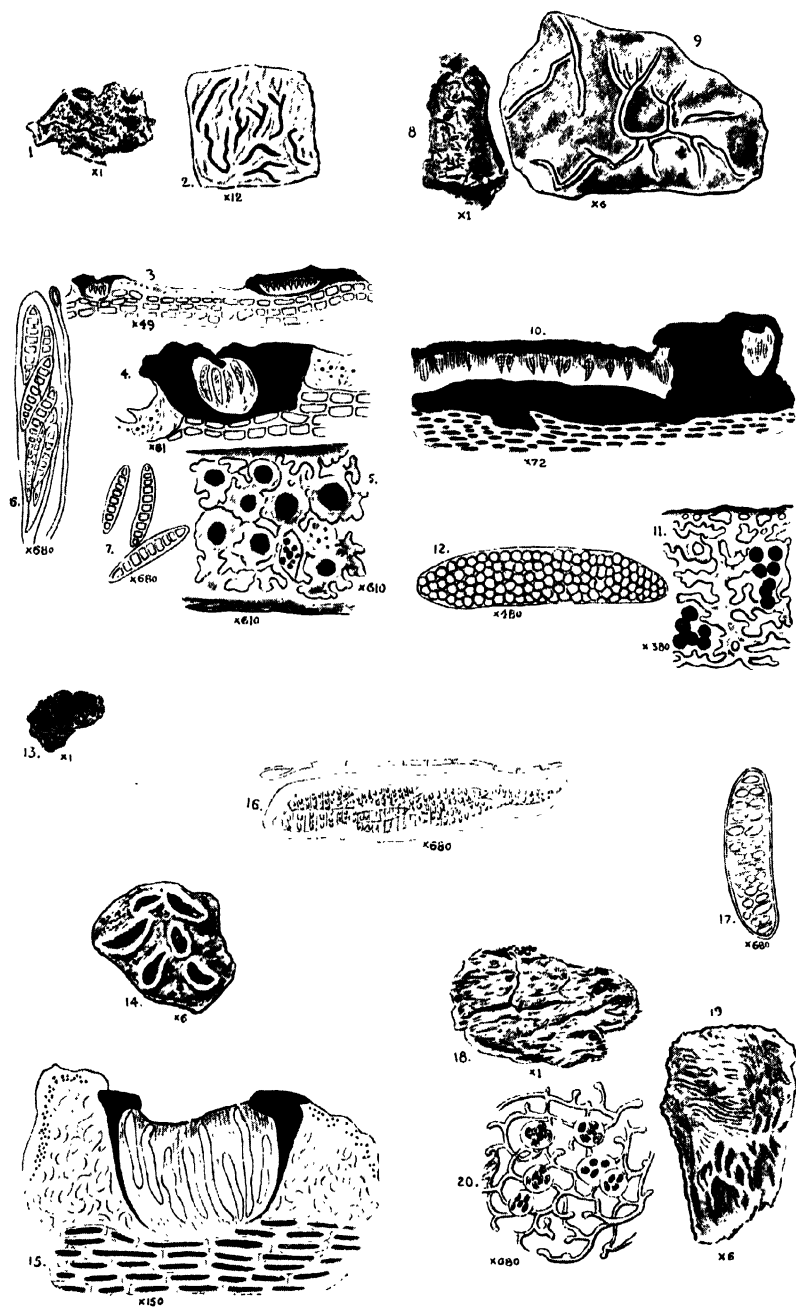
**CHAUDHURIA INDICA A. Zahl. (Fig. 10-12.)**

10. Portion of plant.
11. Vertical sections of apothecium.
12. Spores.

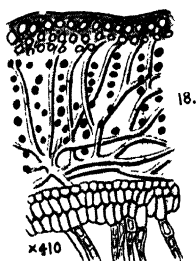
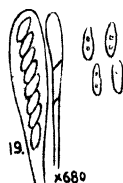
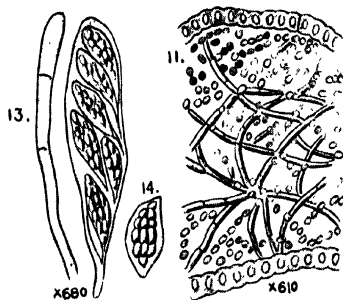
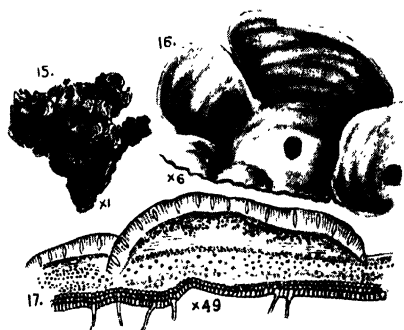
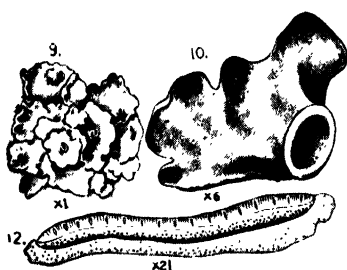
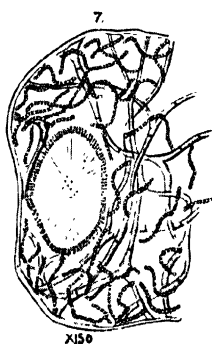
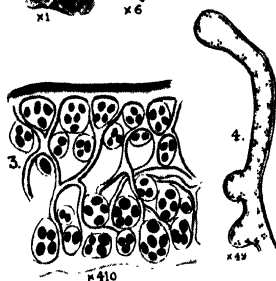
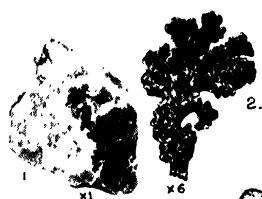




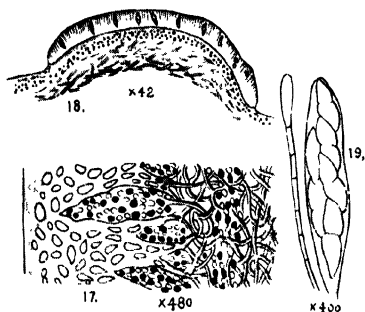
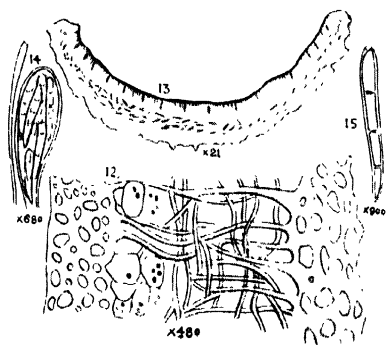
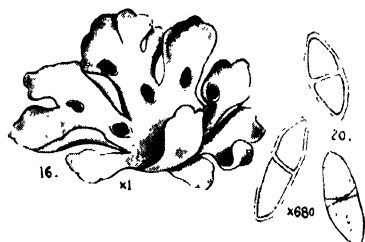
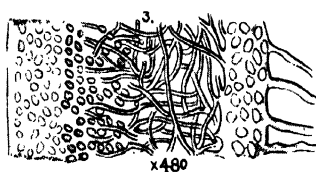
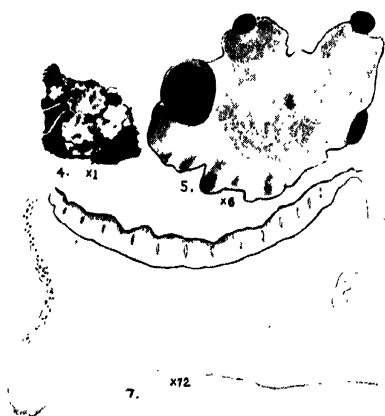




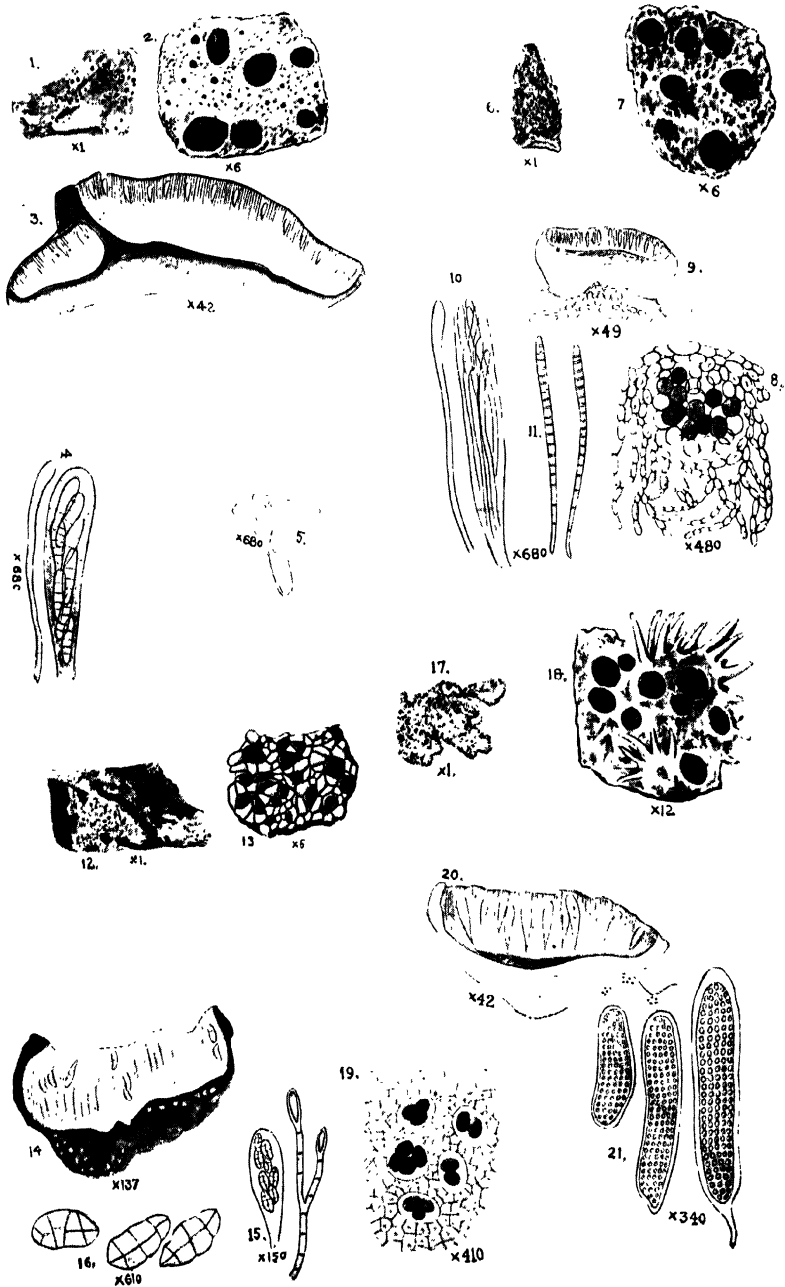














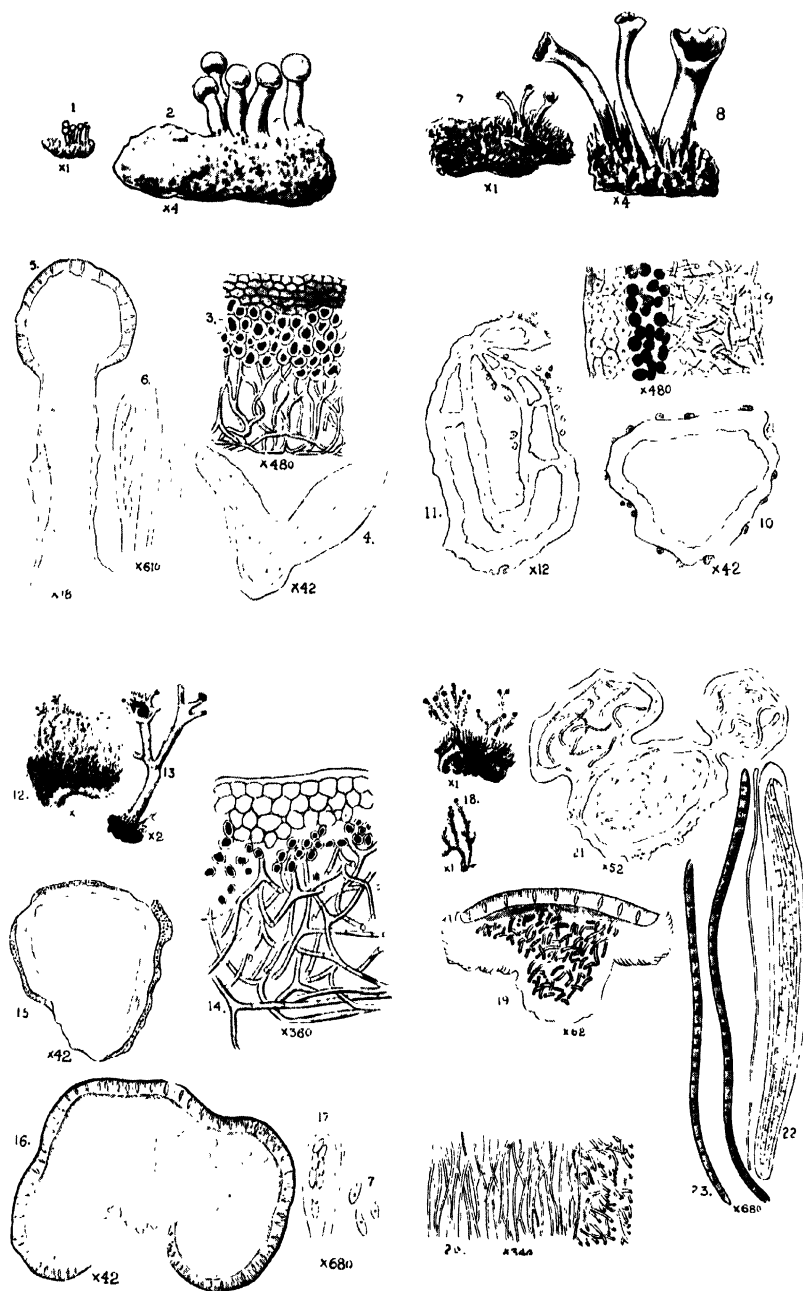




Plate VII.

